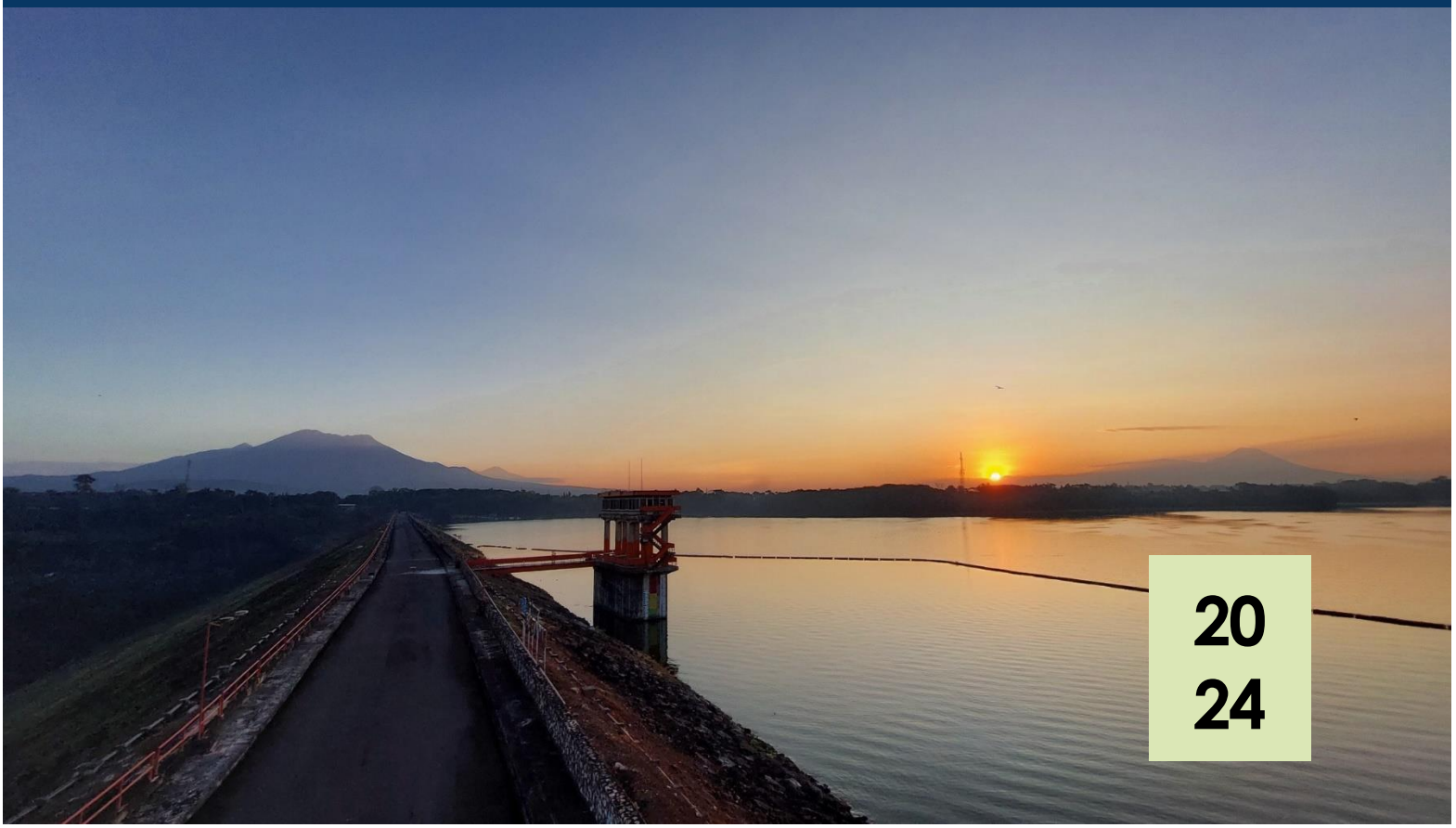
Brantas Harmoni

Background report on planning for strengthened Integrated Water Quality Management in the Brantas River Basin, Indonesia

8 June 2024

'Brantas Harmoni' is an output of the Brantas Water Quality project (2019-2024), produced to support aligned and planning and implementation of water quality management and pollution control in the Brantas River basin. This report offers key data on water quality conditions and pollution sources, information on institutional and management challenges and opportunities, a review of standing policies and strategies of key stakeholders, and research outputs related to water quality management. The report aims to harmonize water quality management strategies and policies, support strengthened institutions and practices for water quality management, and recommend actions to address key challenges related to river health in the Brantas River basin based on combined inputs from project team representatives from TU Delft, BBWS Brantas, Perum Jasa Tirta I, and DLH Jatim.



Netherlands Enterprise Agency

TU Delft

JASA TIRTA I

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This report represents the culmination of efforts from the multi-stakeholder project, "Fostering inclusive growth, health, and equity by mainstreaming water quality in the Brantas River Basin, Indonesia," also known as the Brantas Water Quality Project. The Brantas Water Quality Project was funded by the Sustainable Water Fund (FDW) of the Netherlands Enterprise Agency as part of an Indonesia-Netherlands cooperation. The Sustainable Water Fund programme (FDW) is a Public-Private Partnership (PPP) facility that aims to contribute to global water safety and water security.

This report was authored by a project team from Delft University of Technology (TU Delft), based on extensive inputs from government, community, and academic stakeholders in the Brantas River basin, who provided information, data, and insights through extensive consultations, interviews, and project workshops. We wish to particularly acknowledge the invaluable contributions and support provided by the staff of Balai Besar Wilayah Sungai Brantas (BBWS Brantas), Dinas Lingkungan Hidup Provinsi Jawa Timur (DLH Jatim), and Perum Jasa Tirta I (PJT I), who provided data, strategy and policy inputs, and important technical, institutional, and administrative information regarding water quality management. These agencies and the nominated staff were committed partners over the five-year project, and their expertise and collaboration have been integral to the success of this endeavor.

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In conclusion, we would like to thank all individuals, organizations, and communities who have contributed to this effort. Your collective dedication and collaboration have been instrumental in advancing the cause of water quality management and improved river health in the Brantas River Basin.

FOREWORD

The Brantas River, a National Strategic River, is an invaluable resource for the society, economy, and environment of Indonesia. Sustainable management of the Brantas River depends upon increased attention to water quality and reduction of water pollution from various order to safeguard the health and integrity of the basin for present and future generations. Achieving water quality goals in the Brantas River basin depends on cross-sectoral coordination and cooperation, strengthened and coordinated planning, and inclusive and effective participation.

Brantas Harmoni was developed to serve as a harmonized source of information and input for the formulation of more detailed water quality plans and policies. Brantas Harmoni was prepared by Delft Technical University based on published data, policies and plans, as well as consultations with the Brantas River Basin Center (BBWS), East Java Environment Office, Perum Jasa Tirta I, and other key stakeholders as part of the project "Fostering inclusive growth, health and equity by mainstreaming water quality in River Basin Management in the Brantas River Basin, Indonesia". This report presents a situation analysis based on available water quality, institutional and pollution source data, and a review of existing water quality management plans and strategies. These inputs provide the basis for proposed actions to strengthen water quality management and reduce water pollution in the Brantas River Basin, framed under seven key challenges, namely:

- Reduce contamination from domestic wastewater,
- Reduce contamination from poorly managed industrial wastewater,
- Reduce pollution from agriculture and untreated livestock waste,
- Control erosion and reduce sedimentation in water resources,
- Reducing the volume of solid waste in water resources, including plastics and organic waste,
- Promote equitable, efficient and effective water quality management, based on best IWRM practices,
- Strengthen community participation and river management.

Brantas Harmoni is a step towards achieving water quality standards in the Brantas. Addressing the challenges posed by water pollution and degradation of water quality relies, however, on ongoing cooperation to support coordinated planning, implementation, monitoring, and evaluation for water quality protection and management, as well as inclusive community participation and public awareness. By leveraging our collective strengths and resources, we can make meaningful progress towards achieving shared goals of improved water quality and sustainable development in the Brantas River basin.

KATA PENGANTAR

Sungai Brantas yang merupakan Sungai Strategis Nasional merupakan sumber daya yang tak ternilai bagi masyarakat, ekonomi, dan lingkungan hidup di Indonesia. Pengelolaan Sungai Brantas yang berkelanjutan bergantung pada peningkatan perhatian terhadap kualitas air dan pengurangan pencemaran air dari berbagai sumber untuk menjaga kesehatan dan keutuhan daerah aliran sungai bagi generasi sekarang dan yang akan datang. Pencapaian sasaran kualitas air di DAS Brantas bergantung pada koordinasi dan kerja sama lintas sektoral, perencanaan yang diperkuat dan terkoordinasi, serta partisipasi yang inklusif dan efektif.

Brantas Harmoni disusun sebagai sumber informasi dan masukan yang selaras untuk perumusan rencana dan kebijakan kualitas air yang lebih rinci. Brantas Harmoni disusun oleh Delft Technical University berdasarkan data, kebijakan, dan rencana yang telah dipublikasikan, serta konsultasi dengan Balai Besar Wilayah Sungai (BBWS) Brantas, Dinas Lingkungan Hidup Provinsi Jawa Timur, Perum Jasa Tirta I, dan pemangku kepentingan utama lainnya sebagai bagian dari Proyek "Mendorong pertumbuhan, kesehatan, dan kesetaraan yang inklusif melalui pengarusutamaan kualitas air dalam Pengelolaan Sungai di Daerah Aliran Sungai (DAS) Brantas, Indonesia". Laporan ini menyajikan analisis situasi berdasarkan data kualitas air, kelembagaan, dan sumber pencemaran yang tersedia, serta tinjauan terhadap rencana dan strategi pengelolaan kualitas air yang ada. Masukan-masukan tersebut menjadi dasar dan saran tindakan untuk memperkuat pengelolaan kualitas air serta mengurangi pencemaran air di DAS Brantas. *Brantas Harmoni* mengusung tujuh tantangan utama yaitu:

- Mengendalikan Kontaminasi Air Limbah Domestik
- Mengendalikan Kontaminasi Air Limbah Industri yang Belum Dikelola
- Mengendalikan Kontaminasi Sektor Pertanian dan Peternakan
- Mengendalikan Erosi untuk Meminimalisir Sedimentasi pada Sumber Daya Air
- Mengendalikan Volume Limbah Padat pada Sumber Daya Air (plastik dan sampah organik)
- Mengutamakan Pengelolaan Kualitas Air Terpadu yang Adil, Efektif dan Efisien
- Memperkuat Partisipasi Masyarakat dalam Pengelolaan Sungai

Brantas Harmoni merupakan sebuah langkah untuk mencapai perbaikan kualitas air di DAS Brantas. Namun demikian, mengatasi tantangan yang ditimbulkan oleh pencemaran air dan penurunan kualitas air bergantung pada kerja sama dari pemangku kebijakan baik dari pemerintahan maupun non pemerintahan yang berkelanjutan untuk mendukung perencanaan, pelaksanaan, pemantauan, dan evaluasi yang terkoordinasi untuk perlindungan dan pengelolaan kualitas air, serta partisipasi masyarakat yang inklusif dan kesadaran publik. Dengan memanfaatkan kekuatan dan sumber daya bersama, kita dapat membuat kemajuan yang berarti untuk mencapai tujuan bersama dalam meningkatkan kualitas air dan pembangunan berkelanjutan di DAS Brantas.

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SUMMARY

The *Brantas Harmoni* policy research report presents a comprehensive and integrated review of water quality and water pollution source data, institutional research, and water quality management programs in the Brantas River basin in East Java, Indonesia. In combination, these inputs are used to propose recommended actions to strengthen water quality management and improve river health in one of Indonesia's most important river basins. The Brantas River courses 320 km through sixteen kota and kabupaten, from Kota Batu at its headwaters to its mouth in Surabaya, Indonesia's second-largest city and a key economic center. The Brantas River and its tributaries are a vital source of freshwater for agricultural irrigation, industrial production, and domestic use in East Java, but the river basin also faces significant water quality challenges due to insufficient sanitation and domestic wastewater management, mismanaged industrial wastewater, the presence of solid waste in water resources, agricultural and livestock runoff, and other non-point sources of pollution. Adopting a long-term vision of a clean Brantas, *Brantas Harmoni* outlines a policy vision for sustainable development and environmental conservation framed as a response to seven key challenges, namely:

	1	Reducing contamination from domestic wastewater (blackwater and graywater)
	2	Reducing contamination from mismanaged industrial wastewater
	3	Reducing the volume of pesticides and untreated livestock wasts
	4	Controlling erosion and reducing sedimentation in water resources
	5	Reducing the volume of solid waste in water resources, including plastics and organic waste
	6	Promoting equitable, efficient, and effective water quality management, based on best IWRM practice
	7	Strengthening community participation and river stewardship

The report presents a water quality situation analysis based on key data and information that characterize water quality standards and current conditions, pollution source contributions, and results from water quality modeling. The situation analysis also reviews institutional challenges, an overview of the tasks and functions involved in water quality management, key stakeholders, and key legal and regulatory instruments that set the terms for water quality management in National Strategic Rivers. This information is considered alongside the standing plans of key agencies involved in water quality management. A significant contribution of *Brantas Harmoni* is in inventorying and summarizing the standing initiatives and policy objectives of national, basin-level, and provincial agencies involved in water quality management, including Balai Besar Wilayah Sungai (BWWS) Brantas, Dinas Lingkungan Hidup Jawa Timur (DLH Jatim), Perum Jasa Tirta I, Kementerian Lingkungan Hidup dan Kehutanan (KLHK), Kementerian Pekerjaan Umum dan Perumahan Rakyat (PUPR), and Pemerintah Daerah Jawa Timur, with a goal of offering a combined and harmonized set of recommendations for strengthened water quality management.

With the adoption of Peraturan Pemerintah 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pendelolaan Lingkungan Hidup, Kementerian Lingkungan Hidup dan Kehutanan is tasked with formulation and management of a Rencana Perlindungan dan Pengelolaan Mutu Air (RPPMA) for the Brantas. The effectiveness of such a plan and its implementation depends, however, on the participation, inputs, and support of a large number of agencies, organizations, and communities who perform various functions of water quality management, pollution source management, and conservation, at the national, provincial, and local levels. The

ongoing and meaningful participation of organizations involved in water resources management and in the management of key pollution sources is paramount to the successful formulation and effective implementation of the RPPMA and other plans that govern water quality management, such as the Pola, RPJMD, RTRW, and agency strategic and work plans. As such, a key requirement for an effective approach to water quality management in the Brantas is the establishment of a formalized, effective, and inclusive coordination mechanism for planning, monitoring, and evaluation across sectors and levels of government, as well as a more coordinated approach to implementation of pollution management and environmental control across levels of government. A key recommendation of *Brantas Harmoni* is the establishment of a regularized and sufficiently-funded coordinating body to facilitate the dissemination of key data and information to support planning, adjustment, and oversight; monitor and evaluate progress; coordinate implementation; and recommend actions for ongoing improvement.

Moreover, a clean Brantas depends on increased provision of services outside of the control of KLHK, DLH Jatim, and kota / kabupaten-level environmental agencies, whose pollution control programs are largely focused on industrial sources. This includes, for example, the expansion of programs to effectively collect and treat domestic wastewater, the greatest contributor to elevated pollution across the watershed. At a basin level, increased attention must be paid also to the effects of agricultural runoff, the high presence of plastic and organic solid waste, and the impacts of land use and development. Reducing water pollution in the Brantas thus depends on coordinated action with agencies such as Dinas Cipta Karya, Balai Prasarana Permukiman Wilayah, Dinas Pertanian, Bappenas, Bappeda Jawa Timur, Dinas Perindustrian dan Perdagangan, and Dinas Peternakan. Effective water quality management also depends on both top-down and bottom-up actions and the inclusion of communities in both decision-making and provision of local services. As such, Brantas Harmoni also recognizes the relationship between improved river health and more inclusive and engaged participation of women and marginalized communities in local-level planning processes.

Brantas Harmoni offers a medium-term roadmap toward improved water quality by proposing medium-term prioritized measures and progress indicators. While water quality targets are drawn from established regulation and published policies, water quality management objectives are derived from a combination of published policies and research. *Brantas Harmoni* identifies programs and key implementers for all of the above challenges, summarizes actions and objectives in standing plans, and offers data to support situation analysis, but does not propose specific measures for every challenge (e.g., for pollution control associated with agricultural and livestock runoff, sedimentation). The report also does not propose specific time-bound targets for reducing pollution source or improving management and public administration. Setting such targets should be a focus of consultation during the processes of RPPMA formulation.

Brantas Harmoni is an output of the five-year project, "Fostering inclusive growth, health and equity by mainstreaming water quality in River Basin Management in the Brantas River Basin, Indonesia" (2019-2024), a public-private partnership amongst Indonesian and Dutch government bodies, knowledge institutions, private sector, and civil society funded by the Netherlands Enterprise Agency. The project goals include strengthened water quality monitoring, increased adoption of industrial wastewater treatment technologies, institutional strengthening, and strengthened community engagement and participation in water quality management. *Brantas Harmoni* was authored by the project team, led by TU Delft of the Netherlands, with significant policy and consultation inputs from Dinas Lingkungan Hidup (DLH) Jawa Timur, Perum Jasa Tirta I, and Balai Besar Wilayah Sungai (BBWS) Brantas.

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LIST OF ABBREVIATIONS AND ACRONYMS

ARG	Anggaran Responsif Gender
AWS	Alliance for Water Stewardship
BAP	Best available practice
BEP	Best environmental practice
BBWS Brantas	Balai Besar Wilayah Sungai Brantas
BOD	Biochemical oxygen demand
BPPW	Balai Prasarana Permukiman Wilayah
COD	Chemical oxygen demand
CSR	Corporate social responsibility
DAD	Dana Insentif Daerah
DAK	Dana Alokasi Khusus
DAS	Daerah Aliran Sungai
DIKPLHD	Dokumen Informasi Kinerja Pengelolaan Lingkungan Hidup Daerah
Dinas CK	Dinas Cipta Karya
Dinas PUSDA	Dinas Pekerjaan Umum Sumber Daya Air
Disperindag	Dinas Perindustrian dan Perdagangan
DLH Jatim	Dinas Lingkungan Hidup Jawa Timur
DO	Dissolved oxygen
DP3AK Jatim	Dinas Pendidikan Pekerja Perempuan di Jatim
DTBP	Daya Tampung Beban Pencemarain Air
EIA	Environmental impact assessment
ESDM	Dinas Energi dan Sumber Daya Mineral (ESDM
FDW	Sustainable Water Fund
IDR	Indonesian Rupiah
IKA	Indeks Kualitas Air
IKA-INA	Modified Indeks Kualitas Air
IKPS	Waste Management Performance Index
IPAL	Instalasi Penegelolaan Air Limbah
IPLC	Liquid waste disposal permit
IWQM	Integrated water quality management
IWRM	Integrated water resources management
JKPKA	Jaringan Komunikasi Pemantauan Kualitas Air
KLHK	Kementerian Lingkungan Hidup dan Kehutanan
KLHS	Kajian Lingkungan Hidup Strategis
KPS	Kommunitas Peduli Sungai
LSM	Non-governmental organization
mg	Milligram
mg/L	Milligrams per liter
MPN	Most probable number
MSME	Micro, small, and medium enterprises
Musrenbang	Musyawarah Perencanaan Pembangunan
NO3-N	Nitrate
ONLIMO	Online continuous real-time water quality monitoring program
OSS	Online single submission

Pergub	Peraturan Gubernor
Perpem	Peraturan Pemerintah
Perpres	Peraturan Presiden
PhACs	Pharmaceutical active compounds
PI	Pollution Index
PJT I	Perum Jasa Tirta I
PKM	Program Kreativitas Mahasiswa
Pokja	Kelompok kerja
PPP	Public-private partnership
PPRG	Gender-Responsive Planning and Budgeting
PROPER	Program Penilaian Peringkat Kinerja Perusahaan (Dalam Pengelolaan Lingkungan)
Prov/Kab/Kota	Province / Kabupaten / Kota
PUG	Pengarusutamaan Gender
PUPR	Kementerian Pekerjaan Umum dan Perumahan Rakyat
PU SDA	Dinas Pekerjaan Umum Sumber Daya Air
Renstra	Rencana strategis
RIPIN	Rencana Induk Pembangunan Industri Nasional
RPIP	Rencana Pembangunan Industri Provinsi
RISPAL	Rencana Induk Sistem Pengelolaan Air Limbah
RPJMD	Rencana Pembangunan Jangka Menengah Daerah
RPJMN	Rencana Pembangunan Jangka Menengah Nasional
RPPLH	Rencana Perlindungan Pengelolaan Lingkungan Hidup
RPPMA	Rencana Perlindungan dan Pengelolaan Mutu Air
RTH	Ruang terbuka hijau
RTRW	Rencana Tata Ruang Wilayah
SANIMAS	Program Sanitasi Berbasis Masyarakat
SDA	Sumber daya air
SIMPEL	Sistem Pelaporan Elektronik
SME	Small and Medium Enterprise
SPALD-T	Centralized sewerage treatment
SPARING	Sistem Pemantauan Kualitas Air Limbah secara Terus Menerus dan Dalam Jaringan
SPPL	Surat Pernyataan Kesanggupan Pengelolaan dan Pemantauan Lingkungan Hidup
TDS	Total dissolved solids
TKPSDA	Tim Koordinasi Pengelolaan Sumber Daya Air
TMDL	Total maximum daily load
TP	Total phosphate
TPA	Terminal disposal site
TPS	Temporary processing facility
TSS	Total suspended solids
TU Delft	Delft University of Technology
UKL/UPL	Upaya Pengelolaan Lingkungan Hidup dan Upaya Pemantauan Lingkungan Hidup
UMKM	Usaha, Mikro, Kecil, dan Menengah
UU	Undang-undang
WS	Wilayah Sungai
WWTP	Wastewater treatment plant

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CHAPTER I. BRANTAS HARMONI

East Java is endowed with an intricate network of rivers that play a vital role in sustaining life, biodiversity, and economic activities across the region. The health of these rivers directly impacts the well-being of communities, the integrity of ecosystems, and the overall quality of water resources. The Brantas River flows 320 km through the province and stands as a testament to the indispensable role rivers play in Indonesia's landscape. The Brantas is the primary source of freshwater for agricultural irrigation, industrial production, and domestic use, and holds cultural and historical importance for communities in the basin. As such, Wilayah Sungai Brantas has been designated as a National Strategic WS.[1]

The Brantas River is not only an important source of water; it is also the most important conveyor of waste for the region and receives high contributions of water pollution from domestic wastewater, solid waste, agriculture and livestock, and industrial wastewater. Poor river water quality increases the costs of water supply, contributes to habitat degradation, threatens public health, and poses a risk to regional food security. Recognizing the significance of river health in the Brantas River basin, the complex arrangements inherent to water quality and pollution source management, and the need for a collective and coordinated approach to tackle the challenges of river health, key stakeholders in the Brantas have developed a set of harmonized policy goals to improve water quality and strengthen water quality management in the Brantas.

This *Brantas Harmoni* policy vision is rooted in a commitment to sustainable development, environmental conservation, and the promotion of resilient ecosystems. It is driven by the understanding that water is a finite resource that requires careful management to meet the needs of present and future generations. Central to this vision is a holistic approach that integrates science, technology, community engagement, and policy alignment. By adopting a multi-stakeholder perspective, the policy envisions the active involvement of government agencies, local communities, industries, and non-governmental organizations in collaborative efforts to monitor, manage, and restore water quality and river ecosystems.

In order to achieve these objectives, *Brantas Harmoni* outlines a series of strategic initiatives and key actions, including implementation of robust and integrated water quality monitoring systems, strengthened pollution control across key pollution sources, and initiatives to improve planning, community engagement, and coordination. As Indonesia advances toward a future where water quality and river health are safeguarded, this *Brantas Harmoni* serves as a step towards more sustainable water resources management.

I.1. OVERVIEW OF BRANTAS HARMONI

Brantas Harmoni is an output of the Brantas Water Quality Project, which was initiated in 2018 to support strengthened integrated water quality management in the Brantas River basin. The project builds on existing policy to strengthen water quality monitoring, improve industrial wastewater management, foster improved institutional coordination and planning for IWRM, and support inclusive and gender-responsive river management. The 5-year project (2019-2024) funded by the Netherlands Enterprise Agency is a public-private partnership amongst Indonesian and Dutch government bodies, knowledge institutions, private sector, and civil society.

Brantas Water Quality Project programs include:

[1] Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 04/PRT/M/2015 tentang Kriteria dan Penetapan Wilayah Sungai, https://sda.pu.go.id/assets/files/PermenPUPR04-2015.pdf

- Water quality monitoring: Strengthened monitoring through capacity-building and synchronized data collection, analysis, and data management,
- Clean Industry Initiative: Support for industrial wastewater management, including promotion of efficient wastewater treatment technologies and support for improved compliance,
- Institutional strengthening: Establishment of a Brantas water quality platform and development of an ongoing Integrated Water Quality Management Plan, and
- Community engagement and gender-responsiveness in IWQM: Strengthened participation, community action for river health, and gender responsiveness in processes of water quality governance.

Under the work package for institutional strengthening, the project envisaged the formulation of a water quality management plan for the Brantas by Balai Besar Wilayah Sungai (BBWS) Brantas, Dinas Lingkungan Hidup Jawa Timur (DLH Jatim), and Perum Jasa Tirta 1 (PJT I). The adoption of Peraturan Pemerintah 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pendelolaan Lingkungan Hidup, changed the regulatory context for water quality planning, however. As such, the project team turned its focus to produce *Brantas Harmoni* as tool to inform the more detailed formulation of a Water Quality Protection and Management Plan (Rencana Perlindungan dan Pengelolaan Mutu Air, RPPMA) for the Brantas basin. The *Brantas Harmoni* report offers recommended measures for inclusion in the RPPMA and other key plans, based on the inputs of key stakeholders in Brantas River management – namely, BBWS Brantas (the river basin management organization) under the Ministry of Public Works and Public Housing (PUPR), DLH Jatim, and PJT I, the state-owned water operator tasked with managing river infrastructure and allocation. Recommended actions are also informed by additional analysis and data collection from the project's academic partner, Delft University of Technology.

I.1.1. TARGET USE

Brantas Harmoni offers joint recommendations of BBWS Brantas, DLH Jatim, PJT I, and its academic partners. It is intended for use by planners in the Ministry of Environment and Forestry (KLHK), Ministry of Public Works and Public Housing (PUPR), Bappeda Jawa Timur, and other key agencies involved in planning for water quality management at the provincial and kota / kabupaten levels of government. Additionally, the document is a resource that may be used by NGOs, communities, and water managers. By offering a strategic framework grounded in research and consultation, this document seeks to empower users to implement effective measures that contribute to the preservation and restoration of the Brantas.

River basin planning stands as a pivotal process that embodies the complexities and interconnected nature of water ecosystems. At the heart of effective river basin planning lies the principle of Integrated Water Resources Management (IWRM), an approach that acknowledges the interplay between water, ecosystems, and human activities. *Brantas Harmoni* report focuses specifically on Integrated Water Quality Management (IWQM), a coordinated approach ensures the sustainable and effective protection and improvement of water quality. Key characteristics of Integrated Water Quality Management include:

- Holistic perspective: IWQM considers natural processes and anthropogenic activities that influence water quality and recognizes interactions between land use, ecosystems, human activities, and water quality.
- Multi-stakeholder involvement and coordination: Effective IWQM involves the collaboration of various stakeholders, including government agencies, local communities, industries, agricultural sectors, and environmental organizations. Inclusion of diverse perspectives is crucial for addressing the different sources

of pollution and diverse water interactions, and mechanisms are needed to facilitate coordinated planning, response, and enforcement of regulations.

- Comprehensive monitoring and assessment: Regular and systematic monitoring of water quality includes assessing physical, chemical, and biological indicators to understand the current state of water quality, identify trends, detect emerging issues, and track progress.
- Prioritization: IWQM prioritizes interventions based on risk assessments and evaluation of pollution load contributions, considering the potential impact on ecosystems, productivity, and human health. This allows for targeted interventions and resource allocation to address the most pressing water quality issues.
- Public awareness, participation, and education: Engaging and educating the public about the importance of water quality, sustainable water use practices, and the potential consequences of pollution is important to access local knowledge and empower communities to take action.

I.2. APPROACH TO HARMONIZATION

The Brantas Harmoni process was initiated by government partners in the Brantas Water Quality project and developed during joint workshops and meetings during 2021-2023. The document was written by researchers from Delft University of Technology and reviewed and revised by staff of all four three organizations. The first steps in harmonization include identifying key stakeholders in Brantas water quality management; reviewing agencies' published strategies, work plans, and other key policy documents related to water quality; and gathering additional data on pollution sources and institutional and management challenges to inform problem analysis.

Brantas Harmoni builds on these existing strategies and adds further value by:

1. Identifying shared objectives,
2. Supporting further specificity and prioritization through additional problem analysis, and
3. Where appropriate, proposing more specific actions to improve water quality (i.e., moving from general to specific recommendations).

Data and information used to inform this problem analysis and harmonization process included:

- Published strategies and plans related to Brantas water, environmental, and pollution source management (Table 1),
- National and provincial laws and regulations related to water quality management,
- Secondary statistical and qualitative data related to pollution sources,
- Outputs of water quality modeling,
- Interviews and survey data on institutional, administrative, and coordination aspects, and
- Consultations with key stakeholders, including BBWS Brantas, DLH Jatim, KLHK, PUPR, PJT I, kota and kabupaten governments (particularly environmental agencies), academics, and communities.

Table 1. Strategy and Planning Inputs to Brantas Harmoni

Pola Tahun 2020 Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (BBWS Brantas, 2020a)	BBWS Brantas
Rencana Strategis BBWS Brantas 2020-2024 (BBWS Brantas, 2020b)	BBWS Brantas
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (BBWS Brantas, 2021)	BBWS Brantas
Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (DLH Jatim, 2019)	DLH Jatim
Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (PJT I, 2018)	PJT I
Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	Bappenas

Rencana Strategis Tahun 2020-2024 Kementerian Pekerjaan Umum dan Perumahan Rakyat (PUPR Ditjen Sumber Daya Air, 2020)	Kementerian PUPR
Rencana Strategis 2020-2024 Direktorat Jenderal Sumber Daya Air Kementerian PUPR (PUPR, 2020)	Kementerian PUPR
Rencana Strategis Kementerian Lingkungan Hidup dan Kehutanan 2020-2024 (KLHK, 2022b)	KLHK
2021 Laporan Kinerja, Direktorat Jenderal Pengendalian Pencemaran dan Kerusakan Lingkungan (KLHK, 2021)	KLHK
KLHK Study for RPPMA Brantas (2023)	KLHK
Rencana Pembangunan Jangka Menengah Daerah (RPJMD) Provinsi Jawa Timur Tahun 2019-2024 (2019) (Pemerintah Daerah Provinsi Jawa Timur, 2019)	Province of East Java
Peraturan Daerah Provinsi Jawa Timur Nomor 5 Tahun 2012 tentang Rencana Tata Ruang Wilayah Provinsi, Tahun 2011-2031 (Pemerintah Daerah Provinsi Jawa Timur, 2012)	Province of East Java

Existing work plans and strategies were reviewed to identify shared goals for water quality management as well as areas of divergence. In structuring this report, the *DLH Citarum Rencana Aksi 2019-2024* and Citarum Harum program was referenced as important examples and resources for focused water quality planning and action in Indonesia (Pemerintah Daerah Provinsi Jawa Barat, 2019).

Concurrently, statistical data on pollution sources and secondary qualitative data on pollution source control was collected to support problem analysis. Problem analysis related to institutional challenges was based on extensive doctrinal legal review to assess institutional gaps and overlaps, as well as interviews with government, community, and academic stakeholders; surveys of water and environmental managers; and consultations with key stakeholders regarding implementation, coordination, and informational barriers to IWQM. These consultations also supported the formulation of more specific actions, building on generalized recommendations in standing plans. Last, water quality modeling was performed to model the relationships between terrestrial pollution sources and water quality in the mainstem of the Brantas.

I.2.1. PRINCIPLES OF BRANTAS HARMONI

The formulation of Brantas Harmoni is based on key principles that underpin effective planning for river health. These include establishing a common vision; continuously engaging stakeholders; addressing governance issues to create an enabling environment; identifying clear actions based on problem analysis; considering options and trade-offs to prioritize; and continuously monitoring and evaluating progress to support learning and adaptation over time. Key principles applied in *Brantas Harmoni* include actionability and accountability; participation and transparency; realism; and prioritization.

Actionability ensures that the proposed strategies and measures included in a river basin plan are practical, feasible, and capable of implementation. Without actionability, plans may remain theoretical constructs, failing to translate into real-world improvements. As such, it is important that the RPPMA and other related plans specify tangible, well-defined, and realistic steps that can be taken to address the water quality-related challenges and goals outlined in the plan. These actions should be accompanied by clearly defined time bounds; guidance for resourcing and financing actions; and specific responsibilities for implementation, coordination, monitoring, and enforcement. *Clear accountability* on the other hand, clarifies implementation responsibility and holds stakeholders responsible for their roles and commitments in the plan's execution. Accountability also requires establishing a framework for tracking progress and transparent reporting on inputs, outputs, and outcomes related to activities included in the plan. Moreover, accountabilities should be specific, with clear delineation of leadership responsibilities and specific contributions to shared programs, activities, and strategies.

Realism and prioritization are essential to navigating the complex challenges inherent in managing water resources and dealing with financial, informational, land, human, and other resource constraints. Realism requires an assessment of the legal, socio-economic, environmental, and political landscape surrounding a river basin. It emphasizes the need to acknowledge constraints, uncertainties, and competing interests in order to craft pragmatic solutions. *Prioritization* is a practice of discerning which issues demand immediate attention, which actions are likeliest to achieve results, and allocating resources accordingly. This involves evaluating the urgency of water-related issues, considering ecological and human needs, identifying alternative options, evaluating alternatives against technical, social, ecological, economic and institutional criteria, and accounting for potential synergies or trade-offs. Evaluating options may involve hydrological and other modelling, quantitative and qualitative information, stakeholder engagement, and other approaches to applying scientific, social, and institutional knowledge to ensure that limited resources are strategically directed.

Transparency and participation stand as pillars of effective and inclusive river basin planning. Transparency ensures that information, data, and decision-making processes are accessible and comprehensible to all stakeholders. It fosters trust among diverse participants, including local communities, governmental bodies, and environmental organizations, by providing a clear understanding of the factors influencing planning decisions. Participation invites the voices and expertise of various stakeholders into the planning process, recognizing that those who live and work in the river basin have valuable insights. By including all relevant stakeholders in the planning process, planners increase the knowledge base upon which the plan is built, build political support, and help mitigate potential risks associated with inadequate understanding of community needs and modes of engagement with the river (Winfield et al., 2020). Involving local communities, academia, and other stakeholders also promotes a sense of ownership. By cultivating an environment where information flows openly, and diverse perspectives are considered, transparency and participation contribute to the creation of river basin plans that are not only robust and well-informed but also reflective of the needs and aspirations of the communities they impact.

Last, the RPPMA and other plans should include a clear monitoring and evaluation framework in order to track progress and inform adjustments to the water quality management plan. *Learning and adaptability* depends on a monitoring and evaluation framework that specifies clear performance indicators, responsibilities for monitoring and reporting, and data sharing and information management arrangements to support reporting. This should also include the timing and focus of regular progress reviews and mechanisms to trigger adjustments when parts of the plan are founds to be underperforming (Winfield et al., 2020).

I.2.2. PLANNING FOR WATER QUALITY: OBJECTIVES, TARGETS, ACTIONS, AND INDICATORS

Water quality objectives include goals for water quality in terms of quantitatively measurable physical, chemical, and biological parameters, as well as in terms of the practices and activities of water quality management. These include such subfunctions as the control and management of water pollution from various sources; planning, monitoring, and evaluation; coordination; and community engagement. Recommended actions in *Brantas Harmoni* aim to support progress towards improved water quality management and pollution control as the means to achieving longer-term improvements to measured water quality.

The overarching vision for water quality in the Brantas is guided by broader national and provincial policy aspirations for water and sustainable development. At the highest level of developmental policy, the Government of Indonesia's Vision 2045, "Wawasan Indonesia 2045" envisions an Indonesia that stands as one of the world's most robust economies upon reaching its centenary in 2045. This vision is built upon sustainable economic

development, a national policy goal that depends on water security and the availability of clean water for drinking water supply and sanitation, agriculture, and manufacturing. Attaining this high-level vision depends on addressing water pollution and strengthening institutions through better coordination and capacity building (Abedalrazq et al., 2021).

The national development plan (RPJMN 2020–2024) reinforces national commitment to improved water quality management. Key actions include extension of the water quality monitoring regime and improved data management; strengthened oversight and enforcement of pollution control; and reduced pollution associated with domestic wastewater and solid waste. More specific to water and the environment, the KLHK Renstra 2019-2024 and PUPR Renstra 2020-2024 include commitments to water security and natural resource management. While the KLHK Renstra 2019-2024 focuses extensively on river water quality, the PUPR Renstra generally affirms the Ministry's commitment to mainstreaming sustainable development and increasing actions to protect water quality under the Directorate of Water Resources (PUPR, 2020).

At the provincial level, the Government of East Java's development plan (RPJMD 2019-2024) also offers a foundation for *Brantas Harmoni* via two component Bhaktis, or devotions. Bhakti 9, Jatim Harmoni, focuses on realizing harmony between nature and society and envisages regional development based on environmental sustainability; watershed-based development; development of eco-tourism and clean industry; development considering the environment's assimilative capacity; and preservation of biodiversity. This includes a commitment to improve waste management specifically to support clean rivers, as well as programs to support community-led river stewardship, such as Kalih Bersih and Adipura Desa. Bhakti 7, Jatim Berdaya, envisages strengthened village government and innovation, including a focus on village-led environmental care and strengthened participation in water and environmental management (RPJMD Jawa Timur, 2019; interview, Bappeda, 2022).

I.3. SEVEN KEY WATER QUALITY CHALLENGES: PROGRAMS AND PRIORITY ACTIONS

Brantas Harmoni lays out objectives and recommended action to strengthen pollution control and water quality management. Objectives are broader, qualitative statements that describe desired outcomes or overarching goals; targets are more specific, time-bound, and measurable goals that provide a benchmark for success; and actions or measures are the means of achieving these objectives and targets. *Brantas Harmoni* objectives are framed as responses to seven key water pollution and water quality management challenges (Table 2).

Table 2. Key Challenges for Brantas Harmoni

	1	Reducing contamination from domestic wastewater (blackwater and graywater)
	2	Reducing contamination from mismanaged industrial wastewater
	3	Reducing the volume of pesticides and untreated livestock waste
	4	Controlling erosion and reducing sedimentation in water resources
	5	Reducing the volume of solid waste in water resources, including plastics and organic waste
	6	Promoting equitable, efficient, and effective water quality management, based on best IWRM practice
	7	Strengthening community participation and river stewardship

While measurable water quality parameter targets are taken from established regulation and water class designations (described further in Chapter II), water quality management objectives come from a combination of

published policies and plans and situation analysis. These objectives focus on strengthening the subfunctions and activities that comprise water quality management.[2] *Brantas Harmoni* includes general objectives, recommended measures, and (where appropriate) progress indicators and implementing agencies, based on established programs and responsibilities.

I.3.1. SCOPE OF RECOMMENDATIONS

Brantas Harmoni identifies programs and key implementers for all challenges, summarizes actions and objectives in standing plans, and offers data to support situation analysis. Based on these inputs and attendant consultations, *Brantas Harmoni* lays out recommendations as either broad guidance or, where appropriate, priority actions and indicators of progress. For challenges that can be directly addressed via programs of BBWS Brantas, DLH Jatim, PJT I, or closely associated agencies at the kota and kabupaten levels (e.g., kota and kabupaten DLH), *Brantas Harmoni* also specifies priority actions and progress indicators. The report does not propose specific time-bound targets but rather recommends that targets be carefully formulated by participating agencies in the process of RPPMA formulation. The report also does not assign specific measures if they fall outside of the remits of BBWS Brantas, DLH Jatim, and PJT I. This applies especially to the implementation of pollution control associated with agricultural and livestock runoff and sedimentation. Table 3 summarizes these scope limits. Cells in gray indicate those for which information is provided in this report.

Table 3. Content Scope of Brantas Harmoni, in relation to key challenges

Seven Key Challenges	Programs	Indicative Data / Problem Analysis	General Recommendations	Priority Actions	Progress Indicators
Reducing contamination from domestic wastewater	Urban wastewater management and sanitation				
	Rural on-site wastewater management				
Reducing contamination from mismanaged industrial wastewater	Support for industrial wasteater management				
	Support for environmental compliance and innovation				
	Industry monitoring and enforcement				
Reducing pollution from agriculture, livestock, and fisheries	Agricultural runoff management				
	Livestock waste management				
	Fisheries waste management				
Controlling erosion and reducing sedimentation	Control of riparian areas				
	Reforestation				
	Green open space (RTH) development				
	Green riparian development				
Reducing volume of solid waste in water resources, including	Solid waste management				
	Community engagement for waste reduction and management				

[2] These goals also align with KLHK's developing Regional Performance Response Index (IRKD) initiative, which recognizes the importance of strengthening local government response to improve environmental quality.

plastics and organic waste	River and riparian waste removal				
Promoting equitable, efficient, and effective water quality management, based on best IWRM practice	Clarity of roles and responsibilities				
	Integrated planning and evaluation				
	Water quality governance				
	Integrated WQ planning				
	Spatial planning				
	Development planning				
	Environmental planning				
	Participatory planning and evaluation				
	Joint monitoring and evaluation				
	Coordination				
	Water quality monitoring and information management				
Strengthening community participation in water quality management	Community education and outreach				
	Public information				
	Participation in planning, implementation, and monitoring				
	Green business and ecotourism development				

CHAPTER II. OVERVIEW OF THE BRANTAS RIVER BASIN (DAS BRANTAS)

The Brantas River runs 320 km through East Java, Indonesia, from its headwaters in the mountainous terrain of Mount Arjuno above Kota Batu. The river moves clockwise towards the Madura Strait and through the lowlands near Mojokerto, where it splits into two branches. The Porong River flows eastward to the Madura Strait, and the Surabaya River, which further divides into the north-flowing Kali Mas and east-flowing Wonokromo, empties into the Surabaya and Madura straits through Surabaya, Indonesia's second-largest metropolitan area. It drains a basin, or Daerah Aliran Sungai (DAS), of approximately 12,000 km^2 (BBWS Brantas, 2020a) that is home to approximately 18 million residents. The Brantas basin also contains two active volcanoes – Mount Semeru to the East and Mount Kelud near the basin's center. Volcanic ash is both a major source of soil fertility and a primary cause of reservoir sedimentation within the basin (Harnanto & Hidayat, 2004).

Wilayah Sungai Brantas is designated as one of Indonesia's National Strategic River Areas due to its high water potential and recognized importance to provincial and national development in terms of social, environmental, and economic impact.[3] Around 59% of the province's GDP is generated in DAS Brantas, and the river is a critical water supply source for manufacturing, fisheries, tap water supply, hydropower, and irrigation. Agriculture utilizes approximately 75% of the river's water availability (Schroeder et al., 2013) and accounts for over half of the basin's land use. The Brantas and its tributaries irrigate an agricultural region that produces 10-25% of Indonesia's rice crop (Adi et al., 2013; Jennerjahn et al., 2004; Sudaryanti et al., 2001), which brings critical focus on the region in terms of national water and food security.

The Brantas also provides raw water for domestic and industrial use and hydropower. Approximately 300 million m^3 of raw water is supplied annually to six regional water supply enterprises (Perusahaan Daerah Air Minum, or PDAMs), and about 191 million m^2 is supplied to 143 industries licensed to directly extract water. The manufacturers that utilize and discharge wastewater to the river are centered largely around Malang and the greater Surabaya area. Ten hydropower stations along the river produce an approximate 1.031 billion kWh each year to serve both East Java and the Java-Bali power system.

The river basin is located within the Intertropical Convergence Zone, whose wind patterns give rise to distinct wet (November-April) and dry (May-October) seasons with significantly different rainfall levels. Annual precipitation averages 2,000 mm – 80% of which falls during the rainy season (PUPR, 2010). The water potential of the Brantas River is some 8 to 13 billion m^3 per year (Fujimoto, 2013; PUPR, 2010). At present, nearly the full dry season availability is utilized, and water stress is predicted to increase due to a growing population and intensified manufacturing and agricultural production.

II.1. ADMINISTRATIVE SEGMENTS OF *BRANTAS HARMONI*

Brantas Harmoni presents key data and information that characterize water quality challenges, both with respect to load volumes and source contributions of pollution, to support formulation of the Rencana Perlindungan dan Pengelolaan Mutu Air (RPPMA). Formulation of river water quality plans and accompanying evaluation tools necessitates the explicit demarcation of territorial (and/or hydrological) bounds in order to structure data collection and analysis. For the purposes of water quality assessment, planning, and evaluation, it is important to note the distinction between Wilayah Sungai (WS), or river territory, and Daerah Air Sungai (DAS), or river basin. As

[3] Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 04/PRT/M/2015 tentang Kriteria dan Penetapan Wilayah Sungai, https://sda.pu.go.id/assets/files/PermenPUPR04-2015.pdf

defined in UU 17 or 2019 on Water Resources, a Wilayah Sungai is an area designated as the jurisdiction of a water management unit, in this case, BBWS Brantas. DAS Brantas is the hydrologically determined river basin – i.e., the terrestrial area that actually drains into the Brantas River. *Brantas Harmoni* focuses on DAS Brantas, since this more directly accounts for the terrestrial area that drains to the Brantas River.

Box 1. Differentiation between DAS and WS in Indonesian water law

11. **Wilayah Sungai** adalah kesatuan wilayah Pengelolaan Sumber Daya Air dalam satu atau lebih Daerah Aliran Sungai dan/atau pulau-pulau kecil yang luasnya kurang dari atau sama dengan 2.000 (dua ribu) kilometer persegi.	11. **River Territory** is a unified Water Resources Management area in one or more River Basins and/or small islands whose area is less than or equal to 2,000 (two thousand) square kilometers.
12. **Daerah Aliran Sungai** adalah suatu wilayah daratan yang merupakan satu kesatuan dengan sungai dan anak-anak sungainya, yang berfungsi menampung, menyimpan, dan mengalirkan Air yang berasal dari curah hujan ke anau atau ke laut secara alamiah, yang batas di darat merupakan pemisah topografis dan batas di laut sampai dengan daerah perairan yang masih terpengaruh aktivitas daratan.	12. A **River Basin / Watershed** is a land area which is one unit with a river and its tributaries, which functions to accommodate, store and channel water originating from rainfall to lakes or the sea naturally, where the land boundary is a topographical divider and the area between the sea and water resource area is affected land activities.

Source: Undang-Undang Republik Indonesia Nomor 17 Tahun 2019 tentang Sumber Daya Air, Bab 1, Pasal 1, 11-12

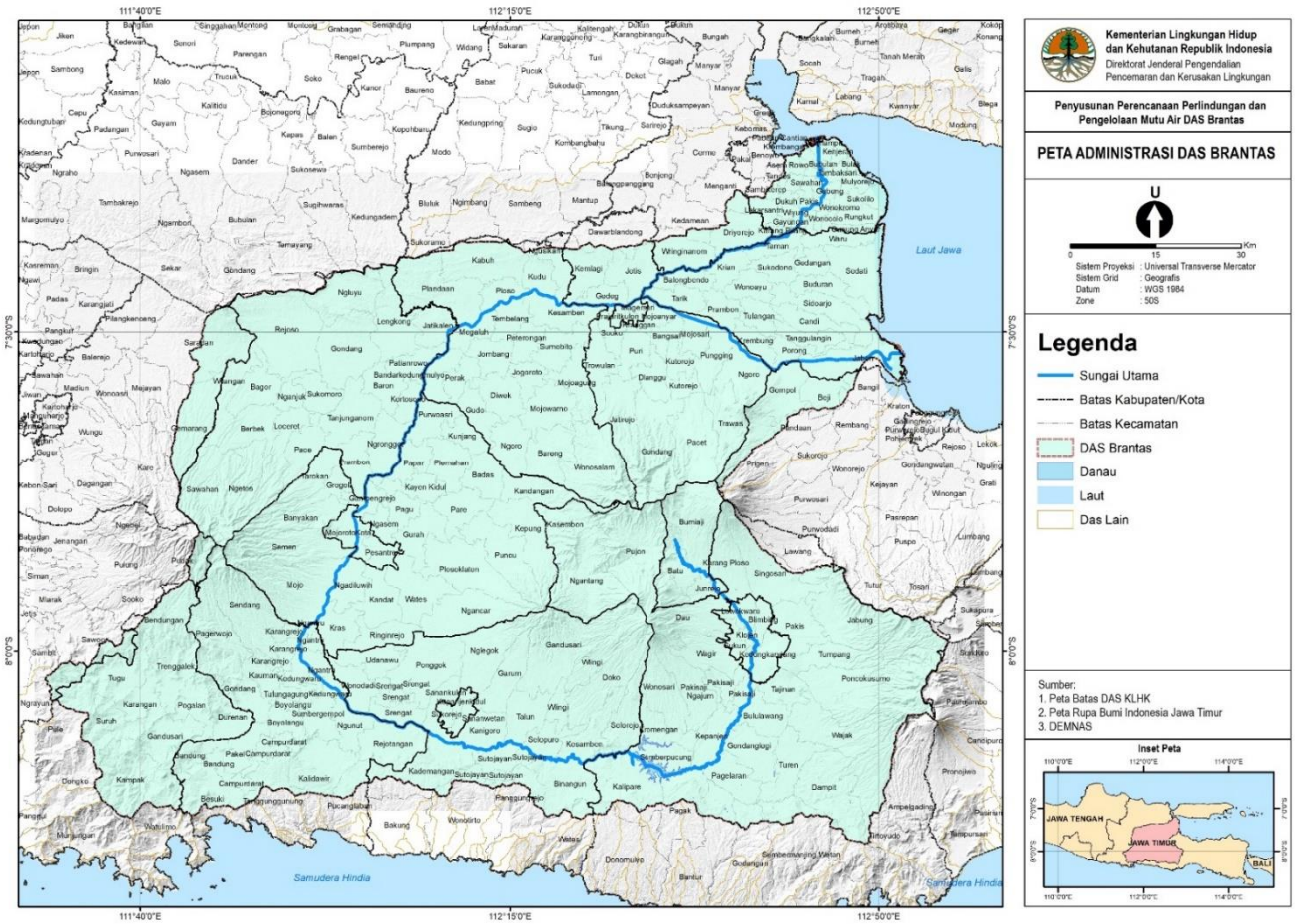
The areas included in river management plans have changed over time. Over the past twenty years, management plans and reports have focused alternatively on the WS Brantas and the DAS Brantas, with differences in the composition of each, as updated by law. The area designated as WS Brantas in the 2010 Pola, for example, included four DAS. This number increased to 220 DAS in 2015, based on updated regulations on the designation of Wilayah Sungai.[4] In both specifications, DAS Brantas accounted for an overwhelming majority of WS Brantas (85.0% and 83.8%, respectively) (BBWS Brantas, 2020a; PUPR, 2010).

Similarly, the 2010 Pola denotes fifteen administrative regions of the DAS Brantas: Kota Batu, Kabupaten Malang, Kota Malang, Kabupaten Kediri, Kabupaten Blitar, Kabupaten Sidoarjo, Kabupaten Mojokerto, Kabupaten Jombang, Kota Kediri, Kota Mojokerto, Kabupaten Trenggalek, Kota Blitar, Kabupaten Tulungagung, and Kabupaten Nganjuk. The 2020 Pola, alternatively, includes sixteen kota and kabupaten (additionally including Kabupaten Gresik). Plans have also employed various river segmentation schemes for analysis and reporting – e.g., hulu-tengah-hilir (upper-middle-lower) with different division points, segmentation by kota / kabupaten, and other alternative segmentations of either the WS or DAS Brantas territorial areas (e.g., a proposed five-segment scheme in 2023 by consultants of KLHK).

While the boundaries of DAS Brantas are hydrologically determined, Brantas Harmoni employs the sixteen kota and kabupaten administrative divisions specified in the 2020 Pola as administrative segments of DAS Brantas. This approach is taken for three reasons. First, DAS Brantas lies entirely within the province of East Java and almost entirely within the territorial bounds of the sixteen kota / kabupaten in Table 4 (see also Figure 1). Only a very small area of DAS Brantas overlays small portions of five other kabupaten (Ponorogo, Pasuruan, Madiun, Lumajang, and Lamongan). With the exception of a sliver of Pasuruan that drains to the Brantas, the areas in these additional five kabupaten that drain to the Brantas are largely rural and are unlikely to contribute significant pollutant loads from domestic or industrial sources.

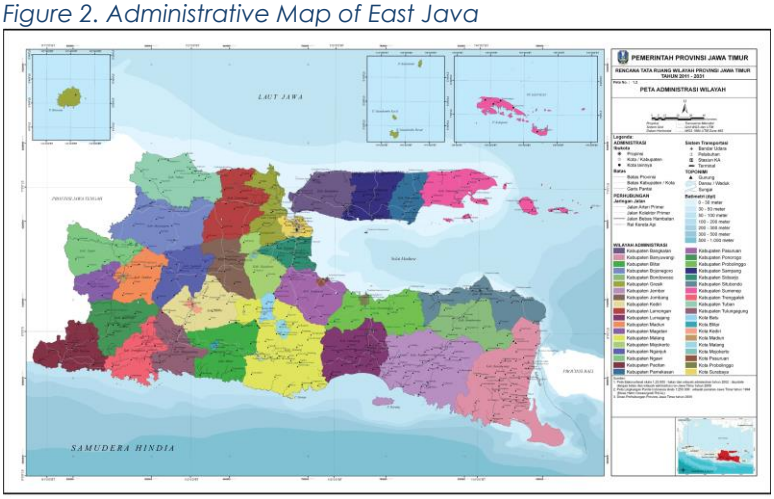
[4] Peraturan Menteri Pekerjaan Umum dan Perumahan Nomor 4/PRT/M/2015 tentang Kriteria dan Penetapan Wilayah Sungai, https://sda.pu.go.id/assets/files/PermenPUPR04-2015.pdf

Figure 1. Map of DAS Brantas, KLHK 2023



Source: KLHK PowerPoint, Study for PPMA Brantas, December 2023

Figure 2. Administrative Map of East Java



Source: RTRW Jawa Timur 2011-2031, 2010

Second, while policy planning and implementation related to river management and environmental pollution control function at several levels of government, many functions of pollution control and waste management are administered by kota and kabupaten with the support of provincial and national bodies. Third, data limitations make it difficult to truncate pollution source data for all sources strictly by the boundaries of DAS Brantas, as most statistical data is reported at a kota / kabupaten level. Most pollution source data described herein is also reported at the kota / kabupaten level. Applying this segmentation approach, the sixteen kota and kabupaten that comprise the segments in *Brantas Harmoni* situation analysis are listed below. Reporting herein follows a data presentation format of upstream-downstream data for these sixteen administrative areas as in Table 4.

Table 4. Administrative segments of Brantas River Water Quality Management, based on Dati-III (Kota / Kabupaten) level

	Segment	Kota / Kabupaten
Upstream	1	Kota Batu
	2	Kabupaten Malang
	3	Kota Malang
	4	Kabupaten Blitar
	5	Kota Blitar
	6	Kabupaten Tulungagung
	7	Kabupaten Trenggalek
	8	Kabupaten Kediri
	9	Kota Kediri
	10	Kabupaten Nganjuk
	11	Kabupaten Jombang
	12	Kabupaten Mojokerto
	13	Kota Mojokerto
	14	Kabupaten Sidoarjo
	15	Kabupaten Gresik
Downstream	16	Kota Surabaya

It should be noted that pollution source data from four kabupaten should be interpreted carefully. First, much of Kabupaten Gresik likes outside the hydrological bounds of DAS Brantas, and the northern area drains to the Bengawan Solo River basin and sea. Additionally, the coastal areas of Kabupaten Malang, Blitar, and Tulungagung, and Trenggalek flow directly to the sea towards the south coast, and a small area of northeast Kabupaten Malang flows to the Welang River basin. This does not affect reporting of water quality conditions in the river itself, but it does have relevance to consideration of reported pollution source volumes and patterns of land use in these kabupaten.

II.1.1. LAND USE IN THE BRANTAS RIVER BASIN

Much of the Brantas River basin is covered by forest and agriculture, though the region is also characterized by increasing urbanization. Over 50% of the land area in WS Brantas is utilized for agricultural production, fairly evenly distributed between plantation and rice paddy agriculture, and forests account for approximately 30% of land use (Pola 2020) (see Table 5 and Table 6). Intensive agricultural development since 1970 has led to significant land use changes over fifty years, most dramatically for plantation agriculture, which rose from 5% in 1970 to more than 20% in 2004 and nearly 26% in 2015 (Adi et al., 2013; BBWS Brantas, 2020a).

Table 5. Land use in WS Brantas (2015 data)

Penggunaan Lahan	Use Category	Luas / Area (Ha)	Percent WS
Pertanian	Agriculture	382,974.55	27.09%
Tanaman Tahunan	Plantations	362,438.38	25.7%
Hutan Produksi	Production Forest	238,532.00	16.9%
Permukiman	Settlements	210,627.37	14.9%
Hutan Lindung	Protected Forest	104,880.00	7.44%
Kawasan Suaka Alam	Nature Reserve	46,110.00	3.27%
Hutan Rakyat	Community Forest	33,762.60	2.39%
Pertambakan	Aquaculture	27,212.64	1.93%
Kawasan Industri	Industrial Area	4,436.25	0.31%
Lainnya	Other	226.21	0.02%
	Total	1,411,200.00	

Source: Pengelolaan Sumber Daya Air Wilayah Sungai Brantas, 2020

Table 6. Land use in DAS Brantas (2023 data)

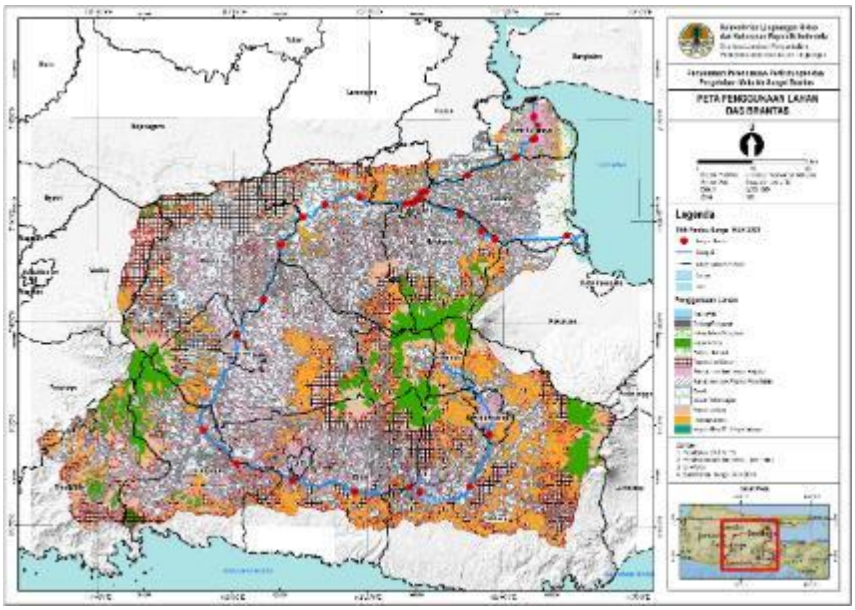
Penggunaan Lahan	Use Category	Luas / Area (Ha)	Percent DAS
Danau/Situ	Lake/Situ	1.880,76	0,16%
Gedung/Bangunan	Building/Building	1.731,99	0,14%
Hutan Bakau/Mangrove	Mangrove/Mangrove Forest	1.292,62	0,11%

Hutan Rimba	Jungle	94.377,44	7,79%
Padang Rumput	Meadow	17.085,71	1,41%
Perkebunan/Kebun	Plantation/Garden	251.323,37	20,74%
Permukiman dan Tempat Kegiatan	Settlements and Places of Activity	195.574,79	16,14%
Rumah Komplek/Properti Real Estate	Complex House/Real Estate Property	35,27	0,003%
Sawah	Ricefield	312.928,95	25,82%
Sawah Tadah Hujan	Rain-Fed Rice Fields	79.889,12	6,59%
Semak Belukar	Shrubs	71.417,16	5,89%
Tegalan/Ladang	Moorland/Field	183.955,22	15,18%
Vegetasi Non Budidaya Lainnya	Other Non-Cultivated Vegetation	342,72	0,03%
	Total	1.211.835,12	0,16%

Source: KLHK Preparation Study for RPPMA, 2023

Land use and land cover (LULC) changes in East Java over past twenty years show a marked increase in built-up area (Indarto et al., 2022; Nurfaizah et al., 2023). Moreover, there is a high degree of non-conformity between planned land use as designated in the provincial spatial development plan, or Rencana Tata Ruang Wilayah (RTRW), particularly for built up areas, paddy field, plantations, and dry land agriculture. These use types are noted to be noncompliant particularly in areas designated as forest land or nature reserve. Moreover, built-up areas are often located in areas designated for agriculture of all types (Nurfaizah et al., 2023). As such, there is an increase in domestic activity – including discharge of domestic wastewater – in areas designated for forest coverage or agricultural use.

Figure 3 Land Use Map, Jawa Timur (2023)



Source: KLHK Study for PPMA Brantas, PowerPoint, December 2023

Within the Regional Spatial Development Plan (RTRW)[5], National Strategic Areas (Kawasan Nasional Strategis, KSN) are areas whose planning is prioritized because of their importance to national sovereignty, security, economy, society, and environment. Cultivation Areas (Kawasan Budi Daya) are designated for primary use as productive area (e.g., agricultural, industrial), natural space, or residential area. Budi Daya (cultivation) areas include production and community forest, agriculture, plantation, livestock, fisheries, mining, industrial, tourism, residential,

[5] Rencana Tata Ruang Wilayah (RTRW), https://Bappeda.jatimprov.go.id/Bappeda/wp-content/uploads/dokren/perda_5_2012.zip

and mainstay areas. Mainstay Areas (Kawasan Andalan) are regions within a Kawasan Budi Daya that are identified as a priority development area for economic growth. Protected Areas (Kawasan Lindung) are areas designated with the function of protecting environmental sustainability in the region.

With respect to development of the watershed, several areas have been identified as "Mainstay Areas" prioritized for development (see Table 7). These development priorities indicate a targeted policy effort to promote industrial growth in the upstream areas surrounding Malang and the downstream areas surrounding Surabaya. They also suggest efforts to intensify agricultural and livestock production as well as small-scale home industry in the midstream areas around Blitar, Kediri, and Tulungagung.

Table 7. Brantas Mainstay Areas and Development Priorities in East Java Spatial Plan 2011-2031 (RTRW Jatim) (2012)

Area	Leading Potential	Development Priorities
Surabaya and surroundings	Trade in services Industry Fishing Tourism	Developing industrial areas Agglomeration of urban settlements Developing tourism Increasing fishery production ponds
Kediri-Tulungagun-Blitar and surroundings	Plantation Food crop agriculture Mining	Developing technical agricultural areas Developing craft and home industry centers Increasing livestock sector Developing agro-industry Developing fisheries potential, especially in Trenggalek
Malang and surroundings	Industry Food crop agriculture Plantation Tourism	Maintaining horticultural plant culture in Batu, Poncokusumo and Nongkojajar and the concept of agropolitan Developing tourism in Malang east Increase attractiveness of nature tourism concentrated in Batu and Malang

Source: Pengelolaan Sumber Daya Air Wilayah Sungai Brantas, 2020

These developments are relevant to considering potential increases of pollutant loads derivative of particular sources, including agriculture and industry. Moreover, priority development locations should be considered as potential target areas for additional investments in wastewater treatment, industrial clustering to share wastewater treatment facilities at various scales, and interventions to address agricultural runoff and livestock waste. Moreover, additional analysis is needed to estimate the impacts of such developments on water quality conditions.

II.1.2. POPULATION AND URBAN DENSITY

With respect to urbanization and urban development, East Java is Indonesia's second-most populous province with high population density but a fairly low and decreasing growth rate of 0.66-0.79% over the past ten years (Badan Pusat Statistik Indonesia, 2023). In 2021, the population density in East Java was 855 people per km^2, making it a "very dense" region based on Ministry of Public Works and Public Housing criteria (Badan Pusat Statistik Indonesia, 2023). Some administrative regions in particular – Kabupaten Malang, Kabupaten Blitar, Kabupaten Trenggalek, Kabupaten Nganjuk, and Kabupaten Gresik – have experienced significant increases in their population densities over the past four years. This is particularly evident for Kabupaten Malang, whose density increased 262% over the 10-year period.

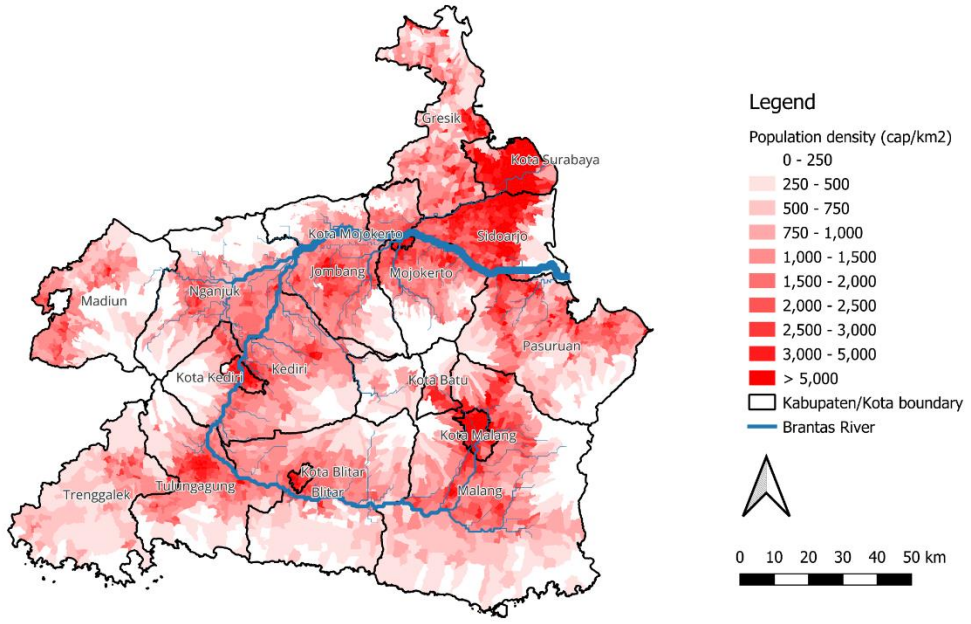
Table 8.Population of Kota and Kabupaten in DAS Brantas

	Kabupaten/Kota Regency/Municipality	Area (km^2)	Population				Annual Population Growth Rate (%)		Population Density per km^2	
			2010	2015	2022	2030*	2010	2020	2010	2020
1	Kota Batu	93	190806	200485	216735	232516	1.25	1.10	1,390	1,558

2	Kabupaten Malang	2979	2451997	2544315	2685900	2842382	0.87	0.79	208	752
3	Kota Malang	110	822201	851298	846126	94501	0.81	0.27	5,644	5,808
4	Kabupaten Blitar	1589	1118919	1145396	1240322	1228717	0.48	0.89	648	916
5	Kota Blitar	33	132383	137908	151960	155897	1.02	1.19	4,053	4,579
6	Kabupaten Tulungagung	1046	992317	1021190	1105337	1113210	0.64	0.93	929	1,032
7	Kabupaten Trenggalek	1205	675584	6892	739669	731721	0.37	0.78	528	637
8	Kabupaten Kediri	1386	1503095	1546883	1656020	1686389	0.64	0.84	816	1,180
9	Kota Kediri	63	269193	280004	289418	315103	0.95	0.64	4,243	4,524
10	Kabupaten Nganjuk	1224	1019018	1041716	1117033	1112802	0.44	0.80	702	902
11	Kabupaten Jombang	904	1205114	1240985	1335972	1355244	0.66	0.89	1,013	1,182
12	Kabupaten Mojokerto	692	1028605	1080389	1133584	1252089	1.23	0.85	2,152	1,559
13	Kota Mojokerto	16	120623	125706	134350	142284	1.00	0.94	7,286	6,553
14	Kabupaten Sidoarjo	634	1949595	2117279	2103401	2711415	2.21	0.68	5,509	3,283
15	Kabupaten Gresik	1266	1180974	1256313	1332664	1512076	1.60	1.05	915	1,101
16	Kota Surabaya	326	2771615	2848583	2887223	3092653	0.63	0.37	7,888	8,200

Sources: Susenas March 2022 (2022 data); BPS Jawa Timur 2015 / Pola 2020; BPS Sensus Penduduk (SP) 2010 dan Proyeksi Penduduk Indonesia 2010–2035/BPS-Statistics Indonesia, 2010 (population growth rate and density data)

Figure 4. Population density in DAS Brantas



Source: Deltares, 2023

The areas of denser population lead to higher concentrations of BOD, fecal coli, oils and detergents, and other domestic source pollutants. Dense urban areas also present a challenge for developing effective centralized wastewater management systems due to the space requirements for construction of networked systems and treatment plants. For areas with rapidly growing populations, urban planning should focus on integrating wastewater treatment facilities prior to further development. Where areas are already densely built up, alternative infrastructure solutions, such as decentralized or community-scale treatment systems, on-site sanitation systems, constructed wetlands, and dual pipe systems (that separate greywater and blackwater for more efficient treatment and greywater reuse) may be required.

II.2 ROLES AND RESPONSIBILITIES IN BRANTAS WATER QUALITY MANAGEMENT

River water quality management involves a range of tasks and functions performed across sectors and levels of government. Key tasks and functions include:

- Water quality monitoring and data management, analysis, and reporting,
- Planning, including water resources and spatial planning,
- Pollution source control, including:
    - Identification (inventory) and evaluation of point and non-point sources of pollution,
    - Standard-setting, permitting, and licensing for wastewater discharge,
    - Enforcement of discharge and other related environmental standards,
    - Service provision to reduce pollution from terrestrial sources (e.g., provision of wastewater collection and treatment services and solid waste management),
- Community engagement, public awareness, and education,
- Restoration and conservation, and
- Coordination in planning and implementation.

In the context of Indonesia, water and environmental law explicitly stipulates the responsibilities and tasks associated with water quality management, with some functions performed by multiple agencies. These responsibilities are encoded in a body of law including:

- Organizational statutes that stipulate specific responsibilities and tasks (tugas pokok dan fungsi or "tupoksi") assigned to agencies, and
- Functional statutes that stipulate rules for and processes of water quality management (e.g., laws on environmental management, pollution control, planning, permitting, water quality management) and ascribe responsibilities for component tasks to specific organizations.

A selection of laws that explicitly allocate responsibilities for water quality management includes those listed in Table 9.[6]

Table 9. Key laws that establish tasks and functions "tupoksi" for water quality management

Year	Law / Regulation / Statute
2021	Government Regulation (Perpem) 22 of 2021 concerning Protection and Management of the Environment
2021	Perpem 22 of 2021 concerning Protection and Management of the Environment
2021	Permen LHK 1 of 2021 concerning Performance Rating Assessment Program in Company Performance for Environmental Management (PROPER)
2020	Brantas River Basin Pola 2020, unpublished
2020	Permen PUPR 16 of 2020 concerning Organization and Work Procedures for Technical Implementing Units in Ministry of Public Works and Public Housing
2020	Perpres 92 of 2020 concerning the Ministry of Environment and Forestry
2019	Law (UU) 17 of 2019 concerning Water Resources
2018	Pergub 49 of 2018 concerning Nomenclature, Organizational Structure, Description of Duties and Functions and Working Systems of Technical Implementing Units Department of Public Works of Water Resources, East Java Province
2017	Permen PUPR 17 of 2017 concerning Guidelines for Establishing a Resource Management Coordination Team Water at the Level of the River Area
2017	Presidential Regulation (Perpres) 10 of 2017 concerning National Water Resources Council

[6] These do not include laws that lay out responsibilities for agencies that govern agriculture and livestock.

2016	Governor's Regulation (Pergub) 76 of 2016 concerning Position, Organizational Structure, Description of Duties and Functions and Working Procedures of DLH Jatim
2016	Governor's Regulation (Pergub) 98 of 2016 concerning Technical Implementation Unit (UPT) of DLH Jatim
2016	Pergub 107 of 2016 on Nomenclature, Organizational Structure, Description of Duties and Functions and Working Systems of Technical Implementing Units, Department of Public Works of Water Resources, Jatim
2016	Pergub 61 or 2016 concerning Position, Organizational Structure, Description of Tasks and Functions and Work Procedures for Public Works Water Resources of East Java Province
2016	Pergub 82 of 2016 concerning Position, Organizational Structure, Description Of Duties And Functions And Working Procedures For Public Housing, Residential Areas And Creation Works Of East Java Province
2016	Pergub 96 of 2016 concerning Nomenclature, Organization Description, Description Of Duties And Functions And Working Systems Of Technical Implementing Units, Public Housing Services, Residential Areas And Creation Works Of East Java Province
2016	Regulation of the Minister of Public Works and Public Housing Number 12 of 2016 concerning Typology Criteria for Technical Implementation Units for River Basin Water Resources Management at the Directorate General of Water Resources of the Ministry of Public Works and Public Housing
2011	Regulation (PP) 38 of 2011 concerning the River
2010	Government Regulation (Perpem) 46 of 2010 concerning Perusahaan Umum (Perum) (General Company) Jasa Tirta
2010	Permen LH 1 of 2010 concerning Procedures for Water Pollution Control
2009	Law (UU) 32 of 2009 Concerning Protection of the Environment
2009	Presidential Decree Number 6 of 2009 concerning Establishment of the National Water Resources Council
2008	Presidential Regulation Number 12 of 2008 concerning Water Resources Council

The following section summarizes the overall responsibilities and reporting lines of agencies involved in water quality management, sub-units that engage in water quality policymaking and management, and a general overview of each agency's primary responsibilities in water resource management. While Balai Besar Wilayah Sungai (BBWS) Brantas is tasked with responsibility for water resources management of the Brantas basin, most activities related to water pollution control and environmental management lie outside of the agency's legal remit.[7] Key stakeholders in water quality management responsible for managing sources of water pollution in the Brantas include:

- Kementerian Lingkungan Hidup dan Kehutanan (KLHK), the national Ministry of Environment and Forestry,
- BBWS Brantas, the river basin organization reporting directly to the Water Resources Directorate in Kementerian Pekerjaan Umum dan Perumahan Rakyat (PUPR), the Ministry for Public Works and Public Housing,
- Dinas Lingkungan Hidup Provinsi Jawa Timur (DLH Jatim), the environmental management agency tasked with significant roles in environmental planning and information management, industrial pollution control, and planning ad policy support for solid waste management,
- Perum Jasa Tirta I (PJT I), the state-owned water operator tasked with operating and maintaining water infrastructure,
- Bappeda Jawa Timur, the provincial planning agency in charge of development and spatial planning,
- Kota and kabupaten-level DLH agencies, who provide similar functions as DLH Jatim at the municipal / regency level,
- Tim Koordinasi Pengelolaan SDA WS Brantas (TKPSDA Brantas), the river basin water resources coordination team, a multi-sectoral body that coordinates water resources management,
- Dinas Cipta Karya (provincial / kota / kabupaten) and BPPW Cipta Karya (national office of PUPR located in Jawa Timur), tasked with developing and maintaining domestic wastewater infrastructure,

[7] See Permen PUPR 16 tahun 2020, pasal 29

- Dinas Pertanian dan Ketahanan Provinsi Jawa Timur, the provincial agricultural agency,
- Dinas Peternakan Provinsi Jawa Timur, the provincial livestock agency,
- Dinas Perindustrian dan Perdagangan (Disperindag) Provinsi Jawa Timur, the department of industry and commerce,
- Dinas PU SDA Jatim, the provincial water resources management agency,
- Village governments, tasked with community-level water and environmental management; and
- Communities.

Table 10 summarizes responsibilities for water quality management. A detailed list of tasks and functions (tupoksi) associated with water quality management is described in Appendix B and referred to further in Chapter IV's discussion of Challenge 6 "Promoting equitable, efficient, and effective water quality management."

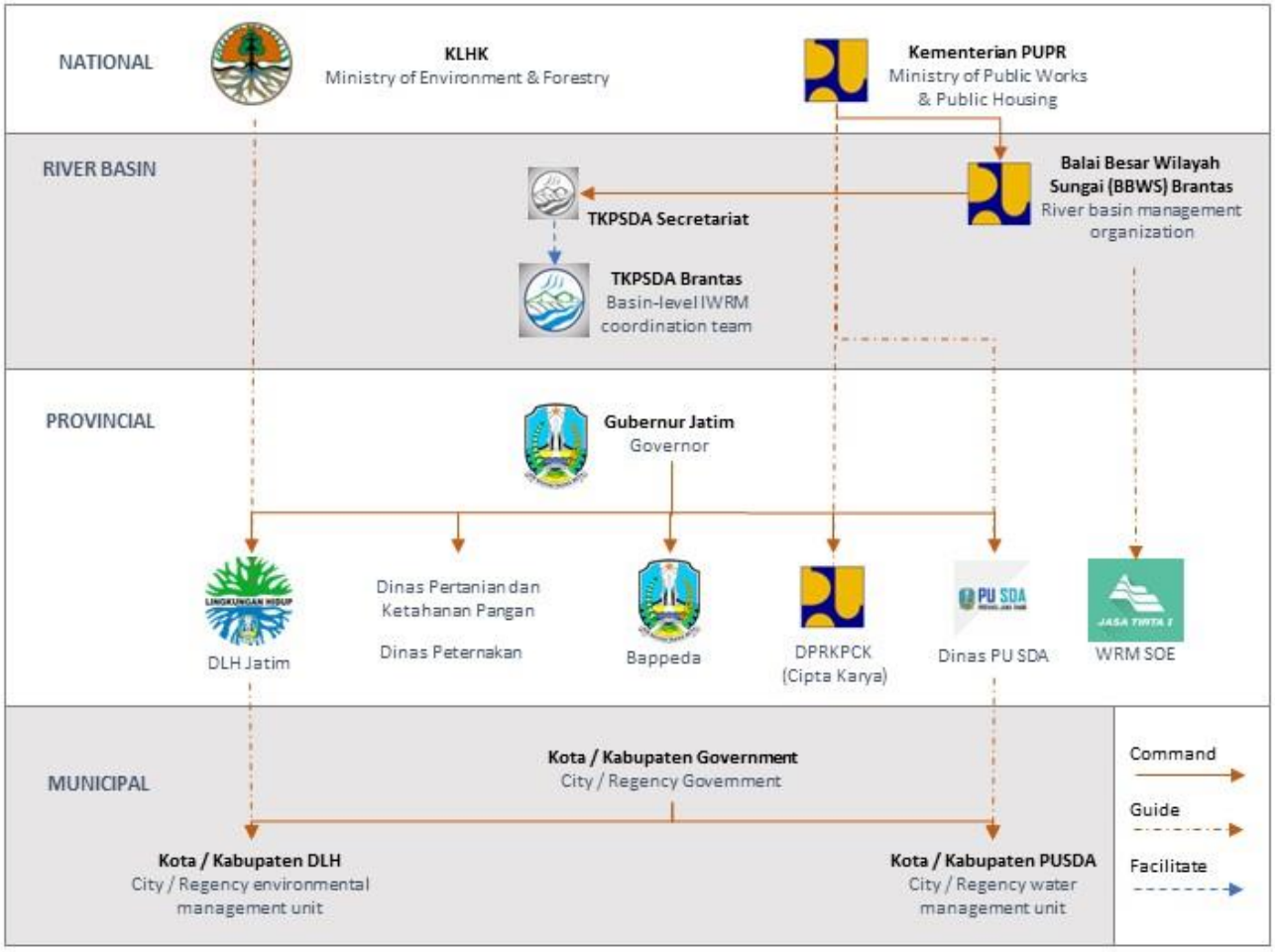
Table 10. Roles and responsibilities in water quality management

Primary Function	Sub-function	Implementing Agencies	Non-governmental Parties
Water quality and data management, analysis, and reporting	Surface Water Quality Monitoring	KLHK, BBWS, PJT I, DLH Prov/Kab/Kota, PU SDA (outside of WS Brantas)	Academia, LSMs
	Data Management	KLHK, BBWS, DLH Prov/Kab/Kota, PU SDA (irrigation channels outside of WS Brantas)	Academia, LSMs (citizen science and academic data)
	Analysis (incl. calculation of carrying capacity)	KLHK, DLH Prov/Kab/Kota	Academia
Planning, including water resources and spatial planning	Formulation of Water Quality Protection and Management Plan (RPPMA)	KLHK	
	Spatial planning (RTRW)	Bappeda Prov/Kab/Kota Cipta Karya, DPRKPCK	
	Water resources planning (Pola and Rencana)	BBWS Brantas	
	Development planning (RPJMD)	Bappeda Prov/Kab/Kota	
Pollution control	Identification (inventory) and evaluation of point and non-point sources of pollution	KLHK, DLH Prov/Kab/Kota	Academia, LSMs
	Standard-setting, permitting, and licensing for development and discharge of wastewater	KLHK, DLH Prov/Kab/Kota	
	Enforcement of discharge standards	KLHK, DLH Prov/Kab/Kota,	
Service provision to reduce pollution from terrestrial sources	Development of domestic wastewater management infrastructure	BPPW, Dinas Cipta Karya	
	Operations and maintenance of domestic wastewater infrastructure	Desa government	Individuals, Businesses, Schools
	Solid waste management	DLH Jatim/Kab/Kota, desa government	LSMs
	Management of agricultural runoff	Dinas Pertanian dan Ketahanan	
	Management of livestock runoff	Dinas Peternakan	
	Riparian area control	BBWS Brantas	
Community engagement, public awareness, and education		BBWS Brantas, DLH Prov/Kab/Kota	Academia, LSMs
Restoration and conservation		KLHK, DLH Jatim, desa government	Academia, LSMs
Coordination[8]		TKPSDA Brantas, Dewan Sumber Daya Air Jatim	

[8] The role of coordinating bodies related to water quality management is unresolved. TKPSDA had a temporary working group on water quality, but it is not a permanent mechanisms.

As demonstrated above, responsibilities for water quality management are dispersed across sectors and levels of government. The relationships amongst select agencies are illustrated in Figure 5.

Figure 5. Relationships amongst key agencies in Brantas River WQM



Two key issues related to strengthening water quality management in the Brantas include (a) providing clarity regarding roles and responsibilities and (b) developing effective coordination mechanisms to align the activities of stakeholder agencies. To the first point, responsibilities and tasks for some functions are poorly understood by stakeholders or subject to confusion due to incomplete or conflicting legal settings. These issues and potential solutions are described in detail in the section on "Challenge 6. Promoting Equitable, Efficient, and Effective Water Quality Management". Secondly, there is a need for sustained and ongoing coordination amongst agencies and across levels of government due to nested, overlapping, and interlinked responsibilities. These, too, are discussed in the same section.

II.3 LEGAL CONTEXT AND REGULATORY DEVELOPMENTS

An extensive body of water and environmental law lays out the principles, rights, and responsibilities related to water quality management in Indonesia. These regulations are discussed more thoroughly in Chapters III and IV and are listed in Appendix A. Key Several major pieces of legislation and recent regulatory changes bear focused attention, however, as they significantly affect water quality management and pollution control.

II.3.1. NATIONAL STRATEGIC RIVER STATUS

Key to the terms of management of the Brantas River is its status as a "National Strategic River," a designation determined by criteria set out in Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 04/PRT/M2015 tentang Kriteria dan Penatapan Wilayah Sungai (see Table 11).[9]

Table 11. Criteria for classification as a National Strategic River

Factor	Criteria for classification as a National Strategic River
Water potential	Greater than or equal to 20% of water potential in the province
Sectors and population in river area	Number of sectors related to water resources in river areas is at least 16 (sixteen); and Population in the river area is at least 30% (thirty percent) of the total population in the province.
National development impact, social	Number of workers in employment areas affected by the water resource constitute at least 30% (thirty percent) of the total provincial workforce; or In the river area there are small islands that border the territory of another country.
National development impact, environmental	There is a threat to specific and rare biodiversity in the water resource that needs to be protected, as stipulated in international conventions; The ratio between the maximum river water discharge and the annual average minimum river water discharge on the main river exceeds 75 (seventy-five); or The ratio of water needs and availability each year in the river area exceeds 1.5 (one point five).
National development impact, economic	There is at least 1 (one) irrigation area with an area greater than or equal to 10,000 (ten thousand) ha; The productive value of industry that depends on water resources in river areas is at least 20% (twenty percent) of the industrial productive value at the provincial level; There is electricity production from hydroelectric power plants connected to the cross-provincial electricity network and/or connected to the national transmission network; or The expected negative impact of water's destructive power on economic growth is an economic loss of at least 1% (one percent) of the Gross Regional Domestic Product (GRDP) at the provincial level.

In accordance with Article 5, Water Resources Management of National Strategic Rivers is the authority and responsibility of the national government under the Ministry of Public Works and Housing (PUPR), where Water Resources Management is defined as "an effort to plan, implement, monitor and evaluate the implementation of water resource conservation, utilization of water resources and control of the destructive power of water" (Peraturan Menteri Pekerjaan Umum Dan Perumahan Rakyat Republik Indonesia Nomor 04/PRT/M2015 Tentang Kriteria Dan Penatapan Wilayah Sungai, 2015). In accordance with supporting regulation (Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 16 Tahun 2020 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis di Kementerian Pekerjaan Umum dan Perumahan Rakyat), Balai Besar Wilayah Sungai (BBWS) are Technical Implementation Units (UPTs) that carry out river management duties for the Ministry and report to the PUPR Water Resources Directorate (PUPR 2020).

This designation of national responsibility for the Brantas affords BBWS Brantas overarching authority over implementing WRM, including river conservation, damage control, and cross-cutting issues such water quality. While many functions of pollution control and environmental management are the responsibility of other agencies, managers in these stakeholder agencies report hesitancy to work in the Brantas without the active support of BBWS Brantas, due to the river basin organization's authority.[10] As such, while BBWS has limited responsibility for managing water quality, the political leadership and support of BBWS Brantas and PUPR are necessary enabling conditions for coordinated actions to improve water quality. Moreover, BBWS Brantas plays an important role in facilitating

[9] https://sda.pu.go.id/assets/files/PermenPUPR04-2015.pdf

[10] Interviews, DLH Sidoarjo, DLH Mojokerto, May 2021

the integration of relevant plans, such as the RPPMA, regional development plan (RPJMD), and regional spatial plan (RTRW) with the Brantas Pola and Rencana.

II.3.2. 2019 WATER LAW (UNDANG-UNDANG 17 TAHUN 2019 TENTANG SUMBER DAYA AIR)

The first overarching water resources management framework was established with Law 11 of 1974 on Irrigation, which served as the main instrument for water management for nearly forty years and focused almost exclusively on water allocation. This relatively simple regulation was replaced by a more extensive Water Resources Law in 2004 (Undang-Undang 07 Tahun 2004 tentang Sumber Daya Air), which established a system of water rights and laid a foundation for water resources management in terms of conservation, infrastructure, and integrated water resources management.[11] Following the 2015 repeal of this legislation, Indonesia's water sector operated under an uncertain implementation environment, as the repeal undermined the legal validity of the law's seven accompanying implementation regulations.[12] The Government of Indonesia issued a new Water Resources Law in 2019, however, which reinforced the legal underpinnings of water rights and clarified terms of water resources management. Undang-Undang (UU) 17 Tahun 2019 tentang Sumber Daya Air maintains much of the 2004 law but establishes more explicit definitions and terms for integrated water resources management (IWRM), including consideration of social, environmental, and economic functions, and coordinated management across levels of government.[13]

As defined in UU 17/2019, Water Resources Management is an effort to plan, implement, monitor, and evaluate the implementation of Water Resources Conservation, Utilization of Water Resources and Control of Water Damage (Article 1). Water quality management is embedded across two of these functions, namely conservation and control of water damage. UU 17/2019 defines Water Resources Conservation is "an effort to maintain the existence and sustainability of the condition, nature, and function of Water Resources so that they are always available in sufficient quantity and *quality* to meet the needs of humans and other living creatures, both now and in the future." Conservation is "intended to maintain the continuity of existence, carrying capacity, and function of Water Resources" (Article 24). This includes protection and preservation of water sources; water quality management; and water pollution control. The explanatory notes also cite that the "protection and preservation of water resources" includes the arrangement of sanitation infrastructure, protection of water resources in relation to land use, forest and land rehabilitation, and preservation of conservation areas, whereas "water pollution control" is carried out by preventing the entry of water pollutants into in water resources.

Control of Water Damage, on the other hand, is defined as "an effort to prevent, overcome and restore damage to environmental quality caused by Water Damage." The law's explanatory notes to Article 35 explain further that water's "destructive power" includes not only flooding but also issues related to water quality, including sedimentation, changes to the chemical, biological, and physical content of water, and water-related threats to plant and animal health.

The above definitions of conservation and control of water damage make apparent that water quality management is a legal component of WRM, which much be carried out according to principles of balance,

[11] https://peraturan.bpk.go.id/Home/Details/40497/uu-no-7-tahun-2004

[12] This law was accompanied by seven implementation regulations that defined the terms of management of drinking water supply, irrigation, water resources, groundwater, rivers, and watersheds. Indonesia's Constitutional Court revoked the law in 2015, however, ruling that the law violated the Constitutional right to water and government mandate to manage water resources.

[13] https://peraturan.bpk.go.id/Details/122742/uu-no-17-tahun-2019

environmental insight, and sustainability (Chapter 1, Article 2). Explanatory comments clarify that "environmental insight" requires that WRM take into account the carrying capacity of the environment and that "balance" requires attention to social, environmental, and economic functions. Chapters IV and V also lay out duties and responsibilities in WRM. The law specifies four "stages" of WRM, including planning, implementation of infrastructure, implementation of operations and maintenance of water resources, and monitoring and evaluation (Article 38), for which Central Government (via BBWS Brantas) is responsible. Whilst other agencies are responsible for controlling pollution from various sources, managing water quality data, and preparing targeted water pollution control plans, the overarching water law assigns WRM – inclusive of conservation and water damage control – to Central Government. Central Government is also tasked with guaranteeing the supply of raw water that meets quality standards (Article 10). Central Government also holds the authority and responsibility to stipulate and manage protected areas in National Strategic River basins (Article 11).

WATER QUALITY AS A CROSS-CUTTING ISSUE IN WRM

The above definitions are important for two reasons. First, they reaffirm that water quality management is a legally determined component of WRM by way of conservation and control of water damage. These characterizations have implications for coordinated water quality management, especially within established coordinating mechanisms such as Tim Koordinasi Pengelolaan Sumber Daya Air (TKPSDA) Brantas, which is organized according to these functional areas. Because water quality management is an issue that *cuts across* conservation, control of water damage, and pollution source control (the remit of many agencies), the mode of coordination for water quality planning, implementation, monitoring, and evaluation, is an important area for further development.

For National Strategic Rivers, Central Government is responsible to formulate the Water Resources Management Pola (for long-term implementation of WRM) and the Water Resources Management Plan (Rencana), which serves as a reference for other agencies' work programs and the regional spatial plan. For planning, implementation, monitoring, and evaluation, Article 2 also stipulates that WRM is intended to be carried out with the principle of harmony and is to be regularly coordinated and integrated across sectors and administrative areas. This article underpins the *Brantas Harmoni* exercise and underscores the importance of alignment and coordination, not only in terms of planning, but also for implementation, policy and service adjustment between planning periods, and in the evaluation of water management policies and activities. The law also establishes legal certainty for public participation in water resources management, including in planning, monitoring, and evaluation (Article 3). Village governments also play a key role, as they are responsible for encouraging the participation of communities in Water Resources Management (Article 17).

II.3.3. PERATURAN PEMERINTAH 22 TAHUN 2021 TENTANG PENYELENGGARAAN PERLINDUNGAN DAN PENDELOLAAN LINGKUNGAN HIDUP

Another important development in river environmental management in Indonesia is the adoption of Government Regulation Number 22 of 2021 regarding Environmental Protection and Management (Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup).[14] This implementing regulation for Undang-Undang Nomor 11 Tahun 2020 tentang Cipta Kerja (the 2020 "Omnibus Law") updates the multi-level system of environmental management in Indonesia and lays out definitions

[14] https://peraturan.bpk.go.id/Details/161852/pp-no-22-tahun-2021

of water quality, water quality standards, and targets.[15] "Water quality" is defined as "a measure of water conditions at a certain time and place which is measured and/or tested based on certain parameters and certain methods in accordance with statutory provisions," and water quality standards are the "the limits or levels of living things, substances, energy, or components that exist or must exist and/or pollutant elements that are allowed to exist in water."[16] These standards and targets are described thoroughly in Chapter III.

Chapters 10 and 11 explain government's duties to provide assistance and guidance concerning environmental protection and management policy, permitting processes, and other technical issues; monitor and enforce compliance; and administer administrative sanctions for non-compliance. Chapter 10 also discusses the authority of Environmental Supervisor Officials charged with monitoring compliance and enforcing standards.

ENVIRONMENTAL APPROVALS AND COMPLIANCE FOR WASTEWATER DISCHARGE

A set of important changes relates to the control of water pollution from industrial sources. First is a transition from a permitting regime that previously required multiple environmental permits for industrial operations to a more simplified "Environmental Approval" (Chapter 2). Attainment of an Environmental Approval for any new facilities does, however, require Technical Approvals, including (where relevant) an approval for compliance with wastewater quality standards (Articles 107-162) (see Box 2). To attain such a Technical Approval, new business entities must conduct a study of the impact of the planned wastewater discharge to the environment (Article 133). If the study indicates that the wastewater discharge will lead to an exceedance of applicable standards based on the calculated pollution load carrying capacity for a river segment, the business entity may not discharge wastewater to the environment directly. In such cases, a new business' only recourse water reuse or recycling, transport of wastewater to an alternative processing facility, or (future) use of a pollution load trading system that will allow businesses to purchase carrying capacity from other producers.

Moreover, in the previous Wastewater Discharge Permit system, the permit was valid only for three years and was required to be renewed periodically. In practice, however, businesses with established permits rarely faced pressure to reduce emissions, as permits are routinely renewed without technical review and adjustment. Rather, discharge allowances are adjusted in the event of operational changes that significantly change discharge volumes or composition (interview, DLH Jatim, October 2023). As such, permit decisions that consider river carrying capacity apply only to new businesses. Under the new regulation, the process of Technical Approval review and renewal is still unclear. Further implementing regulations should consider how law can incentivize companies with standing technical approvals to reduce pollution contributions.

Box 2. Content of Technical Approval for Wastewater Discharge

Technical Approval for wastewater discharge shall contain:

Technical approval to meet compliance with wastewater discharge standards, including:

- Parameters and numerical thresholds for wastewater quality
- Wastewater treatment facility (IPAL) design
- Facility point with location and name

[15] https://peraturan.bpk.go.id/Details/149750/uu-no-11-tahun-2020

[16] Definitions in PP 22 of 2021 (BAB 1, Pasal 1): Mutu Air adalah ukuran kondisi air pada waktu dan tempat tertentu yang diukur dan/atau diuji berdasarkan parameter tertentu dan metode tertentu sesuai dengan ketentuan peraturan perundang-undangan. Baku Mutu Air adalah ukuran batas atau kadar makhluk hidup, zat, energi, atau komponen yang ada atau harus ada dan/atau unsur pencemar yang ditenggang keberadaannya di dalam air. Mutu Air Sasaran adalah lvlutu Air yang ditentukan pada waktu tertentu untuk mencapai Baku Mutu Air yang ditetapkan.

- Discharge point with monitoring point location at surface water body, groundwater, and/or land (name and location)
- Estimated cost for wastewater treatment / management
- Obligations (e.g. to separate wastewater channel from rain water channel, etc.)
- Prohibitions (e.g. dumping of wastewater outside the compliance point, etc.)

Availability of appropriate human resources to meet competency standards (e.g., personnel in charge of water pollution control, IPAL operation, etc.)

Demonstration of an environmental management system, including a wastewater quality monitoring system, system to monitor compliance, periodic monitoring of ground and surface water, and reporting system for pollution control

Businesses are also required to internalize water quality protection and management by bearing the responsibilities and costs of pollution prevention, monitoring, and restoration and by demonstrating compliance with wastewater discharge standards. Another interesting development is the introduction of an Environmental Restoration Guarantee Fund (Chapter 8), which stipulates the obligation of business entities to establish an environmental restoration guarantee fund in a government-owned bank, which may be used for environmental restoration in the event of a breach of compliance.

Permitting and monitoring information is to be recorded and maintained in an Environmental Information System, which records environmental data related to businesses as well as information about environmental hazards in any given region. Chapter 9 elaborates the obligation of government to develop an environmental information system to include environmental document information, data on environmental approvals, monitoring, and compliance (including sanctions); environmental status data; and mapped data on environmental hazards.

RENCANA PERLINDUNGAN DAN PENGELOLAAN MUTU AIR (RPPMA)

Of significant relevance to this Brantas Harmoni document is Chapter 3 on Water Quality Protection and Management (Perlindungan dan Pengelolaan Mutu Air, or PPMA), where "Water Quality Protection and Management" is defined as the "systematic and integrated effort to maintain water quality" based on principles of state responsibility, sustainability, harmony and balance, cohesiveness, equitable distribution of benefits, acknowledgement of ecoregions, preservation of biodiversity, "polluter pays", participation, and regional autonomy. The chapter defines "Water Quality" as the water condition measured and/or tested at certain times and places based on certain parameters and methods in accordance with statutory provisions and "Water Pollution" as the entry or introduction of living creatures, substances, energy and/or other components into water by human activities that leads to the exceedance of established standards. Brantas Harmoni adopts these definitions.

The law further stipulates three important functions of PPMA:

- Planning, including the specification of water quality standards, calculation and determination of pollutant load allocations, and preparation of Water Quality Protection and Management Plans (RPPMA);
- Utilization, where decisions regarding water use must now take into account water quality standards and targets;
- Control, including prevention of water pollution (e.g., through infrastructure and service provision, determination and oversight of wastewater compliance standards, etc.), countermeasures to pollution, and restorative activities;
- Maintenance, including conservation activities and management of protected areas; and
- Community participation.

Rencana Perlindungan dan Pengelolaan Mutu Air (RPPMA), or Water Quality Protection and Management Plans, for National Strategic Rivers like the Brantas are the responsibility of the National Government and are to be prepared by KLHK in coordination with ministers in charge of water resources (PUPR), energy and mineral resources, spatial planning, and forestry, as well as governors, regents, and mayors (Article 118).

CHAPTER III. WATER QUALITY IN DAS BRANTAS

Water quality standards are based on definitions set out in PP 22/2021 and several additional regulations that indicate allowable levels of substances in water resources and discharged effluents. Targets are time-bound measurements (physical, chemical, etc.) of progress towards meeting these standards that are set out in plans and policies. In Indonesia, water quality goals are framed by three sets of standards:

1. Designation of Water Classes based on acceptable use, which in turn determine allowable substance limits per physical and chemical parameter,
2. River pollution load carrying (assimilative) capacity (Daya Tampung Beban Pencemenaran Air, DTBP), which designates the amount of BOD that can be effectively assimilated by a segment (or whole) of the river, and
3. Effluent discharge limits, which set out parameter limits for discharged water from manufacturing, agriculture, and domestic sources.

An additional metric, the Water Quality Index (Indeks Kualitas Air, or IKA), is a generalized indicator of water quality used to track progress. Rivers are also assessed and rated on scales from "highly polluted" to "not polluted". This section describes standards of river water quality in the Brantas, followed by a discussion of current water quality measurements in relation to these standards.

III.1 WATER QUALITY STANDARDS

III.1.1. WATER CLASSES AND ALLOWABLE PARAMETER CONCENTRATIONS

Government Regulation (PP) 22 of 2021 on Environmental Protection and Management reaffirmed an established system of water classes based on acceptable use (Table 12).[17]

Table 12. Indonesia water classification system

Class I	Water that can be used for raw drinking water and/or other uses that require the same quality
Class II	Water that can be used for water recreation, freshwater fish cultivation, animal husbandry, irrigating plants/crops, and/or other usages requiring similar quality
Class III	Water that can be used for freshwater fish cultivation, animal husbandry, water for irrigating plants/crops, and/or other usages requiring similar quality
Class IV	Water that can be used to irrigate plants/crops, and other usages requiring similar quality

Each of the four water classes is associated with an accompanying set of concentration limits for 48 physical and chemical parameters. A selection of these is listed in Table 13.

[17] This system was originally established via Government Regulation (PP) 82 of 2001 on Management of Water Quality and Control of Water Pollution.

Table 13. Concentration limits by select water quality parameter and water class designations

			Concentration Limit			
Parameter		Unit	Class I	Class II	Class III	Class IV
1	Temperature[18]	C	Dev 3	Dev 3	Dev 3	Dev 3
2	Total dissolved solids (TDS)[19]	mg/L	1000	1000	1000	2000
3	Total suspended solids (TSS)[20]	mg/L	40	50	100	400
4	Color	Pt-Co Unit	15	50	100	-
5	Acidity (pH)[21]		6-9	6-9	6-9	6-9
6	Biochemical oxygen demand (BOD)	mg/L	2	3	6	12
7	Chemical oxygen demand (COD)	mg/L	10	25	40	80
8	Dissolved oxygen (DO)	mg/L	6	4	3	1
9	Sulfate (SO_4^{2-})	mg/L	300	300	300	400
10	Chloride (Cl-)	mg/L	300	300	300	600
11	Nitrate	mg/L	10	10	20	20
12	Nitrite	mg/L	0.06	0.06	0.06	-
13	Ammonia	mg/L	0.1	0.2	0.5	-
14	Total Nitrogen	mg/L	15	15	25	-
15	Total Phosphate (TP)	mg/L	0.2	0.2	1	-
16	Fluoride	mg/L	1	1.5	1.5	-
17	Hydrogen Sulfide (H_2S)	mg/L	0.002	0.002	0.002	-
18	Cyanide (CN^-)	mg/L	0.02	0.02	0.02	-
23	Dissolved Arsenic (As)	mg/L	0.05	0.05	0.05	0.1
36	Fenol	mg/L	0.002	0.005	0.01	0.02
46	Fecal coliform	MPN/100 mL	100	1000	2000	2000
47	Total coliform	MPN/100 mL	1000	5000	10000	10000
48	Garbage		None	None	None	None

Source: Government Regulation (PP) 22 of 2021 on Environmental Protection and Management

Governor's Regulation (PergGub) 61 of 2010 regarding the Determination of Water Classes in Rivers further stipulates which segments of the Brantas are to be managed at Class I, II, or III standards. Coupling a selection of the concentration limits by class above (limited to WQI/IKA parameters), Table 14 indicates thresholds for TSS, BOD, COD, DO, Total Nitrates (TN), Total Phosphates (TP), Fecal Coli, and Total Coli (the eight parameters used to calculate the water quality index) by class-differentiated segments of the Brantas River. The policy target for the Brantas River is adherence to per-parameter limits for each segment based on class designation.

Table 14. Select Brantas River Water Quality Standards (IKA parameters), by seven segments designated in PerGub 16 / 2010

River	Segment	Designated Class	TSS	BOD	COD	DO	TN	TP	Fecal Coli	Total Coli
			(mg/L)						(MPN/100mL)	
Brantas	Sumber Brantas Village, Bumiaji – Pendem Bridge, Kab. Malang	I	40	2	10	6	15	.2	100	1,000
	Pendem Bridge, Kab. Malang - confluence with Sungai Widas	II	50	3	25	4	15	.2	1,000	5,000
	Confluence with Sungai Widas - Mlirip sluice and Lengkong Dam	II	50	3	25	4	15	.2	1,000	5,000

[18] Difference from air temperature above surface of river.

[19] Not applicable to estuaries

[20] Not applicable for peat water (based on natural conditions)

[21] Sic.

Surabaya	Mlirip sluice - Jagir Dam	II	50	3	25	4	15	.2	1,000	5,000
Porong	Lengkong Dam to Porong Village, Porong District[22]	II	50	3	25	4	15	.2	1,000	5,000
	Porong Village, Porong District - estuary	III	100	6	40	3	25	1	2,000	10,000
Konto	Upstream to mouth at Sungai Brantas	III	100	6	40	3	25	1	2,000	10,000

Sources: Peraturan Gubernur Jawa Timur Nomor 61 Tahun 2010 tentang Penatapan Kelas Air Pada Air Sungai; Government Regulation (PP) 22 of 2021 on Environmental Protection and Management

III.1.2. POLLUTION LOAD CARRYING CAPACITY

A second standard for water quality is adherence to the maximum calculated "Water Pollution Load Carrying Capacity" (Daya Tampung Beban Pencemarain Air, or DTBP). Commonly referred to as "carrying capacity," this calculated standard is more accurately a measure of the assimilative capacity of the river. Environmental assimilative capacity refers to the ability the river to absorb or assimilate pollutants and disturbances without causing significant harm to the ecosystem or exceeding its capacity to recover. In Indonesia, river assimilative capacity is calculated in terms of the daily loads of Biochemical Oxygen Demand (BOD) that can be borne by each segment. Ministerial Decree (KLHK) 316 of 2018 regarding Determination of Water Pollution Load Carrying Capacity and Brantas River Water Pollution Burden Allocation stipulates the calculated carrying capacities of the Brantas River by segment, as well as 2018 average loads and target reductions per segment (Table 15).[23]

[22] According to the water quality classification Doc. Legal Information - JDIH East Java Provincial Secretariat Legal Bureau 4

[23] This table includes Pasuruan and Madiun (not in DAS Brantas / Brantas Harmoni), as expressed in the regulation; see Keputusan Menteri Lingkungan Hidup dan Kehutanan Nomor SK.316/Menlhk/Setjen/KUM.1/7/2018 tentang Penetapan Daya Tampung Beban Pencemaran Air dan Alokasi Beban Pencemaran Air Sungai Brantas, https://ppkl.menlhk.go.id/website/filebox/622/190724204802Kepmen%20LHK%20Nomor%20SK%20316%20Tentang%20Penetapan%20Daya%20Tampung%20Beban%20Pencemaran%20Air%20dan%20Alokasi%20Beban%20Pencemaran%20Air%20Sungai%20Brantas.PDF

Table 15. Estimated carrying capacity of the Brantas River, by segment (2018)

Segment	Kota / Kabupaten	Current BOD Load (kg/day) Beban Pencemar BOD Existing (kg/hari)	Carrying Capacity DTBP BOD (kg/day))	Target Reduction (Difference in BOD Load, kg/day) Selisih Beban BOD (kg/hari)
1	Kota Batu	1,319.22	40.02	1,279.20
2	Pasuruan	9,800.86	1,095.62	8,705.24
3	Malang	11,148.11	4,275.31	6,872.80
4	Kota Malang	1,143.79	370.41	773.38
5	Blitar	16,592.86	2,791.77	13,801.09
6	Kota Blitar	1,058.13	239.47	818.66
7	Tulungagung	312.03	505.36	-193.32
8	Trenggalek	1,248.14	2,021.43	-773.29
9	Kediri	19,603.62	20,095.64	-492.02
10	Kota Kediri	12.30	2,190.06	-2,177.76
11	Nganjuk	3,754.37	7,581.48	-3,827.11
12	Madiun	3.85	64.80	-60.95
13	Jombang	13,693.64	11,009.96	2,683.68
14	Mojokerto	5,512.18	3,666.07	1,846.11
15	Kota Mojokerto	130.09	147.60	-17.50
16	Sidoarjo	3,152.64	2,553.34	599.29
17	Gresik	1,891.58	1,532.00	359.58
18	Kota Surabaya	2,522.11	2,042.67	479.44
	TOTAL	92,899.51	62,223.01	30,676.51

Source: Kep. Men. LHK No. 316 Tahun 2018 tentang Penetapan Daya Tampung Beban Pencemaran Air dan Alokasi Beban Pencemaran Air Sungai Brantas

These calculated carrying capacities are to be used in decision-making regarding issuance of permits and environmental approvals for new businesses to prevent further divergence between limits and actual loads in areas where DTBP is exceeded (as in ten of the sixteen administrative DAS Brantas segments).

III.1.3. EFFLUENT STANDARDS

Wastewater effluent standards for domestic and industrial sources are established in law, and effluent-related water quality targets may be expressed as specified rates of compliance (e.g., percentage of discharged domestic wastewater that meets the effluent standard). Wastewater quality standards for domestic wastewater are stipulated in Regulation of the Minister of Environment and Forestry Number 68 of 2016 (P.68/Menlhk/Setjen/Kum.1/8/2016). Required concentration limits for post-treatment direct discharge are listed in Table 16.[24] These standards apply to discharge from apartments, dormitories, health services facilities, restaurants, public meeting halls, settlements, as well as domestic wastewater from industries and transportation facilities and discharge from wastewater treatment facilities.

Table 16. Domestic Wastewater Discharge Standards

Parameter	Unit	Maximum Concentration
pH	-	6-9
BOD	mg/L	30
COD	mg/L	100
TSS	mg/L	30

[24] See https://jdih.maritim.go.id/cfind/source/files/permen-lhk/p_68_2016_baku_mutu_air_limbah_domestik_menlhk_02112021092838.pdf

Oil and Grease	mg/L	5
Ammonia	mg/L	10
Total Coliform	MPD/100 mL	3000

Source: Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor P.68/Menlhk/Setjen/Kum.1/8/2016 tentang Baku Mutu Air Limbah Domestik

Industrial wastewater discharge standards, on the other hand, are stipulated in a set of regulations of the Minister of Environment and Forestry, including Peraturan Menteri Lingkungan Hidup Republik Indonesia Nomor 5 Tahun 2014 tentang Baku Mutu Air Limbah (Number 5 of 2014 regarding Wastewater Quality Standards).[25] These explicitly state allowable per-parameter concentration limits for wastewater discharges by type of industry.

III.2 WATER QUALITY MONITORING DATA

Water quality standards and targets represent the policy goals for water quality in the Brantas, whereas water quality conditions can be characterized by water quality monitoring data as well as general indexed measures of water quality. The following section reviews available per-parameter water quality monitoring data as well as more generalized measures of water quality such as the Indeks Kualitas Air (IKA) and Baku Mutu Air.

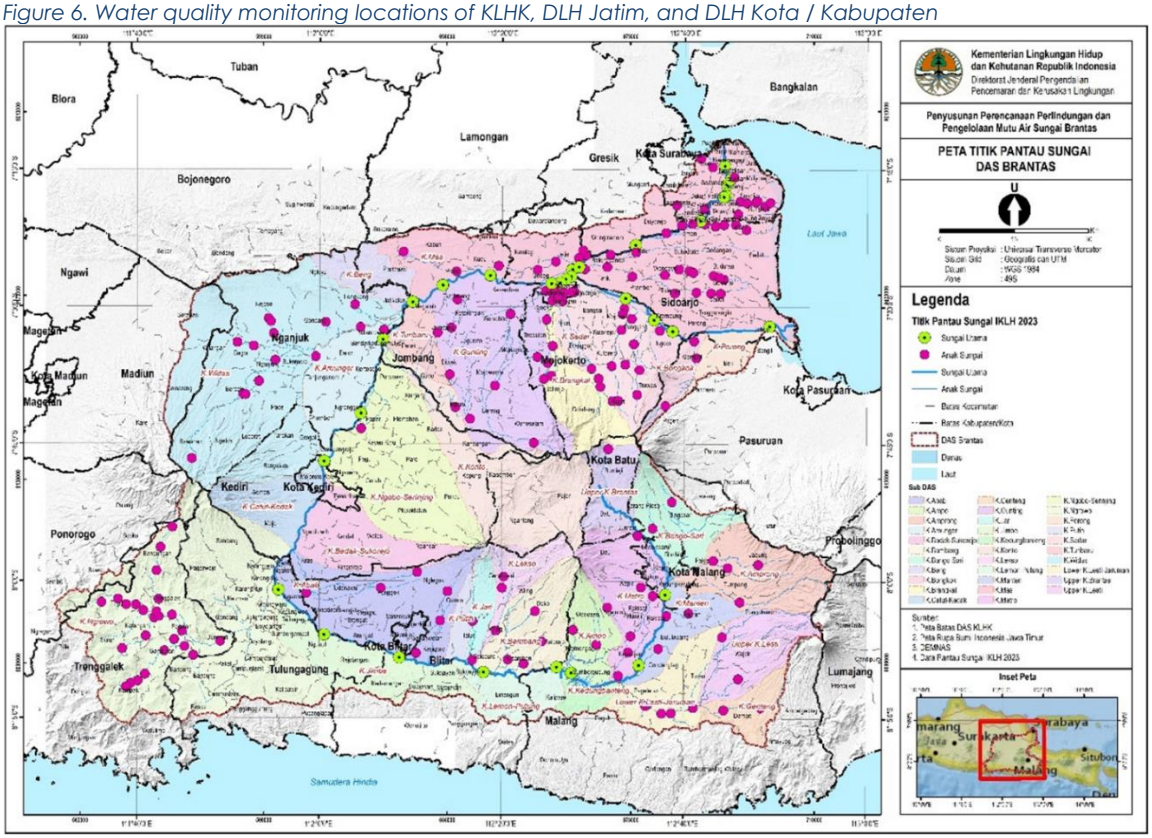
Specific water quality parameters such as dissolved oxygen levels, nutrient concentrations, pH, temperature, and the presence of heavy metals and pesticides can help gauge the ecological integrity and suitability of river water for various uses. Additionally, pollution source data is a crucial component in understanding the origins and types of contaminants affecting water quality. By integrating water quality parameters and pollution source data, agencies can identify potential threats and devise targeted mitigation strategies. This section offers an overview of water quality measurements, whereas Chapter IV offers more information on pollution source data.

A closer look at available water quality monitoring data is more informative with respect to per-parameter pollution levels. Water quality is monitored by BBWS Brantas, PJT I, KLHK, DLH Jatim, and kota and kabupaten DLH agencies in DAS Brantas at various frequencies and different locations.[26] The locations of monitoring sites of KLHK, DLH Jatim, and DLH kota / kabupaten in the Brantas basin are illustrated in Figure 6. The sampling locations of BBWS Brantas and PJT I are registered with DLH Jatim. There is a higher concentration of monitoring in the lower reaches of the Brantas for PJT I and DLH Jatim, but coverage is fairly extensive due to additional points from kota / kabupaten DLH. DLH Jatim and PJT I generally take measurements monthly, whereas BBWS Brantas collects data quarterly. None collect data with a consistent sampling schedule.

[25] See https://jdih.maritim.go.id/cfind/source/files/permen-lhk/mlh-p.5.pdf

[26] PU SDA Jatim collects additional data in the region, including and from Brantas tributaries and irrigation channels that connect to the river.

Figure 6. Water quality monitoring locations of KLHK, DLH Jatim, and DLH Kota / Kabupaten



Source: KLHK, 2023, Peta Titik Panatu Sungai DAS Brantas, PowerPoint shared through direct communication

Because of data limitations, low frequency of sampling, and the flow rate of the Brantas, it is difficult to make generalizations regarding water pollution levels per parameter across all river segments. Nevertheless, various analyses generally show elevated concentration levels for BOD and fecal coliform, as well as insufficient levels of DO across the basin. Most other parameter samples, including pH, phosphates and nitrates, have reported median levels that fall within class concentration limits, with exception of the area around Kota Malang, where phosphates and nitrates are high. It is important to note, however, that some substances of high concern associated with agriculture (the fertilizer chemical atrazine, for example) and industry (heavy metals) have been recorded as well above standards alongside within-standard levels of general pollutant indicators such as phosphates and nitrogen markers.[27]

Key observations are summarized in the section to follow, and more extensive data (additional parameters) from 2020-2023 is available in Appendix C. Water quality from four data sets is presented and discussed in more detail below. These include:

- Water quality monitoring data from KLHK, DLH Jatim, and kota / kabupaten DLH agencies compiled by the authors, data collected over a three-year period between 2021 and 2023;
- 2020 data extracted from *2020 Buku Statistik: Statistik Kualitas Air, Udara, dan Tutupan Lahan* (KLHK, 2020); and
- Estimated median BOD loads derived from water quality modeling from 2013 to 2023 (described in detail in Appendix D).

Appendix C also provides additional parameter graphs complied by Willard (2022) based on data collected by PJT I, BBWS, and DLH Jatim from 2009 to 2019.

[27] Interview, Universitas Airlangga Department of Water Resources Engineering, February 2024

III.2.1. OXYGEN MARKERS (DO, BOD, COD)

DO (Dissolved Oxygen), BOD (Biochemical Oxygen Demand), and COD (Chemical Oxygen Demand) are parameters used to measure water quality in terms of oxygen levels. DO refers to the amount of oxygen present in water, essential for the survival of aquatic organisms. BOD is a measure of the amount of dissolved oxygen consumed by microorganisms while decomposing organic matter in water. High BOD levels indicate the presence of organic pollutants such as sewage or other biodegradable waste, including organic food wastes and effluent from food processing industries. Elevated BOD can deplete dissolved oxygen, potentially harming aquatic life. COD is a measure of the amount of oxygen required to chemically oxidize both organic *and* inorganic substances in water. As such, COD provides a broader assessment of water quality than BOD, as it includes both biodegradable and non-biodegradable substances. High COD levels suggest the presence of various pollutants, including industrial chemicals and complex organic compounds, in addition to organic wastes. BOD, COD, and DO are all expressed in milligrams per liter (mg/L) or parts per million (ppm). While these parameters are good general measures of water quality, it is difficult to use them to identify specific contributing sources, since they are all associated with agriculture, domestic wastewater, solid waste, and industrial waste.

Historical data suggests that BOD has significantly exceeded regulated standards for the past decade, while recorded COD levels fell within limits (Table 17).[28] More recent data suggests a similar pattern. Both data sets from 2009-2019 and 2021-2023 report elevated BOD levels and COD levels generally below Class II limits, with the exception of downstream areas around Gresik and Surabaya (see Figure 7 and Figure 8).

Table 17. Average Water Quality of the Brantas River in 2010-2014

	2010	2011	2012	2013	2014	Average	Environmental Standard
BOD (mg/L)	5.12	4.41	4.33	3.60	4.27	4.35	3.00
COD (mg/L)	17.94	15.45	13.64	10.92	12.45	14.08	25.00

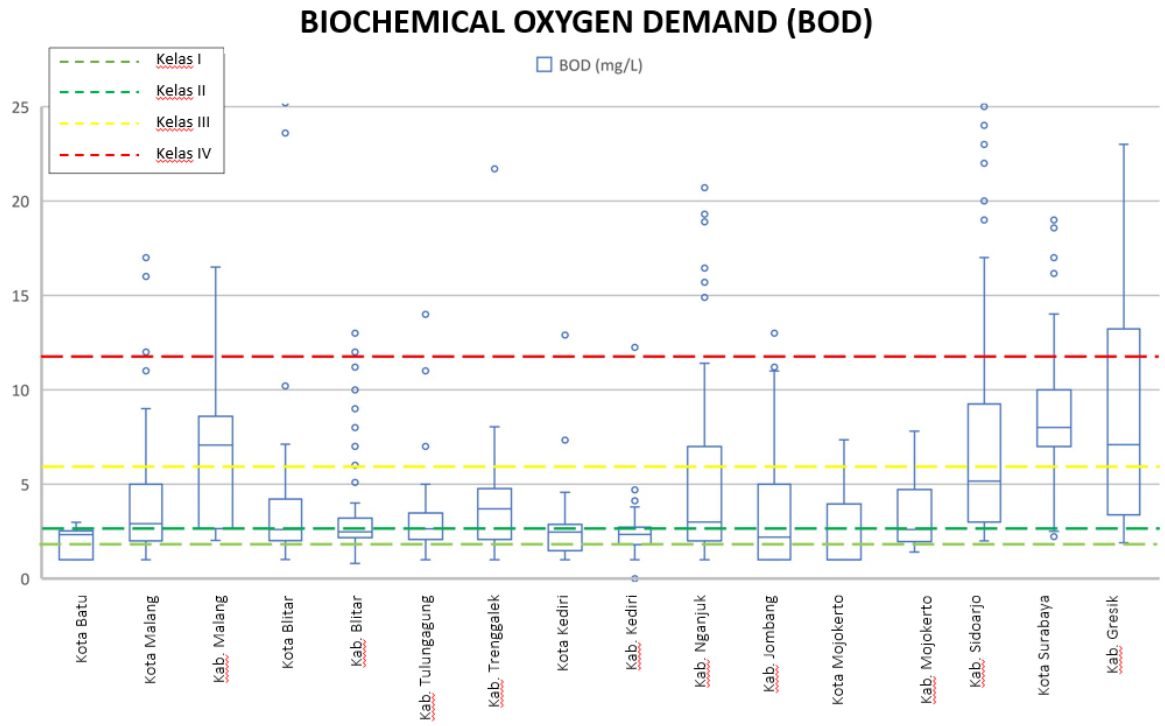
Sources: BLH East Java, Japan International Cooperation Agency, 2019; Note: frequency and sampling locations unknown

BOD levels are reportedly highest in the area of Kabupaten Malang downstream of Kota Malang and in the downstream regions around Sidoarjo, Surabaya, and Gresik, where they tend to exceed Class III threshold limits. Noticeably, there is also an increase in BOD in the midstream area, in Trenggalek. COD levels demonstrate a similar pattern, with higher concentrations in the same administrative regions.

Generally high BOD levels suggest that much of the pollution load in the Brantas River is from domestic wastewater, and organic wastes, which may come from food waste or effluent from food processing industries. Decreasing DO levels in the lower reaches (Figure 9) show how this organic waste pollution increasingly accumulates downstream and is likely exacerbated by the number of food processing industries located in industrial areas of the lower reaches.

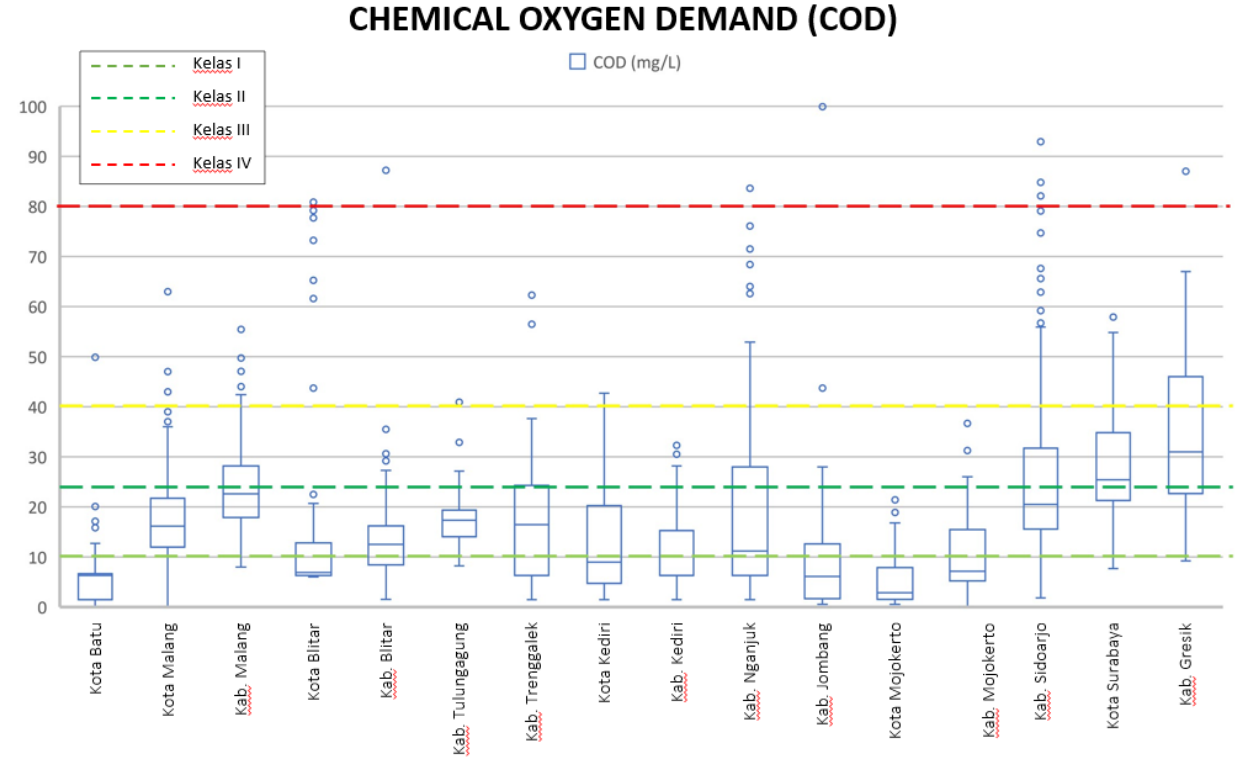
[28] The applied standard was not reported, but the indicated standard limits match those for Class II water.

Figure 7. BOD spread per kota / kabupaten, 2021-2023



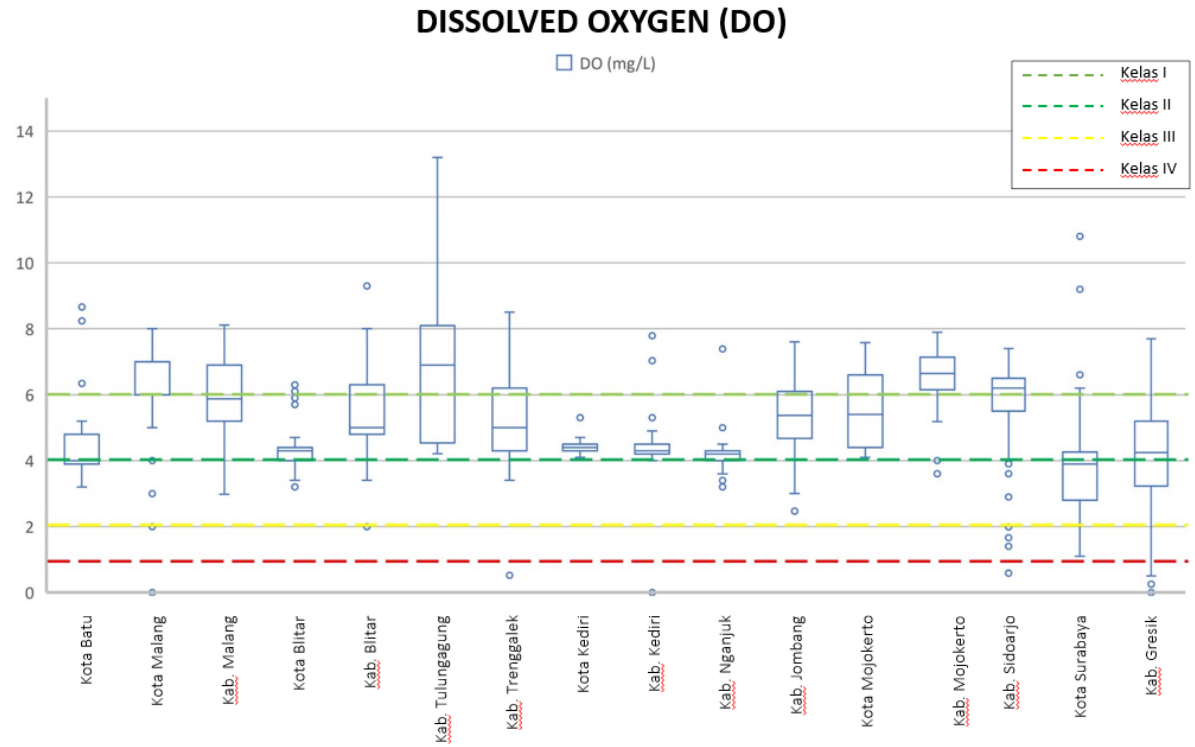
Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

Figure 8. COD spread per kota / kabupaten, 2021-2023



Source: Authors, based on data from DLH Jatim, KLHK, kabupaten / kota DLH

Figure 9. DO spread per kota / kabupaten, 2021-2023

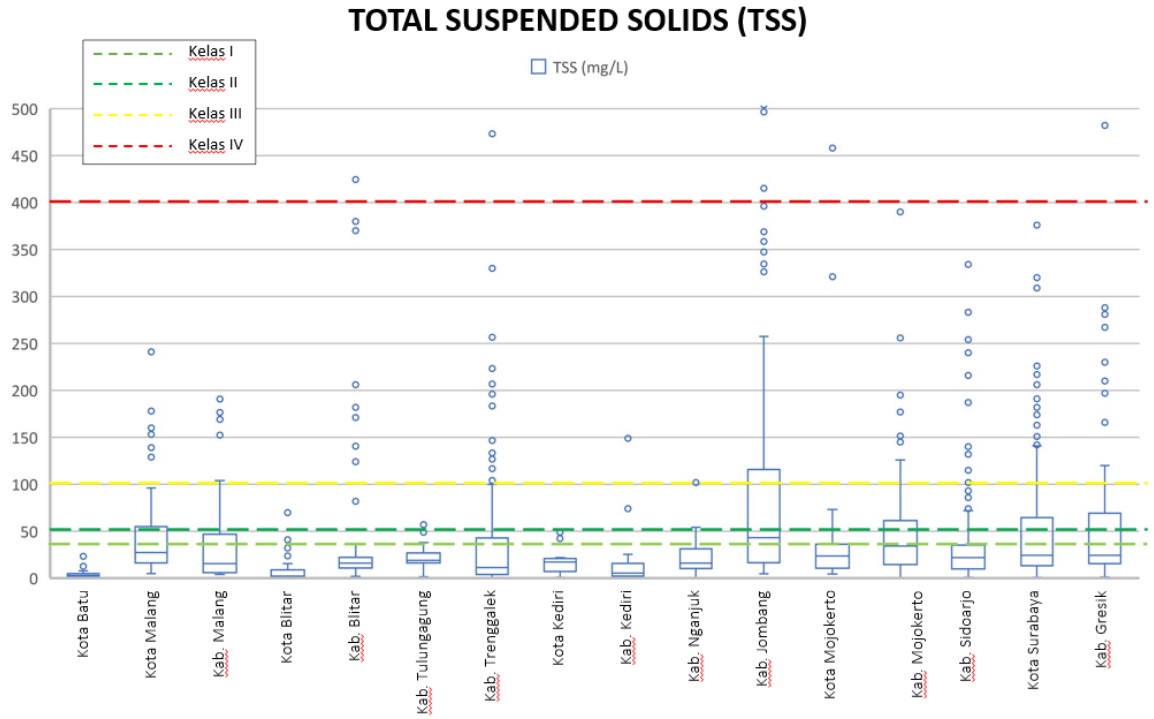


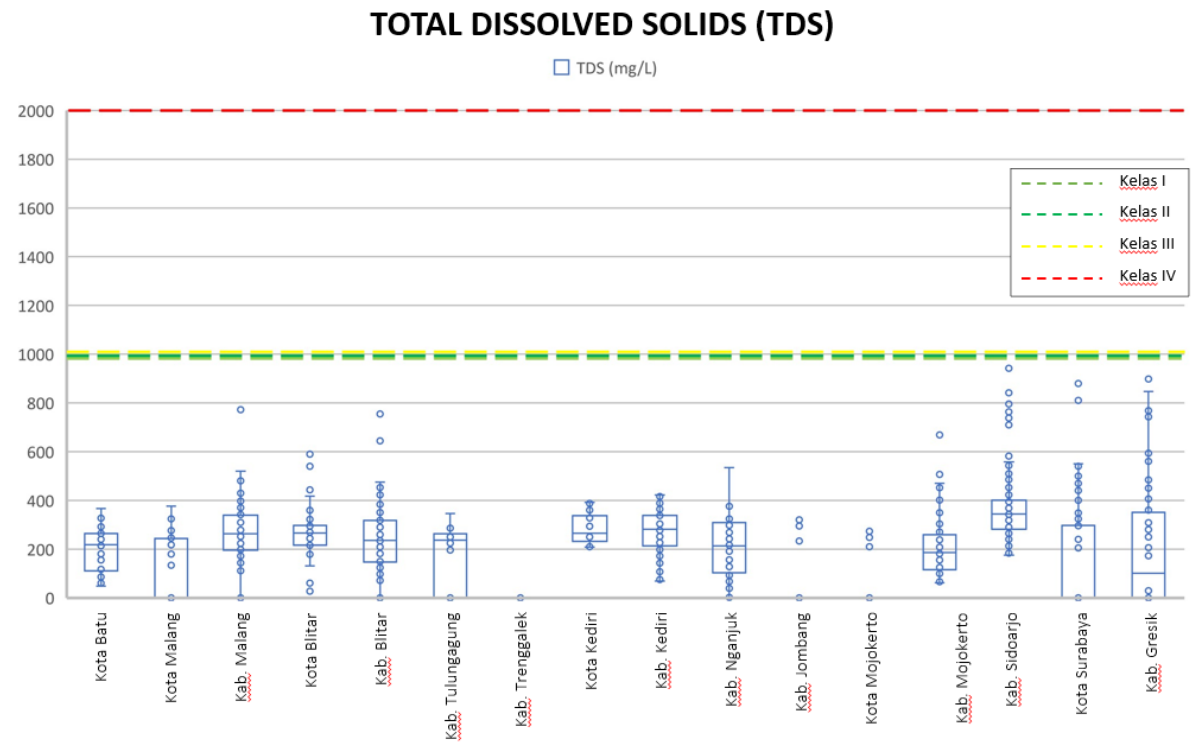
Source: Authors, based on data from DLH Jatim, KLHK, kabupaten / kota DLH

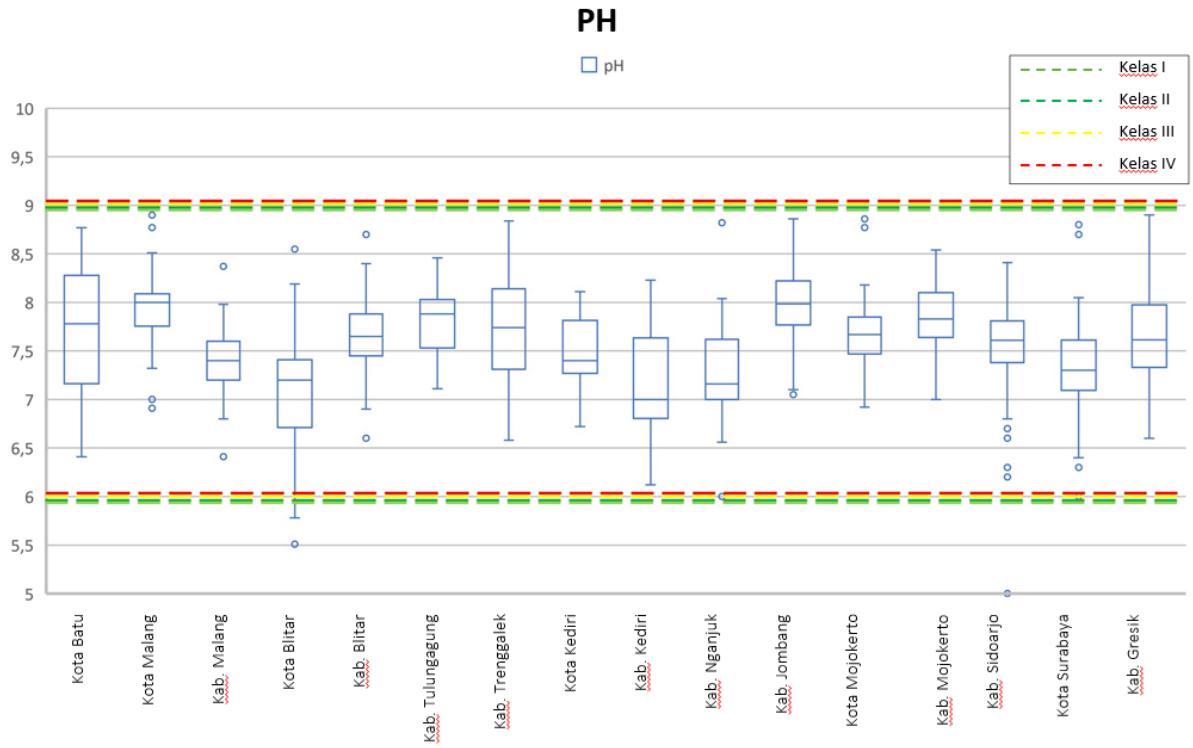
III.2.2. TOTAL SUSPENDED SOLIDS (TSS), TOTAL DISSOLVED SOLIDS (TDS), AND PH

While sedimentation is a noted problem for the Brantas River, TSS and TDS generally fall within limits.

Figure 10. TSS, TDS, and pH spreads per kota / kabupaten, 2021-2023





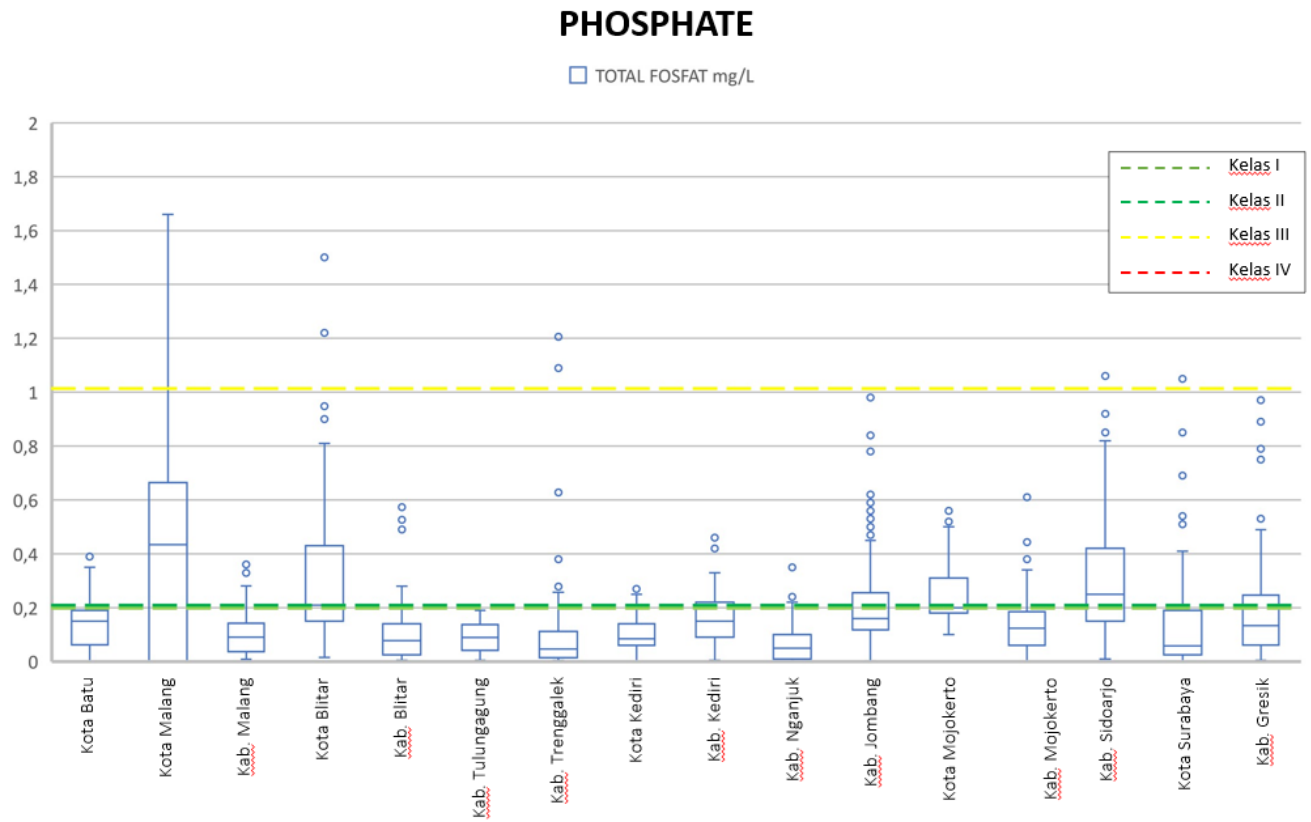


Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

III.2.3. PHOSPHATE, NITRATE, AND NITRITE

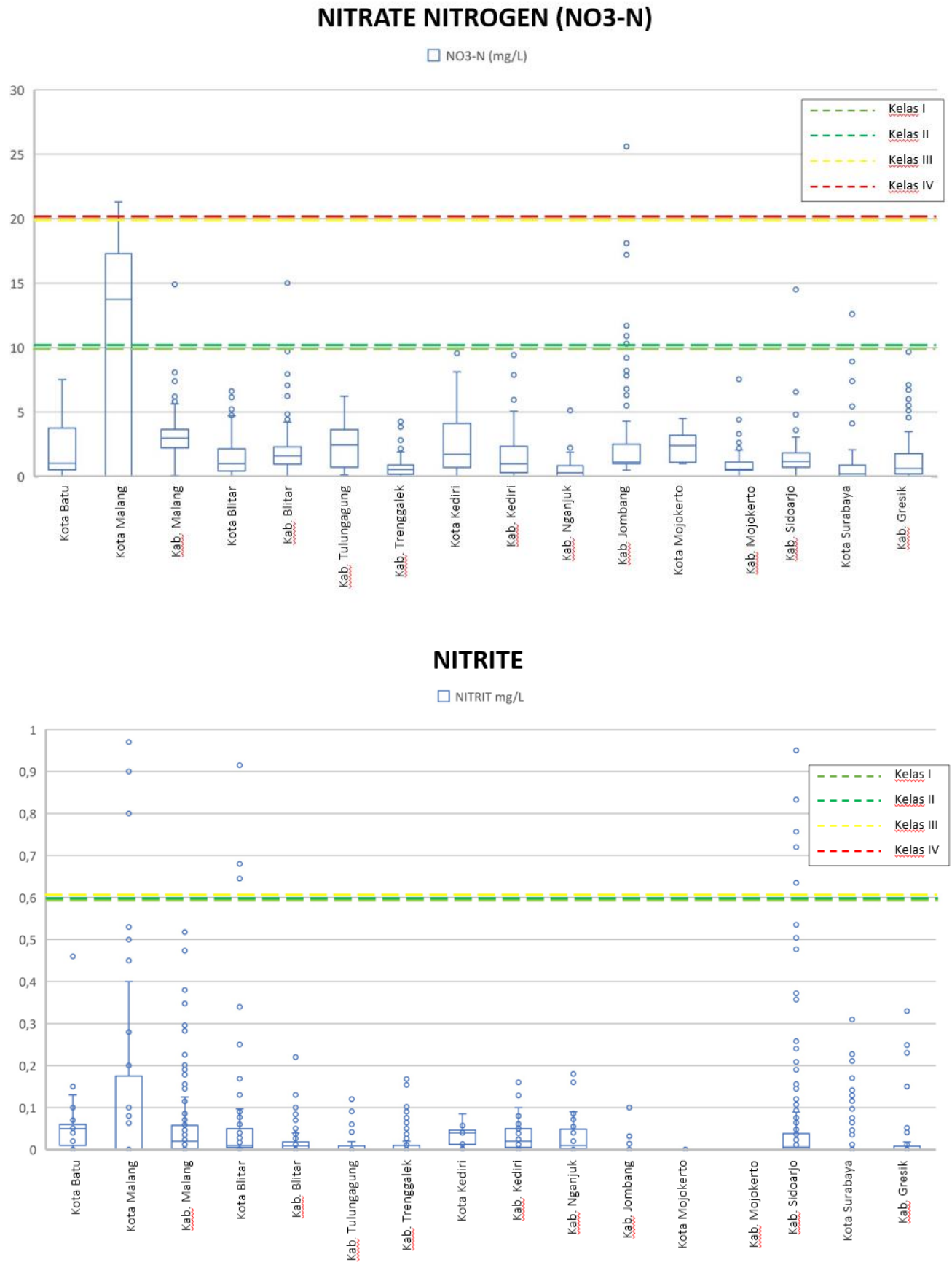
Phosphate, nitrate (NO3-N), and nitrite pollution can also come from a number of sources. In addition to natural sources, phosphates and nitrates are often present in fertilizers, domestic sewage, and industrial discharges. Detergents, conveyed from households, can also contribute to phosphate pollution. Elevated nitrite levels are largely attributed to agricultural runoff or wastewater discharges. Reported samples for all three parameters tend to fall within Class II limits, with the exception of phosphate and nitrate measurements in Kota Malang, which exceed Class II limits, and a distinct spike in phosphates in Jombang, particularly around Tambangan Cheil Jedang.

Figure 11. Phosphate spreads per kota / kabupaten, 2021-2023



Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

Figure 12. Nitrate Nitrogen and Nitrite spreads per kota / kabupaten, 2021-2023

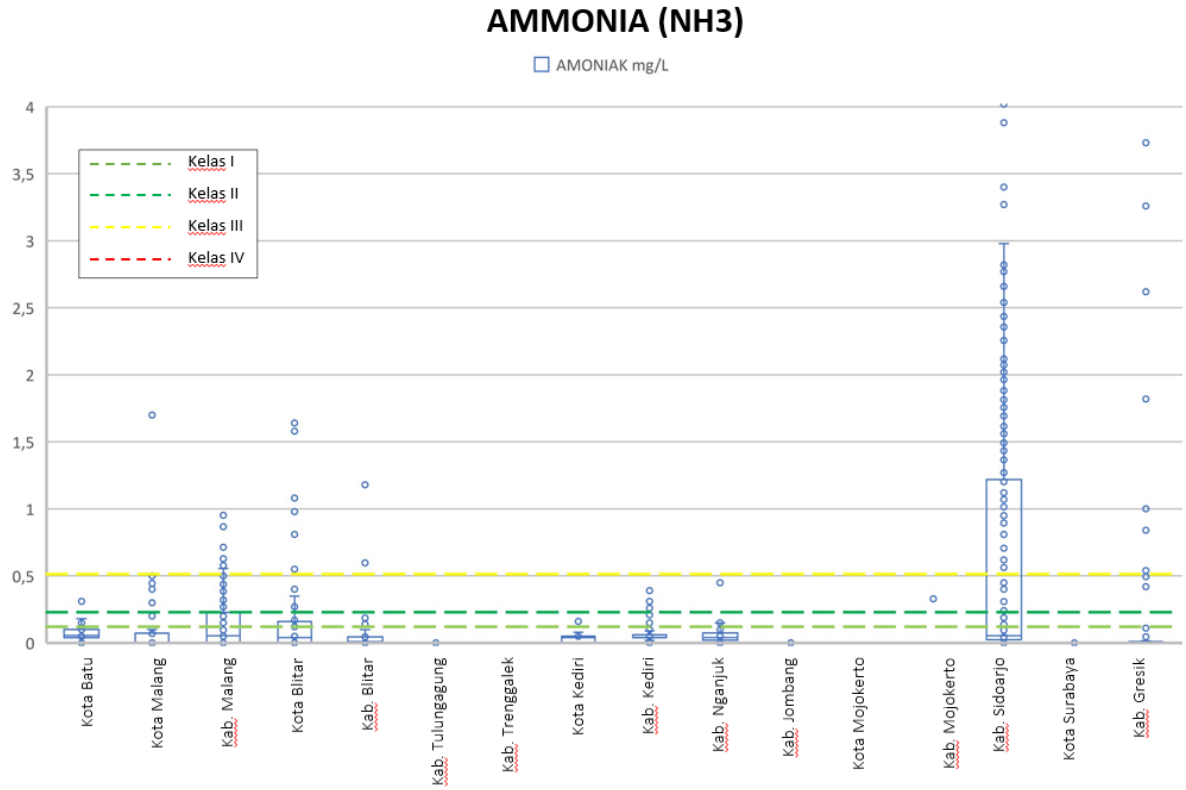


Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

III.2.4. AMMONIA (NH3)

Ammonia (NH3) primarily originates from both natural and anthropogenic sources. These may include agricultural runoff (from nitrogen-based fertilizers), livestock waste, and domestic and industrial wastewater. As with phosphates, ammonia levels measured between 2009-2019 fall largely within standard limits, with the exception of a spike in Jombang at Tambangan Cheil Jedang. This signal is undetected in the 2021-2023 data, but elevated levels are recorded in Sidoarjo downstream.

Figure 13. NH3 spread per kota / kabupaten, 2021-2023

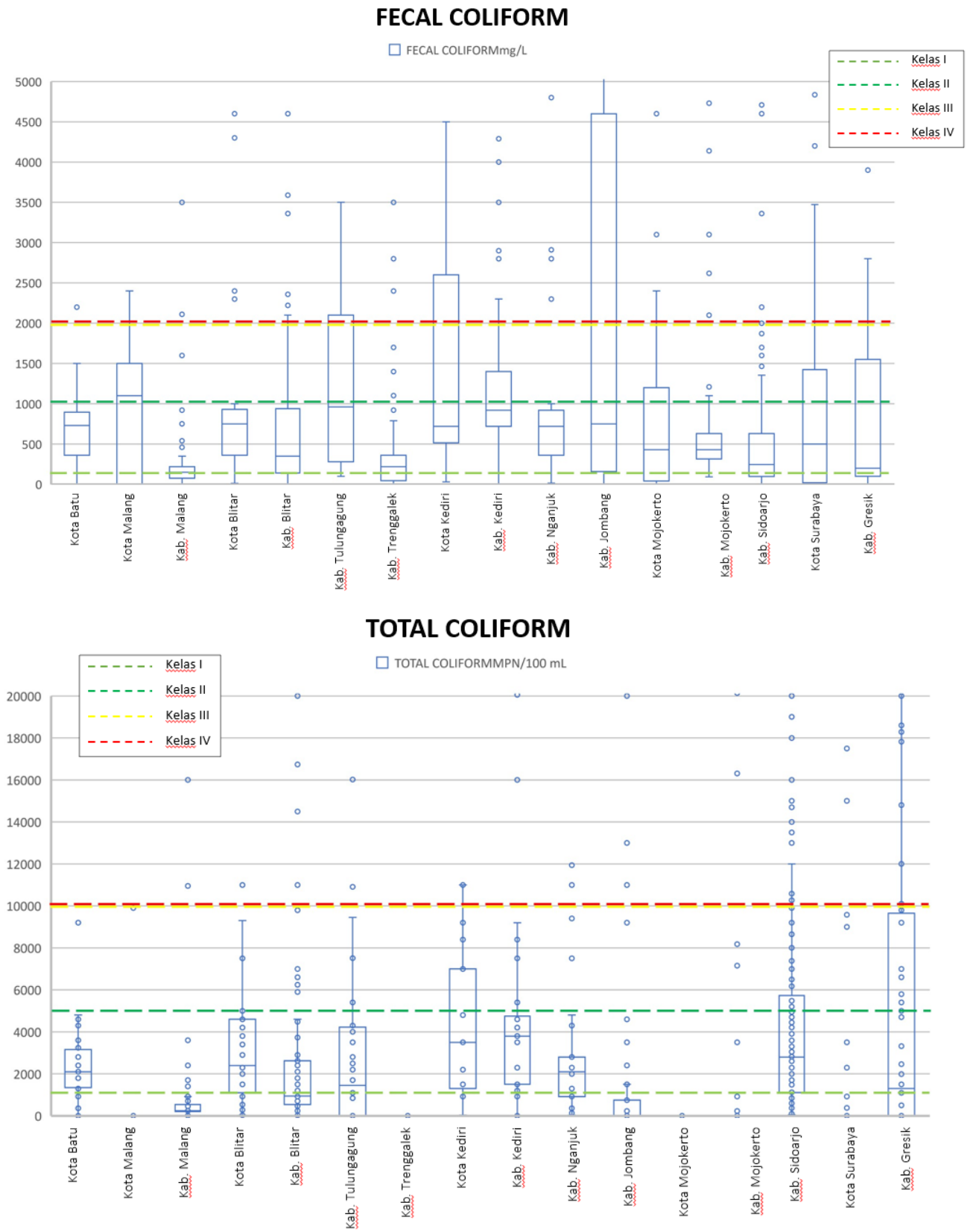


Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

III.2.5. FECAL COLIFORM AND TOTAL COLIFORM

Total coliform and fecal coliform are both indicators of bacterial contamination and particularly signal the presence of fecal contamination. Total coliforms can come from various sources, including soil, vegetation, and the feces of humans and animals. Fecal coliforms, on the other hand, are a subgroup of total coliforms more specifically associated with human and mammal feces. Fecal coliform spreads for the period between 2021-2023 demonstrate that observed concentrations regularly exceed Class II limits, with a large number of observations that exceed even Class III and IV limits in Kota Kediri and Jombang.

Figure 14. Fecal and Total Coliform spreads per kota / kabupaten, 2021-2023



Source: Authors, based on data from DLH Jatim, PJT I, kabupaten / kota DLH

III.2.6. KLHK 2020 DATA

As with the above, 2020 data extracted from KLHK's Buku Statistik suggests that all river segments (upstream, midstream, downstream) have elevated levels of BOD and fecal coli. In contrast, however the data from 2020 also shows exceeding levels of TSS, cyanide, nitrate, hydrogen sulfide, copper, lead, zinc, total coli, and oils and detergents, as well as sufficient levels of DO. Reported phosphate levels exceed Class I and Class II limits in the upstream areas only.

Table 18 below illustrates a comparison of measured median concentrations of each parameter and concentration limits for Classes I, II, and III. This comparison is expressed as a ratio of the median concentration to the concentration limit. Ratios higher than 1.0 are shaded light blue and ratios higher than 1.2 are noted in dark blue. This data implies a more polluted river compared to the data from 2020-2023, particularly in terms of heavy metals (e.g., lead, zinc, copper).

Table 18. Median concentrations of select water quality parameters per hulu-tengah-hilir river segment and ratio of average concentrations to class limit concentrations (2020 KLHK data)

Parameter	(Gray field) Class limit concentration per parameter (Below) Ratio of median concentration to class limit concentration			2020 Median concentration
	Class I	Class II	Class III	
TDS (mg/L)	1000.0	1000.0	1000.0	
Hulu	0.28	0.28	0.28	280.42
Tengah	0.23	0.23	0.23	231.58
Hilir	0.28	0.28	0.28	276.50
TSS (mg/L)	40.00	50.00	100.00	
Hulu	1.76	1.41	0.70	70.25
Tengah	1.53	1.22	0.61	61.22
Hilir	2.57	2.06	1.03	102.85
pH	6-9	6-9	6-9	
Hulu	Good	Good	Good	8.08
Tengah	Good	Good	Good	7.73
Hilir	Good	Good	Good	7.99
BOD (mg/l)	2.0	3.0	6.0	
Hulu	2.06	1.37	0.69	4.11
Tengah	1.81	1.20	0.60	3.61
Hilir	2.19	1.46	0.73	4.38
COD (mg/l)	10.0	25.0	40.0	
Hulu	1.01	0.40	0.25	10.12
Tengah	0.89	0.36	0.22	8.90
Hilir	1.08	0.43	0.27	10.83
DO (mg/L)	6.0	4.0	3.0	
Hulu	1.26	1.89	2.52	7.56
Tengah	1.22	1.84	2.45	7.34
Hilir	1.22	1.84	2.45	7.34
Phosphate (mg/L)	0.2	0.2	1.0	
Hulu	1.25	1.25	0.25	0.25
Tengah	0.50	0.50	0.10	0.10
Hilir	1.05	1.05	0.21	0.21
Nitrate (NO3) (µg/L)	10.0	10.0	20.0	

Hulu	0.30	0.30	0.15	3.02
Tengah	0.19	0.19	0.10	1.90
Hilir	0.19	0.19	0.09	1.88
Ammonia (NH3) (mg/l)	0.1	0.2	0.5	
Hulu	0.10	0.05	0.02	0.01
Tengah	0.00	0.00	0.00	0.00
Hilir	0.10	0.05	0.02	0.01
CN (mg/l)	0.02	0.02	0.02	
Hulu	4.00	4.00	4.00	0.08
Tengah	4.00	4.00	4.00	0.08
Hilir	6.00	6.00	6.00	0.12
F (mg/l)	1.0	1.5	1.5	
Hulu	0.11	0.07	0.07	0.11
Tengah	0.13	0.09	0.09	0.13
Hilir	0.17	0.11	0.11	0.17
NO2-N (mg/l)	0.06	0.06	0.06	
Hulu	117.67	117.67	117.67	7.06
Tengah	99.17	99.17	99.17	5.95
Hilir	169.33	169.33	169.33	10.16
Sulphate (SO_4) (mg/l)	300.0	300.0	300.0	
Hulu	0.00	0.04	0.09	12.42
Tengah	0.00	0.04	0.07	12.98
Hilir	0.00	0.07	0.16	21.80
H_2S (mg/l)	0.002	0.002	0.002	
Hulu	10.00	10.00	15.00	0.02
Tengah	10.00	10.00	10.00	0.02
Hilir	10.00	10.00	10.00	0.02
Fecal Coliform (Jml/100mL) (MPN)	100.0	1000.0	2000.0	
Hulu	41.00	6.10	5.10	6100.00
Tengah	31.00	5.44	4.55	5441.67
Hilir	28.00	4.10	3.75	4100.00
Total coli (Jml/100mL) (MPN)	1000.0	5000.0	10000.0	
Hulu	11.78	2.36	1.18	11783.33
Tengah	10.73	2.15	1.07	10733.33
Hilir	7.96	1.59	.76	7958.33
Co (mg/L)	0.20	0.20	0.20	
Hulu	0.10	0.10	0.10	0.02
Tengah	0.10	0.10	0.10	0.02
Hilir	0.10	0.10	0.10	0.02
Cd (mg/L)	0.01	0.01	0.01	
Hulu	1.00	1.00	1.00	0.01
Tengah	1.00	1.00	1.00	0.01
Hilir	1.00	1.00	1.00	0.01
Cr6+ (mg/L)	0.05	0.05	0.05	
Hulu	0.20	0.20	0.20	0.01
Tengah	0.20	0.20	0.20	0.01
Hilir	0.20	0.20	0.20	0.01
Cu (mg/L)	0.02	0.02	0.02	

Hulu	1.50	1.50	1.50	0.03
Tengah	1.50	1.50	1.50	0.03
Hilir	1.50	1.50	1.50	0.03
Fe (mg/L)	0.30	-	-	
Hulu	0.20	-	-	0.06
Tengah	0.20	-	-	0.08
Hilir	0.20	-	-	0.09
Pb (mg/L)	0.03	0.03	0.03	
Hulu	1.33	1.33	1.33	0.04
Tengah	1.33	1.33	1.33	0.04
Hilir	2.00	2.00	2.00	0.06
Mn (mg/L)	0.10	-	-	
Hulu	0.20	-	-	0.02
Tengah	0.10	-	-	0.01
Hilir	0.40	-	-	0.04
Zn (mg/L)	0.05	0.05	0.05	
Hulu	172.00	172.00	172.00	8.60
Tengah	211.60	211.60	211.60	10.58
Hilir	183.40	183.40	183.40	9.17
Minyak dan Lemak (mg/l)	1.00	1.00	1.00	
Hulu	1837.50	1837.50	1837.50	1837.50
Tengah	1837.50	1837.50	1837.50	1837.50
Hilir	1837.50	1837.50	1837.50	1837.50
Klorin Bebas (mg/l)	0.03	0.03	0.03	
Hulu	0.33	0.33	0.33	0.01
Tengah	0.33	0.33	0.33	0.01
Hilir	0.67	0.67	0.67	0.02

Sources: Average concentrations extracted from Tabel 3.17. Kualitas Air Sungai, Provinsi Jawa Timur Tahun 2020, pg 75 (2020 data); Class concentration limits extracted from Government Regulation 22 of 2021 on Environmental Protection and Management

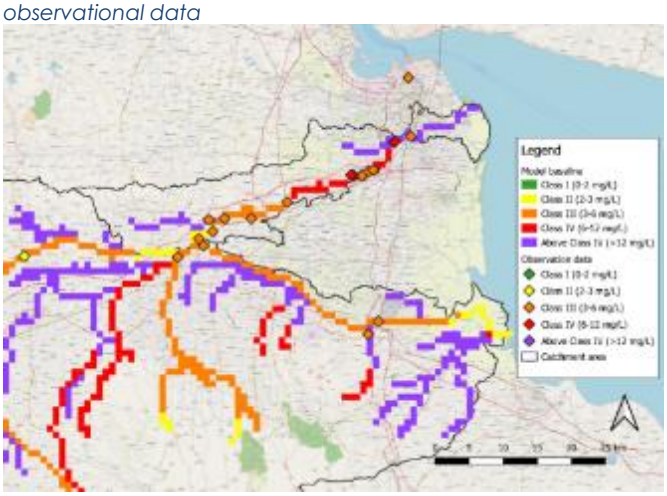
III.2.7. DISCUSSION OF WATER QUALITY DATA

While the mean and median reported water quality data is consistently high for BOD and fecal coli, many other parameters are reported to fall within Class II limits. These results should be taken with caution, however, for several reasons. First, the limited frequency of data collection in most locations (monthly or quarterly) means that calculated averages and median values are based on a limited data set that may not capture concentration fluctuations in a dynamic river environment. Moreover, concentrations are not spread evenly across waterways, and sampling locations can make a significant difference in observed concentrations. As important as median levels are spreads of data, which more effectively capture variations. This is particularly important when considering the effects of seasonality. During the dry season, the Brantas River exhibits poorer water quality in many areas because of the reduced flow and lesser dilution. That said, water quality at the beginning of the rainy season often shows the highest values of organic parameters, as high accumulated loads of organic waste are washed into waterways (Harnanto & Hidayat, 2004). Without real-time and continuous monitoring, contamination may be missed. Literature also suggests that water pollution loads can be significantly different across the basin. In contrast to the data above, recent research in the Brantas suggests heavily polluted water around Malang in terms of BOD and COD due to domestic wastewater (Yetti et al., 2011); high phosphates in the downstream regions (Fulazzaky,

2009); particularly poor water quality downstream of Malang and in the Surabaya area (Harnanto & Hidayat, 2004); and highly polluted river classification in the downstream reaches (Sholichin & Othman, 2006).

One way of dealing with these data limitations is by modeling expected concentrations in waterways, based on models that account for emissions by various pollution sources and rainfall runoff processes. In the work program of the Brantas Water Quality project, a water quality model was used to estimate average levels of BOD (by 1-km segments of the river), based on estimated BOD emissions per square kilometer from agriculture, livestock, and domestic wastewater in the river basin area. Model validation demonstrated that modeled BOD levels corresponded well with observed levels. Figure 15 shows modeled water classes (river segments) compared to observational data (diamond points).

Figure 15. Modeled water class (in terms of BOD) compared to observational data



Source: Deltares and TU Delft water quality modeling analysis, 2023

The results of this exercise are further discussed in the following section, but the primary point here is that similar modeling exercises could be used to estimate average per-segment concentrations for additional pollution key parameters (e.g., fecal coli or phosphates) based on source emission data. Such estimations can provide additional data on water quality and also support decisions about approaches to reduce pollution levels.

III.3 GENERAL INDICATORS OF WATER QUALITY: IKA AND BAKU MUTU AIR

Indonesia's Water Quality Index (IKA) provides a single condensed index measurement of water quality based on several water quality parameters. While it cannot substitute for more granular water quality parameter data, it offers a simplified metric for policy makers to monitor water conditions and set general targets. The IKA ranges from 0-100, where higher values indicate better water quality. The IKA is based on a weighted adjustment of other established water quality indexation methods, including Pollution Index and STORET, which compare water parameters to determined limits for water health (based on use). These approaches, in turn, classify water status on a scale (e.g., polluted to very good).

The Pollution Index (or STORET or other approved indexation approaches) is used to compare physical and chemical parameter data with water quality standards according to the stipulated class for a river or segment, in order to determine the level of pollution relative to permissible parameter levels. Until 2018, IKA included seven parameters (TSS, DO, BOD, COD, Total Phosphate, Fecal Coli, and Total Coliform). In 2019, a new calculation protocol, the modified IKA (IKA-INA), was introduced, which additionally includes pH, ammonia, and total dissolved solids (TDS), though some IKA calculations include lesser parameters due to data limitations (Ratnaningsih et al., 2021).

With the most common indexing method (Pollution Index), PI_j is the pollution index for class designation *j*, and is calculated as follows:

$$PI_j = \sqrt{\frac{\left(\frac{C_i}{L_{ij}}\right)_M^2 + \left(\frac{C_i}{L_{ij}}\right)_R^2}{2}}$$

where C_i represents the measured concentration of water quality parameter *i* and L_{ij} represents the concentration of water quality parameter *i* determined in the quality standard for water designation *j*. Applying the PI approach, water pollution is classified as follows, based on calculated PI_j in relation to designated Class I standards based on Government Regulation Number 82 of 2001 (see above).[29]

While the designation used to calculate PI is Class I, the calculated PI is converted to a Water Quality Index (IKA / IKA-INA) value based on a numerical categorical grading scale that assigns an IKA score based on weights determined by quality standards of Classes II, III, and IV in comparison to Class I limits (KLHK, 2018). A higher IKA score indicates better water quality. The calculated PI value is multiplied by the percentage of fulfillment of quality standards (KLHK, 2022a).[30] This conversion to IKA-INA for each parameter *j* is performed as follows:

Table 19. Conversion from calculated PI to IKA-INA score

IKA_j	PI_j
100	<= 1.0
80	>1.0 and <= 4.67 (where 4.67 is the PI_j value of Class II quality standards as compared to Class I)
60	>4.67 and <= 6.32 (where 6.32 is the PI_j value of Class III quality standards as compared to Class I)
40	>6.32 and <= 6.88 (where 6.88 is the PI_j value of Class IV quality standards as compared to Class I)
20	>6.88

Source: KLHK (2018), Indeks Kualitas Lingkungan Hidup Indonesia 2017

The IKA / IKA-INA calculated for a kota, kabupaten, or province is the average IKA / IKA-INA of all samples of the region. At present, East Java's IKA achievements have reached or exceeded targets, though published targets and achievements differ somewhat between DLH Jatim and KLHK sources. The Provincial IKA achievement as reported by DLH Jatim in an October 2022 workshop with TKPSDA WS Brantas is 53.36. This reported IKA exceeds the targets set out in the 2019-2024 Jawa Timur Regional Medium-term Development Plan (RPJMD) for 2022, 2023, and 2024 (see Table 18).

Table 20. Jawa Timur IKA Targets

2019	**2020**	**2021**	**2022**	**2023**	**2024**
52.97-53.94	53.95-54.92	48.50-48.55	48.56-48.60	48.61-48.64	48.66-48.70

Source: RPJMD Jawa Timur 2019-2024

While this reported achievement differs slightly from the scores of 53.37 and 56.13 reported by KLHK (KLHK Status Lingkungan Hidup, 2022), KLHK's published achievement and 2022 target of 53.39 suggest that, at a provincial level, water quality targets determined by IKA have been achieved over the past two years (Table 21).

Table 21. Water Quality Achievements and Targets: IKA Jawa Timur

Year	IKA Targets	IKA Achievements
2021	48.50-48.55 (RPJMD Jatim, 2019-2024)	53.57 (Profil Indeks Kualitas Linkungan Hidup Provinsi Jawa Timur, 2021)
2022	48.56-48.60 (RPJMD Jatim, 2019-2024) 53.39 (KLHK Status Lingkungan Hidup, 2022)	53.37 (KLHK Status Lingkungan Hidup, 2022) 56.13 (Profil Indeks Kualitas Linkungan Hidup Provinsi Jawa Timur, 2022, Laporan Kinerja Dit PPA, 2022)

[29] See https://ppkl.menlhk.go.id/website/filebox/502/180719182446Indeks%20Kualitas%20Air.pdf

[30] The percentage is calculated by dividing the sum of sampling points that the quality standards by the number of samples.

2023	48.61-48.64 (RPJMD Jatim, 2019-2024) 53.73 (2023 target, RKPD Provinsi Jawa Timur, 2023)	55.86 (Profil Indeks Kualitas Lingkungan Hidup Provinsi Jawa Timur, DLH Jatim, 2023)

Sources: KLHK Status Lingkungan Hidup, 2022, https://www.menlhk.go.id/cadmin/uploads/SLHI_2022_upload_final_77f9948571.pdf ; KLHK Laporan Kinerja Direktorat Pengendalian Pencemaran Air 2022, https://ppkl.menlhk.go.id/website/filebox/1174/230829142703LKj%20Es.%20II%20DIT.PPA%20tahun%202022.pdf; DLH Jatim personal communication, 2023; RJPMD Jatim, 2019-2024

Data on kabupaten and kota IKA are summarized in Table 22. These data were provided by DLH Jatim and the DLH at the kota and kabupaten levels. Reported IKA data is not accompanied by methodological notes nor presented in a standardized format from year to year. Methodological notes are important to ensure the comparability of data (i.e., it is unknown if the below are IKA or IKA-INA formulated values). Standardizing reporting across all data types is an important opportunity to better organize and ensure the reliability of available data.

Table 22 Reported IKA for segments of the Brantas River

IKA	2021	2022	2023
Kota Batu	57.27	68.54	63.18
Kabupaten Malang	50.22	66.39	65.00
Kota Malang	56.32	50.00	49.44
Kabupaten Blitar	61.67	60.53	59.41
Kota Blitar	51.58	59.73	67.78
Kabupaten Tulungagung	56.67	58.00	57.06
Kabupaten Trenggalek	51.56	67.30	49.48
Kabupaten Kediri	43.33	62.22	62.97
Kota Kediri	50.00	58.24	62.86
Kabupaten Nganjuk	54.00	61.61	60.97
Kabupaten Jombang	57.95	48.90	55.14
Kabupaten Mojokerto	60.00	61.33	54.93
Kota Mojokerto	Not reported	58.95	52.63
Kabupaten Sidoarjo	54.05	47.75	54.32
Kabupaten Gresik	48.75	48.24	49.38
Kota Surabaya	Not reported	49.15	49.02

Source: DLH Jatim Bidang PPKL, Kota/Kabupaten IKA calculations, 2021-2023

Calculated PI and IKA scores are also used to classify rivers qualitatively. Prior classifications have been based on PI values (Table 23) or IKA / IKA-INA alone. Between 2016-2020, KLHK rated the Brantas River as "Heavily Polluted" (KLHK, 2020). A revised scheme is based on calculated IKA-INA as in Table 24, where calculated IKA-INA are further scored on a scale from 1-5.

Table 23. Pollution categories associated with calculated PI

PI	Pollution Category
0-<=1.0	Meets standards (Good)
> 1.0-5.0	Slightly polluted
> 5.0-10.0	Moderately polluted
>10.00	Heavily polluted

Source: KLHK (2018), Indeks Kualitas Lingkungan Hidup Indonesia 2017; PowerPoint KLHK, Usulan Metode Penentuan Indeks Kualitas Air (IKA) di Indonesia Tahun 2020-2024 (nd)

Table 24. Pollution classification based on IKA-INA score (2023 revision)

IKA-INA	Classification	Score
90 - 100	Very good	5
80 - <90	Good	4
60 - <80	Moderate	3
40 - <60	Poor	2
0 - <40	Very poor	1

Source: KLHK consultation and PowerPoint, 2023

This revised scoring scheme is used to consider IKA-INA with additional factors under a scoring scheme entitled Baku Mutu Air (BMA) or Water Quality Standard. The BMA was introduced with PP 22 of 2021 to account for additional factors beyond measured parameters (Articles 527-531). This BMA value utilizes the IKA-INA as a primary

and most heavily weighted input but also considers land use, compliance with spatial planning, and the water debit (ratio of max-min discharge), where each factor has a scoring protocol (1-5) laid out in regulation. **Because these scoring approaches are new, capacity building to calculate and apply BMA in planning and evaluation at the provincial and kabupaten / kota levels is an important need.**

III.4 WATER QUALITY MODELING & LOAD CONTRIBUTIONS BY SOURCE

General information about relative pollution loads by sector and locations of concern derived from water quality modeling are provided in the following sub-section, as they provide a high-level comparative view of pollution source impacts on river conditions.

III.4.1. CONSIDERING LOAD CONTRIBUTIONS AND AREAS OF HIGHER CONCERN

Interventions may be prioritized according to a number of criteria, including effectiveness with respect to reducing pollution levels or source loads, feasibility, and efficiency. Assessment of alternatives according to likely effectiveness in reducing pollution levels can be informed by comparing pollution contributions across sources and locations and estimating the likely impacts of interventions. With respect to the relative contributions to pollution, biological oxygen demand (BOD) is one of the most commonly utilized measures of pollution. BOD is also used in the Brantas Harmoni report as a general pollution measure, but it should be noted that even small traces of some substances of high concern can have serious ecological and public health implications. Moreover, the Brantas is polluted by high loads of plastics (World Bank, 2021) as well as heavy metals and harmful endocrine-disrupting chemicals (EDCs), such as hormones, plasticizers, agrochemicals, pharmaceutical active compounds (PhACs), and preservatives that have serious impacts on human health and biodiversity (Ismanto et al., 2022).

Nevertheless, BOD is an important general indicator for water quality and pollution levels. KLHK, BBWS Brantas, and DLH Jatim have published estimated relative pollution loads in terms of BOD from domestic wastewater, solid waste, industry, livestock, agriculture, and non-point sources. These studies should be carefully reviewed for RPPMA formulation, however, as they do not include detailed methodological information or referencing to data used in estimations (DLH Jatim 2022; KLHK 2023) or are based on older studies (Binnie & Partners (Overseas) Ltd, 1999). Based on the 1999 Binnie report estimations, the 2020 Pola reports that approximately 483 industries discharge wastewater to the Brantas, contributing an estimated load of 125 tons of BOD daily (BBWS Brantas, 2020a; Binnie & Partners (Overseas) Ltd, 1999). A 2018 KLHK decree (Keputusan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor SJ.316/Menlhk/Setjen/KUM.1/7/2018 tentang Penetapan Daya Tampung Beban Pencemaran Air dan Alokasi Beban Pencemaran Air Sungai Brantas) indicates existing BOD loads per segment and target reductions per segment, per source (domestic, industry, livestock, and non-point source) but does not indicate updated loads from each source.[31]

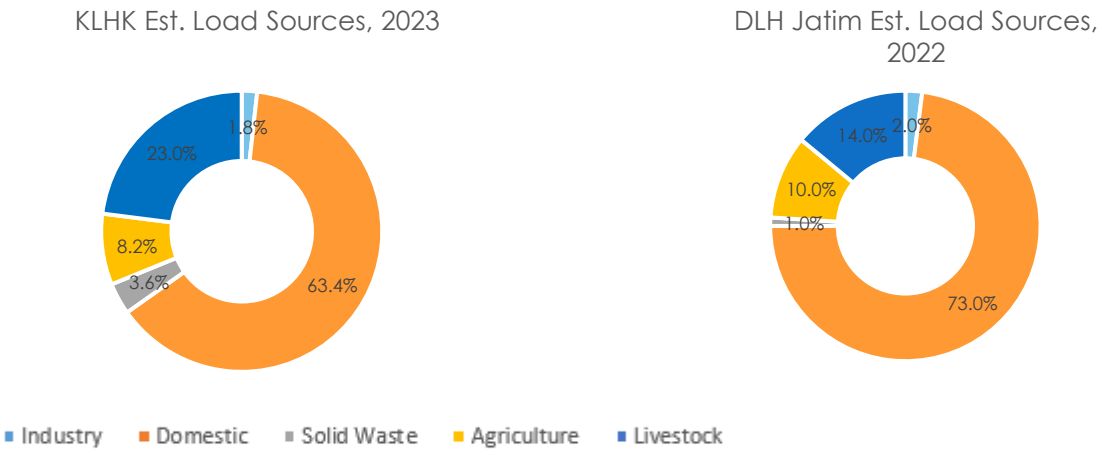
Reporting from KHLK, DLH Jatim, and BBWS all attribute the largest loads of river pollution in terms of BOD to domestic wastewater effluents. KLHK estimates that approximately 63% of the BOD load in DAS Brantas comes from domestic wastewater effluent, and DLH Jatim estimates an even higher 73% contribution.[32] BBWS Brantas Renstra and Pola report that an estimated 205 tons of BOD per day comes from domestic sources, though this figure is based on a

[31] https://ppkl.menlhk.go.id/website/filebox/622/190724204802Kepmen%20LHK%20Nomor%20SK%20316%20Tentang%20Penetapan%20Daya%20Tampung%20Beban%20Pencemaran%20Air%20dan%20Alokasi%20Beban%20Pencemaran%20Air%20Sungai%20Brantas.PDF

[32] PowerPoint presentations from KHLK, 2023, and DLH Jatim, 2022

1999 study (BBWS Brantas, 2020a, 2020b). Water quality performed in 2023 suggests that BOD loads from domestic sources may be over four times higher at 885 tons per day (see below).

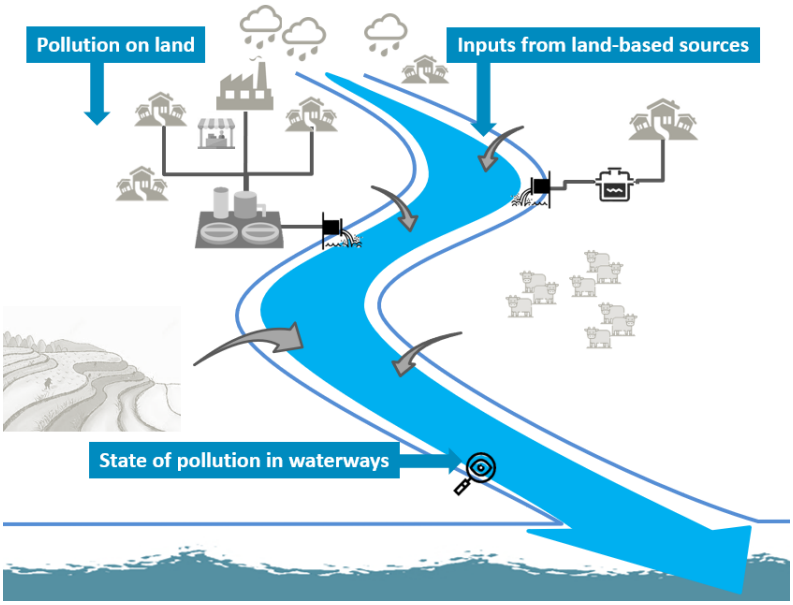
Table 25. Relative estimated pollution source contributions (BOD, average kg/day)



Sources: KLHK RPPMA Study (unpublished, 2023); DLH Jatim PowerPoint presentation to TKPSDA meeting 12 October, 2022

A 2023 water quality modeling exercise performed by Deltares as part of the Brantas Water Quality Project confirms these analyses but also suggests that **BOD loads from both domestic and agricultural runoff are highly underestimated**. The water quality model combines a rainfall-runoff model with a pollution load transport model to estimate the effect of pollution inputs on measured BOD in the main Brantas (Figure 16). These results are based on detailed estimation of terrestrial pollution source loads by location (kg per day BOD emissions, by source, per square kilometer). The study reviewed only domestic wastewater and runoff from livestock and agriculture and did not attempt to estimate pollution from industrial sources due to data limitations with respect to estimating industrial effluent loads. Detailed results of the model are included in Appendix D, but results are summarized here in relation to prioritizing interventions.

Figure 16. Conceptualization of water quality model



III.4.2. FOCUS ON DOMESTIC WASTEWATER AND AGRICULTURE

Results suggest that, of total estimated BOD loads from domestic, agriculture, and livestock combined (i.e., not including industrial wastewater and solid waste), emissions from domestic wastewater and agriculture are the largest, accounting for comparable daily loads of BOD into the Brantas basin (see Table 26). By modeling estimations, agriculture contributes and estimated 870,000 kg per day, while domestic wastewater contributes an estimated 802,855 kg per day. As such, reductions in the loads from these two sources will be most effective to reduce BOD concentrations in the Brantas River.

Table 26. Summary of BOD and TN loads per source (average kg/day)

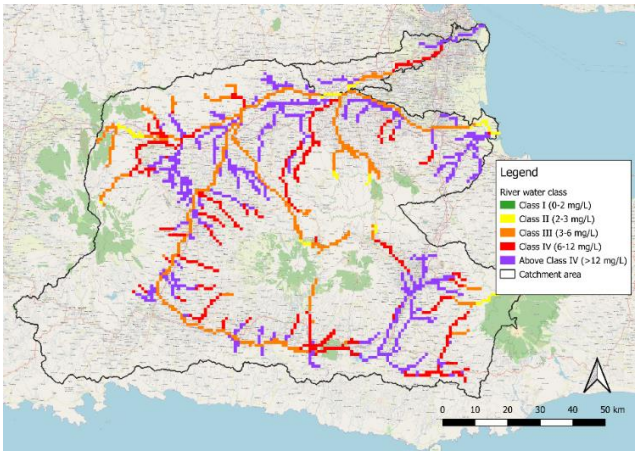
	Total estimated load by source	
Source	BOD (kg/d)	TN (kg/d)
Domestic wastewater	802,855	372,747
Agriculture	870,675	75,355
Livestock	307,860	108,943
Total	1,981,390	557,045
	Percent total estimated load by source	
Source	BOD (%)	TN (%)
Domestic wastewater	41%	67%
Agriculture	44%	14%
Livestock	16%	20%
Total	100%	100%

Source: Deltares water quality modeling analysis, 2023

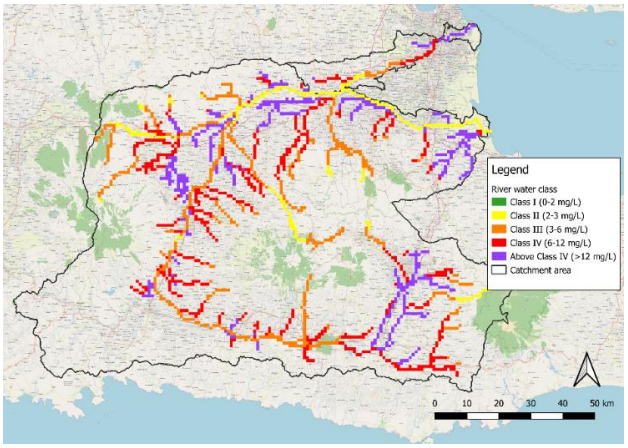
The modeling exercise also allowed for various intervention scenarios to be compared. Notably, a 30% reduction of BOD loads from all three sources yielded similar results to reducing *only* domestic wastewater and agriculture loads by 30%, suggesting that interventions targeting livestock waste will have a much more limited effect on overall BOD loads than will interventions targeting domestic wastewater and agriculture. A combined 30% reduction scenario (all sources) leads to a 20-30% reduction in the modelled, median BOD concentrations in large parts of the Brantas River and changes from river water Class III to Class II for the downstream part of Sungai Brantas and Sungai Porong. A 30% reduction of emissions from domestic wastewater and agriculture only leads to similar modeled outcomes (Figure 17). Nevertheless, while livestock has a limited effect on overall BOD levels in the basin, it will have a much more marked effect on local BOD concentrations where livestock is concentrated (Figure 21).

Figure 17. Estimated water class, baseline (left), effect of reducing all three sources (agriculture, livestock, and domestic wastewater) emissions by 30% (middle), and effect of reducing only agriculture and domestic wastewater by 30% (right)

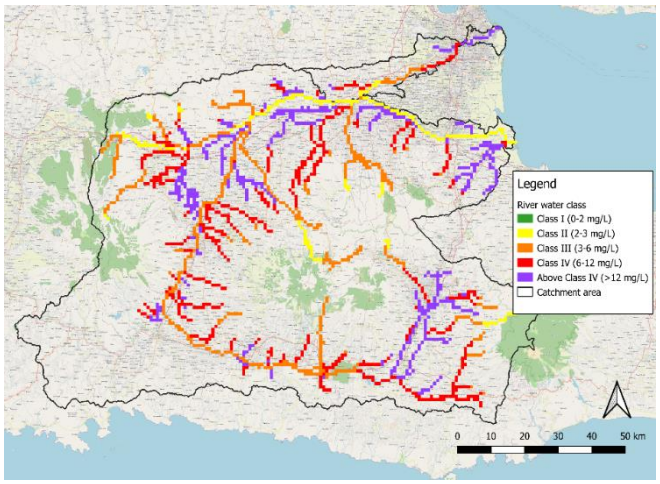
Baseline



Scenario: Reduce all sources by 30%



Scenario: Reduce only agriculture and domestic wastewater by 30% (no livestock reduction)



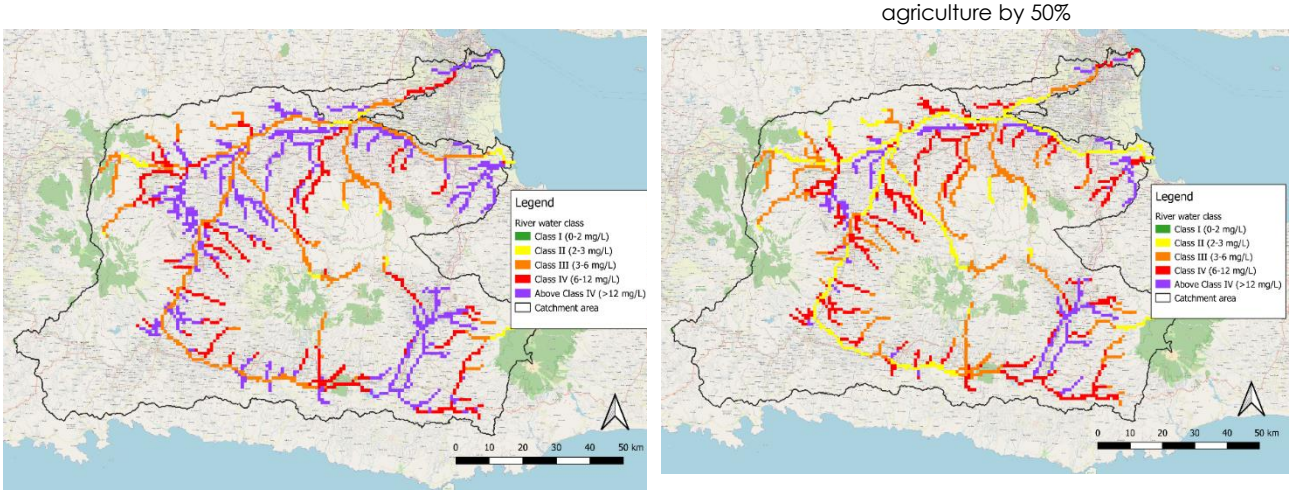
Source: Project modeling results, Deltares and TU Delft, 2023

Notable improvements to water quality will undoubtedly require a combination of efforts, however, and reducing agricultural emissions alone is insufficient to achieve Class II levels for BOD. Reductions in agricultural pollution must be accompanied by marked reduction in domestic wastewater emissions, which is important to achieve Class II for BOD, particularly around cities where domestic wastewater BODs loads are both high and further concentrated. Even a major (e.g., 80%) reduction of agricultural BOD emissions would fail to reduce BOD levels in waterways around cities (e.g., Kota Kediri and Kota Blitar), despite converting large parts of the river from Class III to Class II (Figure 18, d).

Figure 18. Estimated water class, baseline (left) and effects of reducing agriculture and domestic wastewater emissions by various amounts (%)

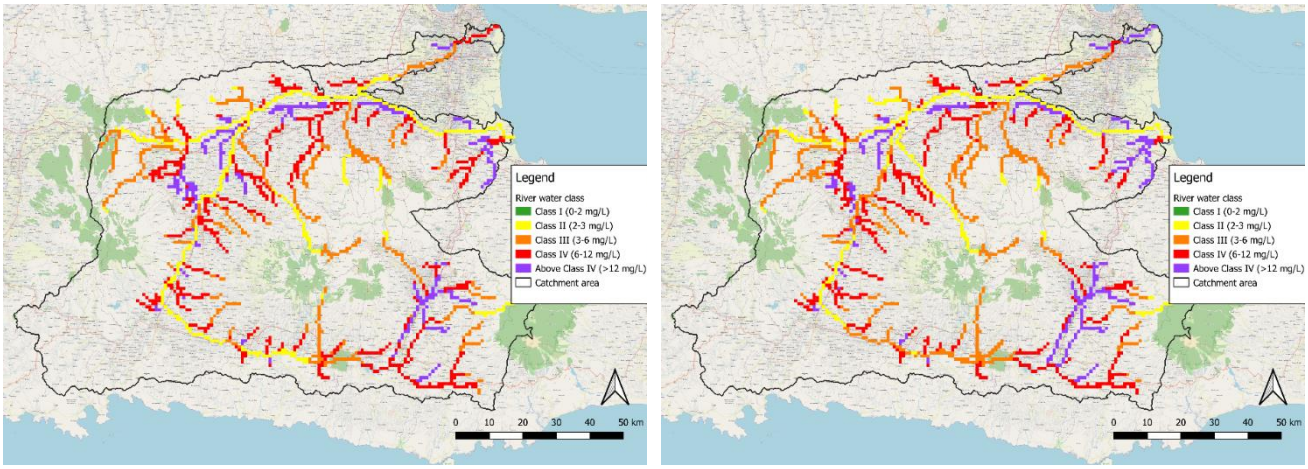
a. Baseline

b. Scenario: Reduce domestic wastewater by 50% and agriculture by 50%



c. Scenario: Reduce domestic wastewater by 60% and agriculture by 30%

d. Scenario: Reduce domestic wastewater by 30% and agriculture by 80%



Source: Project modeling results, Deltares and TU Delft, 2023

The balance of sectoral interventions should also consider cost to decide between equally-effective combined measures. A reduction of 60% in domestic wastewater and 30% in agricultural emissions (Figure 18, c) for example, has a similar effect as reducing each source by 50% (b). Both options would lead to a conversion from Class III to Class II standards for a large part of the Brantas River, but the costs of interventions would allow for planners to select the most cost-effective approach.

Data from Appendix D offers more guidance with respect to prioritizing particular geographic areas for targeted intervention for each pollution source type. The baseline estimated BOD loads per square kilometer show, for example, that agricultural emissions are fairly distributed across the basin (Figure 20), whereas livestock emissions loads are more concentrated (albeit lower, overall) around Malang, Tulungagung, Kediri, and Jombang (Figure 21). As such, interventions to reduce agricultural emissions may be more evenly dispersed across the basin, whereas livestock-focused measures should be more geographically targeted. For domestic wastewater, loads are concentrated around waterways where population density also tends to be higher. As with agriculture, significant improvements to management are required evenly across the basin, and particularly for dense urban areas nearest waterways.

Figure 19. Baseline BOD load for domestic wastewater (kg/d/km²)

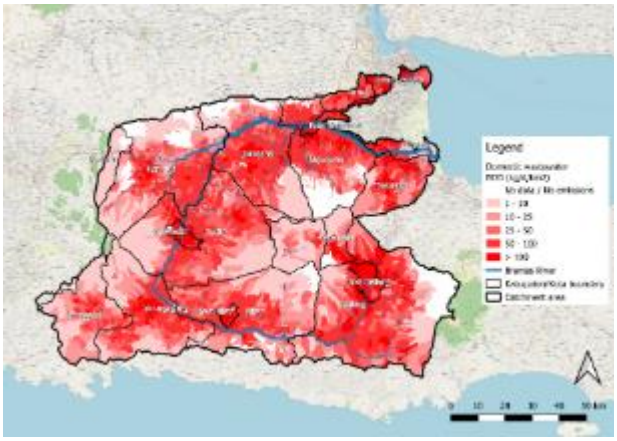


Figure 20. Baseline BOD load for agriculture (kg/d/km²)

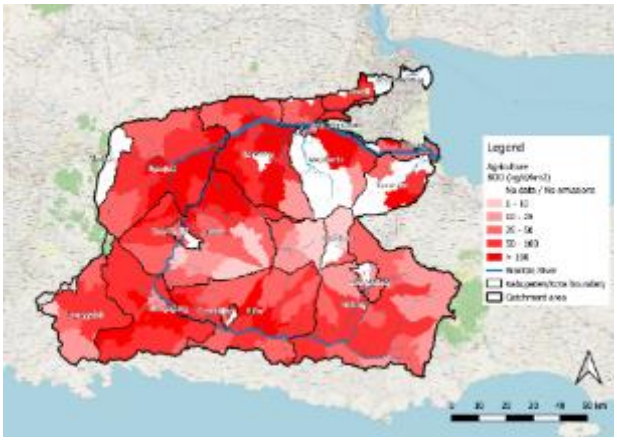
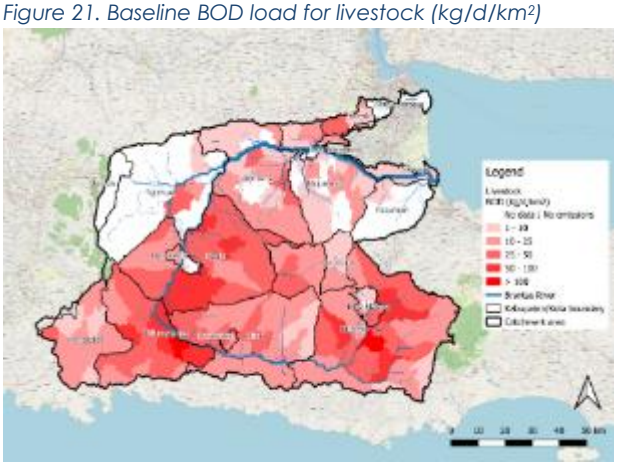


Figure 21. Baseline BOD load for livestock (kg/d/km²)



STRENGTHENING WATER QUALITY MODELING CAPACITY AND DECISION SUPPORT

Generally, **improved water quality models should be developed in the Brantas region in partnership with technical experts to help support planning, investment decisions, and consideration of alternative intervention strategies**. Such models could be constructed and managed, for example, through a university-government partnership involving local academic faculties or agency experts with established capacities for modeling and policy analysis. The outputs of modeling are helpful to guide deliberations regarding the selection of sites for infrastructure development, the sectoral focus of interventions, and broad versus targeted approaches to reduce particular kinds of pollutants.

CHAPTER IV. SEVEN KEY CHALLENGES AND PRIORITY ACTIONS

Seven key challenges have been identified as broad areas of development needed to achieve water quality standards and improved river health in the Brantas basin. First, *Brantas Harmoni* address the urgent issue of domestic wastewater contamination, encompassing both blackwater and graywater, which stands as the key contributor to water pollution in the river area. Scaled-up wastewater management and sanitation solutions are needed to minimize the adverse impact of household activities on water quality. Industrial wastewater mismanagement constitutes the second challenge, and proposed interventions include strengthened oversight and enforcement of discharge regulations and support for adoption of wastewater treatment technologies.

The third challenge revolves around curbing the volume of pesticides, fertilizers, and untreated livestock waste entering the river. *Brantas Harmoni* does not detail interventions for this challenge but does offer available data and modeling analysis to support prioritization of target areas for promoting of more sustainable agricultural practices and animal waste management. Controlling erosion and reducing sedimentation in water resources marks the fourth challenge addressed herein. By implementing erosion control measures, reducing illegal riparian development and sand mining, and promoting sustainable land management, *Brantas Harmoni* recommends actions to mitigate the adverse effects of sedimentation. Fifth, there is an urgent need to reduce the volume of solid waste in water resources, with a particular emphasis on the pervasive challenges of plastics and organic waste. A critical aspect of this initiative involves adopting sustainable waste management practices and promoting responsible consumption habits among communities.

Promoting equitable, efficient, and sustainable management, based on best Integrated Water Resources Management (IWRM) practices, constitutes the sixth challenge. *Brantas Harmoni* calls for the adoption of holistic water resource management strategies and coordinated public administration to ensure the long-term health of the Brantas River. The seventh and final challenge focuses on strengthening community participation and river stewardship. Recognizing the integral role that local communities play in the sustainable management of the river, Brantas Harmoni encourages active involvement, education, and empowerment of the communities residing along the Brantas River.

Brantas Harmoni also recognizes that **preventing and controlling water pollution are far more effective and efficient approaches to managing river health than treating polluted water and rehabilitating damaged ecosystems**. Costs associated with technologies for large-scale water resource treatment (particularly for agriculture), rehabilitation of damaged soils and ecosystems, advanced and intensive treatment for drinking water supply, and public health costs are typically significantly higher than costs of mitigating pollution. Moreover, limited availability of technology and resources makes it difficult to sufficiently treat raw water to support safe drinking water supply.

In line with the principles of realism and prioritization, Brantas Harmoni acknowledges that significant resource limitations – financial, human, spatial, infrastructural, and informational – constrain the set of feasible short- and medium-term actions to improve water quality. Prioritization of interventions according to clear criteria will help agencies focus on the most critical issues and select interventions that have the greatest impact with respect to various measures of performance. By concentrating resources on high-priority interventions or interventions with high likelihoods of successful implementation, governments can optimize their use and maximize the positive outcomes for society.

Prioritization becomes even more crucial in resource-constrained environments like the Brantas River basin, where careful allocation of available budget is essential to ensure that resources are not spread too thinly across

numerous initiatives, risking inefficiency and ineffectiveness. Prioritizing interventions based on urgency, feasibility, and potential impact on pollution loads is a pragmatic strategy that enables governments to navigate resource limitations while striving to meet the diverse needs and demands of their populations.

Brantas Harmoni does not fully prioritize interventions; rather, the report offers data and situation analysis to help inform consideration of various options to reduce pollution levels. In this case, support for prioritization is based on offering information to help (a) identify the most important source contributors to water pollution; (b) identify locations of high concern; and (b) consider relative feasibility of potential interventions. This is supported by three types of data:

- Statistical data on pollution sources that characterize pollution loads (e.g., geographically, by source, etc.) or pollution control and management practices that affect load contributions,
- Water quality modeling to estimate likely effects of sectoral interventions on BOD loads (see previous section), and
- Qualitative survey and interview data with key informants to identify critical institutional, managerial, and community challenges.

Statistical and qualitative data is presented in the following sections for each challenge.

IV.1. CHALLENGE 1. REDUCING CONTAMINATION FROM DOMESTIC WASTEWATER

Untreated domestic wastewater poses arguably the most severe threat to the Brantas Rivers. Untreated domestic black- and graywater account for a significant proportion of the riverine pollution load, both in terms of BOD (and other general indicators of pollution) and fecal contamination, as reflected in high measured total coliform and E. coli. Fecal contamination has harmful health effects, including diarrheal illness and other waterborne diseases, and also requires additional and costly processing to treat raw water for water supply. Moreover, E.coli from untreated wastewater contaminates groundwater and is regularly detected in the shallow well water used by around 64% of the population in East Java for household water supply.[33]

Blackwater from toilets is not the only problem, however. **Graywater, particularly from directly discharged kitchen wastewater, is heavily laden with organic materials** and is, thus, reported to be a significant contributor to BOD loads around settlements.[34] Moreover, the **domestic wastewater profiles from restaurant and hospital discharges are particularly high** (estimated 1670 and 125.4 mg/L BOD, respectively, as compared to 11.96 mg/L from households) (Table 27).

Table 27. Estimated Water Quality of Non-point Source Pollution

	Non-Point Source	BOD (mg/L)	COD (mg/L)	TSS (mg/L)
1	Domestic waste	11.96	35.53	304.87
2	Public health center	46.15	99.59	41.6
3	Hospital	125.3	283.62	154
4	Restaurant	1670	2680	1600
5	Education	11.96	35.53	304.87
6	Shop	11.96	35.53	304.87
7	Market	11.96	35.53	304.87
8	Worship place	11.96	35.53	304.87

[33] Source: Susenas March 2022

[34] Interview, E. Soedjono, October 2023

Source: PJT I Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018); Dinas Lingkungan Hidup Jawa Timur (2016), Study of Calculation of Pollution Load in Surabaya River; Data from sample of disposal points of domestic, health center, hospital, and restaurant wastewater. Data for educational activities, shops, markets, and places of worship assumed to be the same as domestic waste.

Approximately 92.6% of urban wastewater in Indonesia is discharged untreated to waterways (Abedalrazq et al., 2021). Despite East Java's progress in recent years with respect to increasing access to safe sanitation (some 81% of households in the province have access to improved sanitation)[35], **there are no centralized domestic wastewater conveyance (sewerage) and treatment systems (SPALD-T) in the region**.

An overwhelming majority of households in the Brantas River basin depend on septic tanks for blackwater collection (Table 28). While coverage is high, **there are significant issues related to leakage from septic tanks due to poor quality construction and insufficient maintenance**. Nationally, only an estimated 8% are sufficiently constructed and maintained to minimized leakage to the environment (Abedalrazq et al., 2021). Such estimates are unavailable for the Brantas, but this is a known challenge for the basin.

Table 28. Location of final disposal of feces

		Tempat Pembuangan Akhir Tinja (*Final Disposal of Feces*)				
	Kabupaten / Kota	Tangki Septik (Septic Tank)	IPAL (WWTP)	Kolam/Sawah/ Sungai/Laut (Water/Paddy)	Lubang Tanah (Land)	Pantai/Lapangan/ Kebun/Lainnya (Coast / Field / Garden / Other)
1	Batu	91.6%	5.0%	2.9%	0.6%	0.0%
2	Malang	75.4%	0.5%	1.9%	21.9%	0.3%
3	Kota Malang	79.0%	10.3%	6.4%	4.0%	0.3%
4	Blitar	76.0%	0.3%	8.1%	15.6%	0.1%
5	Kota Blitar	90.5%	6.6%	2.4%	0.5%	0.0%
6	Tulungagung	84.5%	0.1%	1.5%	13.8%	0.1%
7	Trenggalek	83.0%	0.5%	1.7%	13.3%	1.5%
8	Kediri	92.5%	0.0%	0.7%	6.5%	0.4%
9	Kota Kediri	97.4%	0.8%	1.2%	0.6%	0.0%
10	Nganjuk	94.2%	0.1%	1.2%	4.6%	0.0%
11	Jombang	96.8%	0.6%	0.4%	2.1%	0.0%
12	Mojokerto	95.3%	0.0%	1.8%	2.9%	0.0%
13	Kota Mojokerto	92.0%	6.1%	1.5%	0.0%	0.3%
14	Sidoarjo	96.7%	1.6%	1.4%	0.2%	0.2%
15	Gresik	95.7%	0.4%	0.6%	3.0%	0.3%
16	Kota Surabaya	99.1%	0.1%	0.4%	0.0%	0.4%
	Jawa Timur	83.6%	1.0%	1.9%	13.1%	0.3%

Sumber/Source : Susenas Maret 2022/ The March 2022, Susenas

Some kota (Malang, Blitar, and Mojokerto) have benefited from developing (yet still low) coverage of communal wastewater treatment plants (IPAL kommunal). PUPR has also developed community-based systems (SPALD-S) under the SANIMAS and other related programs, which are developed largely by the central government under the Kementarian PUPR's Balai Prasana Permukuman Wilayah (BPPW) Jawa Timur.[36] These decentralized facilities typically serve a minimum of 70 households with localized collection and on-site treatment and can typically

[35] Source: BPS Jatim, 2021 data; https://jatim.bps.go.id/statictable/2022/10/27/2371/persentase-rumah-tangga-yang-memiliki-akses-terhadap-sanitasi-layak-menurut-kabupaten-kota-di-provinsi-jawa-timur-2016-2021.html

[36] BPPW Jatim Cipta Karya is the provincial outpost of Kementerian PUPR responsible for developing sanitation infrastructure

process about 80m^3 of wastewater per day.[37] **Communal IPAL coverage serves less than an estimated 2% of the Brantas basin**, however, based on coverage data for these programs in the region (Table 29).[38] Construction costs are between 2-3 billion Rupiah per facility, and available funds for East Java limit developments to only a few each year. Moreover, **the most critical issues for community-scale treatment are space availability and low demand**. While these installations are much smaller that centralized plants, there is still limited space available in dense urban environments.[39] There has also been noted resistance from residents asked to cover costs with user fees.[40]

Table 29. Overview of sanitation infrastructure development by PUPR, by kota and kabupaten

	SANIMAS 2003-2021		Sandes 2019-2021		Sanitasi LPK 2019-2021		DAK SANITASI 2015-2021	
	Built Infrastructure (# locations)	Population served	Built Infrastructure (# locations)	Population served	Built Infrastructure (# locations)	Population served	Built Infrastructure (# locations)	Population served
Kota Batu	2	700	0	0	0	0	18	17310
Malang	15	5250	13	4550	2	200	49	30026
Kota Malang	2	700	10	3500	0	0	21	11100
Blitar								
	15	5250	0	0	0	0	55	26711
Kota Blitar	7	2450	0	0	0	0	26	5380
Tulungagung	9	3150	0	0	0	0	115	35696
Trenggalek	7	2450	10	3500	0	0	154	49168
Kediri	4	1400	10	3500	3	300	8	5840
Kota Kediri	12	4200	0	0	0	0	18	6575
Nganjuk	7	2450	10	3500	0	0	30	8370
Jombang	13	4550	0	0	2	200	3	1759
Mojokerto	9	3150	10	3500	0	0	15	10916
Kota Mojokerto	11	3850	0	0	0	0	32	6280
Sidoarjo	10	3500	10	3500	0	0	16	6385
Gresik								
Kota Surabaya	2	700	0	0	0	0	6	1635
Total	129	43750	83	25550	7	700	588	223151

Source: BPPW 2022

Most cities also do not have fecal sludge treatment plants (IPLT) to manage pumped septic sludge. Many developed IPLTs are inoperable due to insufficient maintenance (Abedalrazq et al., 2021). Further, many IPLTs are located far from sludge sources. Coupled with low oversight, many conveyance trucks fail to transport sludge to IPLTs and instead dump directly to water resources (Abedalrazq et al., 2021).

Insufficient planning for ongoing operations and maintenance following initial construction is a major issue challenging the extension of domestic wastewater treatment. Government programs to develop IPAL and IPLTs largely cover capital investment costs and do not plan sufficiently for ongoing operations and maintenance.[41] Similar O&M challenges face existing programs to develop communal onsite wastewater treatment facilities (IPAL

[37] Interview, BPPW, 1 February 2021

[38] PowerPoint presentation, BPPW Cipta Karya, TKPSDA Meeting, October 2022

[39] Interview, BPPW, 1 February 2021

[40] Interview, DLH Surabaya, 8 June 2022

[41] Interviews, DLH Jatim and BPPW, March and October 2022

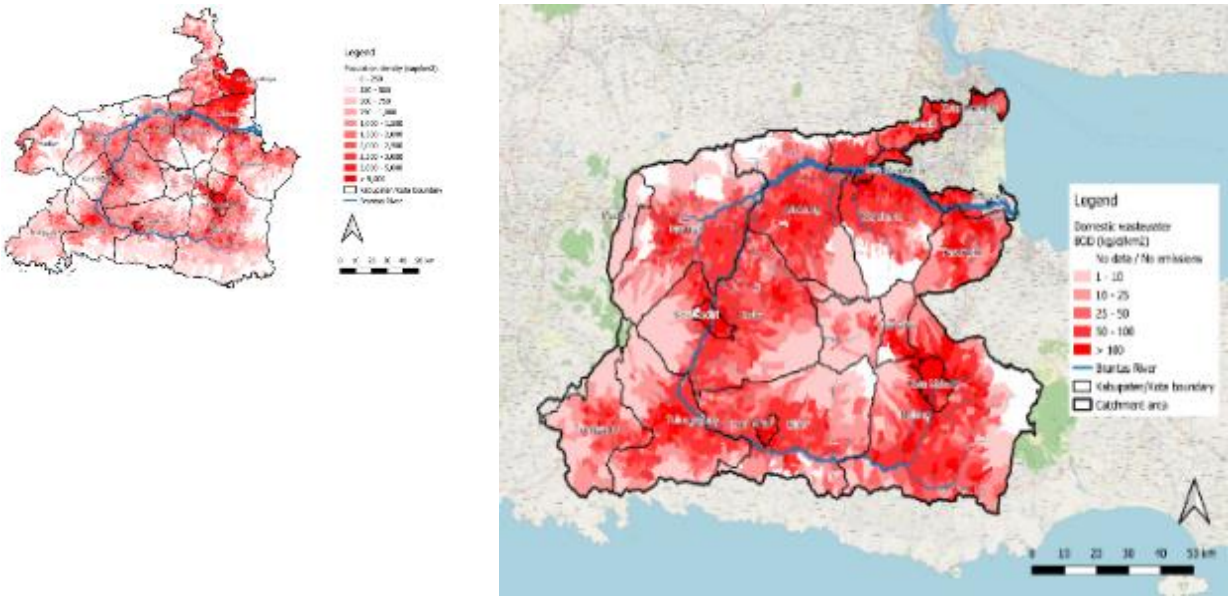
Kommunal) and decentralized community-based sanitation facilities (DEWATS) under the Community Based Sanitation Program (Program Sanitasi Berbasis Masyarakat, SANIMAS).

A number of challenges limit extension of sanitation services. Technical challenges include limited capacity and resources to perform O&M; inadequate quality of planning documents; developed infrastructure that cannot meet domestic effluent standards; and limited technological innovation to deal with issues such as denser urbanization and conveyance. An important step forward, however, is the 2023 policy development whereby **provincial and kota / kabupaten governments are to formulate Wastewater Management System Master Plans (Rencana Induk Sistem Pengelolaan Air Limbah, RISPAL)**.[42] These planning processes should be informed by the consideration of impacts not only on public health and environmental cleanliness, but also on the quality of water resources and localized water pollution conditions.

Institutional limitations include **low commitment from regional leaders**; lack of separation between developers / operators and infrastructure regulators in most kota / kabupaten; low human resource capacity for development or O&M; and limited operational guidance. There are also significant funding gaps and poor cost recovery due to low (or no) tariffs. Lastly, there is very low public interest and demand for sanitation services.[43]

These extreme resource challenges and low levels of public support for developing sanitation mean that careful prioritization for new developments is important to target areas where impacts can be most effective. Naturally, BOD loads from domestic wastewater are highest in urban areas. The Deltares water quality model for the Brantas (see Appendix D) shows that BOD emissions from domestic wastewater are concentrated in urban areas around the river (Figure 22). Moreover, urban residents tend to generate more BOD per capita (Table 30). The model also suggests that **significant reduction of urban wastewater emissions is one the most important measures to improve water quality in the Brantas**. As such, it is critical to scale up centralized and communal IPAL in urban areas and, where these installations are not possible, to improve the construction and maintenance of septic tanks and extend services for IPLT.

Figure 22. Population density in DAS Brantas and modeled domestic wastewater BOD emissions for modeling region (kd/day/km²)



[42] Interview, BPPW, 30 September 2022; RKPD Provinsi Jawa Timur Tahun 2023, https://Bappeda.jatimprov.go.id/Bappeda/wp-content/uploads/dokren/rkpd_jatim_2023.pdf

[43] PowerPoint presentation, BPPW, TKPSDA Meeting, October 2022

Source: Widyarani, et al., (BRIN) (2021); Deltares (2023)

Table 30. Estimated per capita BOD calculation based on production from gray and black water (kg/day per person)

Source	Urban water production (l/d/pp)	Rural water production (l/d/cpp)	BOD (mg/l)	Generation load (kg/day pp)	
				Urban	Rural
Graywater	119	50	263	0.03	0.007
Blackwater	40	18	528	0.02	0.002

Source: Widyarani, et al., (BRIN) (2021); Deltares (2023)

IV.1.1. REVIEW OF STRATEGIES AND ACTIONS IN STANDING PLANS

The following table outlines the recommended strategies related to domestic wastewater and water quality management in the Brantas for the key agencies identified in this report. It should be noted that all reports and strategies referred to the importance of wastewater management to reducing water pollution levels. Key implementers for wastewater management, however, are not amongst the agencies involved in developing Brantas Harmoni. Rather, Dinas Cipta Karya Jatim, BPPW Provinsi Jawa Timur, and local governments are responsible for developing wastewater management services and systems.

Table 31. Agency strategies and actions to reduce domestic wastewater

Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	230	BBWS Brantas	Inventory of Wastewater Regional Regulations and Monitoring of Implementation at the District/City Level / draft regulations for separation of drainage from wastewater; later to monitor	-	-	Separation of household wastewater collection network from rainwater drainage and establishment of a household wastewater collection network in urban areas linked to a centralized wastewater treatment plant (IPAL).	Governor, BPPW Prov. Jatim, Dinas CK Kab/Kota, DLH (Prov/Kab/Kota), PJT I
	230		Establish local regulations regarding prohibitions on draining household wastewater into sewers / rainwater drainage channels	-	-		Governor, BPPW Prov. Jatim, Dinas CK Kab. / Kota, DLH (Prov/Kab/Kota), PJT I
	231		Law enforcement against violations of regulations regarding the prohibition of draining household wastewater into sewers/rainwater drainage channels.	-	-		Governor, BPPW Prov. East Java, Dinas CK (Prov/Kab/Kota), DLH (Prov/Kab/Kota), PJT I
	232		Develop a draft/concept of a program for separating urban household wastewater collection from rainwater drainage networks and developing centralized WWTP systems	-	-		Dinas CK (Prov/Kab/Kota), BPPW Prov. East Java, Provincial/District/City PSDA Office; BAPPEDA (Prov/Kab/Kota)
	232		Develop urban household connection to centralized WWTP systems (include in Strategic Plans)	-	-		Dinas CK (Prov/Kab/Kota), BPPW Prov. East Java; Dinas PU SDA (Prov/Kab/Kota), Bappeda (Prov/Kab/Kota)
	233		Connection of wastewater collection systems to houses via community-based programs	-	-		Dinas CK (Prov/Kab/Kota). Jatim; Dinas PSDA (Prov/Kab/Kota); Bappeda (Prov/Kab/Kota)
	233		Construction of centralized WWTP via community-based programs	-	-		Dinas CK (Prov/Kab/Kota). Jatim; Dinas PSDA (Prov/Kab/Kota); Bappeda (Prov/Kab/Kota)
	233		Strengthen monitoring and supervision of separation of household wastewater from rainwater drainage network, construction of WWTP	-	-		Governor Jatim; BPPW Prov. East Java; Dinas PSDA (Prov/Kab/Kota); Cipta Karya; BBWS; BUMN; BPPW Jatim; Private Companies through CSR.
	181, 233		Enforce laws against rule violations related to domestic wastewater	-	-		Governor Jatim; Dinas PSDA (Prov/Kab/Kota); Cipta Karya; BBWS; BUMN; BPPW Jatim; Private Companies through CSR.
	234		Establish an integrated wastewater management agency to collect wastewater, manage centralized WWTP, and monitor and supervise implementation	-	-	-	-

	258		Improve environmental sanitation facilities and infrastructure around the river; include in Strategic Plan	-	-	Programs in Strategic Plan regard improvement of sanitation infrastructure in river area	DPRKPCK Prov., BPPW Prov.; Bappeda (Prov/Kab/Kota), DLH (Prov/Kab/Kota)
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	419	BBWS Brantas	Rehabilitation/revitalization/reconstruction of environmental sanitation facilities and infrastructure around water sources, namely rivers, reservoirs, reservoirs, springs and others	-	-	-	Pemerintah Daerah (Prov/Kab/Kota), BPPW Jatim
	420		Law enforcement against waste disposers (polluters) of rivers/water sources (reservoirs, reservoirs, springs and others) in all sectors (industry, households and public facilities) in a coordinated manner.	-	-	-	DLH (Prov/Kab/Kota), BBWS Brantas, PJT I
	421		Construct communal domestic IPAL	-	-	-	Pemerintah Daerah (Prov/Kab/Kota), BPPW Jatim
Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	166, 172	PJT I	Construct communal domestic WWTPs in congested residential areas around the river	-	-	-	-
	166, 172		Construct communal WWTPs from activities trade, education, health, hotel, and domestic industry	-	-	-	-
	166		Optimize existing industrial and domestic communal WWTPs (MCK)	-	-	-	-
Rencana Strategis Tahun 2020-2024 Kementerian Pekerjaan Umum dan Perumahan Rakyat (2020)	42	Kementerian PUPR	-	Number of households served by SPALD-T	1.3 million (national baseline)	3 million (national target, 2024)	-
	42		-	Number of households served by fecal sludge treatment plants (instalasi, pengolahan lumpur tinja, IPLT)	n/a (national)	6.5 million (national target, 2024)	-
	41			Percentage of households with access to safe and adequate sanitation	74.6 % (2018 national baseline)	90% (national target, 2024)	

				Rumah Tangga yang menempati hunian dengan akses sanitasi (air limbah domestik) layak dan aman (%)			
	83		Increasing community access to domestic wastewater infrastructure and facilities, both through the provision of local and centralized SPALD infrastructure and waste management, especially in priority districts/cities				

IV.1.2. ADDITIONAL RECOMMENDATIONS

Long-term progress on reducing domestic wastewater contamination will be marked by conformity of total coliform and E.coli levels with class limits. To significantly enhance access to safely managed sanitation and the collection and treatment of wastewater and fecal sludge, a phased and targeted approach is recommended. Given the financial constraints associated with improved domestic wastewater management and limited available funds and space, such an incremental approach should prioritize development through a process guided by analyses of the most critical hotspots (e.g., through additional water quality modeling) and by considerations of feasibility. Efforts must be scaled up particularly in urban riverside areas.

Prioritization and selection of sanitation projects for funding should involve coordinated efforts of DLH Jatim (and KLHK), Bappeda, Cipta Karya, BPPW, and kota / kabupaten government. This coordination may be facilitated by way of Bappeda's Tim Sanitasi and TKPSDA Brantas Pokja Kualitas Air. Such engagements should involve support from academia or government agencies to provide important data regarding emissions hotspots, local conditions, and, if possible, policy analysis based on water quality modeling.

Moreover, because public concern and political support are generally low, the **development of improved sanitation and wastewater treatment services is a political and social agenda-setting project**. Building public support for investment in sanitation will require public campaigns that respond to household interest as well as the active engagement of women in planning. To the first point, research suggests that **households are most concerned with the safety of well water** (Kadek, forthcoming 2024). As such, public campaigns that link groundwater contamination to poor wastewater treatment may be a more effective approach to building support than efforts related to building support for river water quality. Building demand for sanitation and wastewater treatment should be an area of further study and consultation with experts in gender, sociology, political communication, and other relevant fields. Government and civil society must pay attention to the household-level concerns of citizens (e.g. drinking water quality, stunting, health) in order to craft public messaging that can build demand and political support.

At the community level, community mapping, participatory infrastructure development, and other participatory methods are important to understanding local needs related to maintenance and use, which can differ greatly across communities. Moreover, as with solid waste, it is very important to **involve women in village-level planning and decisions related to domestic wastewater management because of the high levels of control they exercise over decisions related to wastewater**, including cleaning, as well as the overwhelming the burdens they bear due to poor water quality, such as care for the sick and coping costs associated with dirty water.

IV.1.3. SUMMARY OF RECOMMENDED ACTIONS

Long-term reduction of wastewater contamination will be reflected in compliance with water class standards for E.coli and total coliforms.

Table 32 includes a summary of recommended actions to reduce contamination from domestic wastewater.

Table 32. Summary of recommended actions to reduce contamination from domestic wastewater

Program	Prioritized Measures	Progress Indicators	Implementing Agencies
Urban wastewater management Separation of household wastewater from rainwater drainage	Explore finance models tied to already-valued public services (e.g., tariff bundling or implementation of a tariff % cut for sanitation, tied to water supply, electricity, etc.)	% Urban households with safely managed sanitation % Urban restaurants and hospitals with wastewater treatment systems	Dinas Cipta Karya, BPPW, Kementerian PUPR, Kota / Kab
	Focus communal domestic IPAL developments on riverside desa / kelurahan	% Urban households with safely managed sanitation	
	Facilitate decentralized IPAL demonstration projects with appropriate technology for e.coli and ammonia treatment (e.g., membrane technology)	% Urban households with safely managed sanitation	
	Develop centralized WWTP for Surabaya and Malang	% Urban households with safely managed sanitation	
Rural on-site wastewater management	Develop and disseminate plans for improved septic systems, with accompanying maintenance guidance	% Rural households with safely managed sanitation	Dinas Cipta Karya
Domestic wastewater management (infrastructure)	Establish WW resource center to support dissemination of technologies, promote WW innovations (including water re-use), and facilitated match-making with finance sources (e.g., CSR, financial tools)	Number of consultations / developments supported	Universities; Dinas Cipta Karya, BPPW
Pollution mitigation	Establish protected areas along waterways as barriers to prevent entry of pollutants to the river; consider natural infrastructure approaches (e.g., constructed wetlands) to increase filtration	Km of river area with sufficient border area from domestic settlements, restaurants, and micro-industry	PUPR, BBWS Brantas, PJT I
Community participation	Develop consultation program for community-level planning, focused on engaging women in sanitation services and musrenbang Scale-up public information campaign on water safety, linked to well water / groundwater safety		Bappeda; Kota / Kab; Dinas Cipta Karya, BPPW Universities and LSMs
Coordination and planning	Facilitate coordination between East Java Tim Sanitasi (Bappeda), KLHK, TKPSDA Brantas to support planning related to domestic wastewater management	Alignment of plans for sanitation and water quality management	Bappeda, KLHK

IV.2. CHALLENGE 2. REDUCING INDUSTRIAL WATER POLLUTION

As a rapidly industrializing region, East Java has experienced an increase in manufacturing and industrial activities, contributing to the release of various pollutants into water bodies. Industrial discharges often contain effluents containing heavy metals, chemicals, and other contaminants. Inadequate wastewater treatment facilities, poor waste disposal practices, resource limitations for oversight, and limited enforcement of industrial wastewater standard exacerbate the problem. Efforts to address industrial pollution involve implementation and enforcement of environmental regulations, including permitting and licensing; promoting the adoption of cleaner production technologies and wastewater treatment systems; and supporting industries with guidance to mitigate the impact of industrial activities on water quality.

Approximately 500 large and medium industries and over 10,000 small and micro-enterprises (Table 33) directly discharge their effluents to the Brantas River. **Estimates of pollution loads attributable to these industrial sources vary widely, however, and there is no reliable estimation of industrial pollution loads available**. This lack of an estimated load is due to two major data limitations. First, discharge data for medium and large industries is not publicly available. Second, there are no available estimates on the discharges of small and micro-industries (UMKM) operating in the basin. Public, academic, and governmental concern is high, however, with regards to their pollution contributions, particularly for the tofu and other small food industries and laundries.[44]

With respect to larger industries, **research in the Brantas suggests that the most polluting industries include pulp and paper; sugar; chemicals (including alcohol distilleries); agriculture and derivatives; textiles; oils and detergents manufacturing; food manufacturing; and metallurgy and metal manufacturing** (Harnanto & Hidayat, 2004).

Table 33. Estimated Number of Small and Micro-Industries by Regency / Municipality

	Leather Industry	Wood Industry	Metal Industry	Cane Work Industry	Ceramic Industry	Clothes/ Weaving Industry	Food and Beverage Industry	Other Industry
	2018	2018	2018	2018	2018	2018	2018	2018
Kota Batu	3	21	2	9	9	13	23	5
Malang	59	338	85	169	206	150	309	86
Kota Malang	39	56	55	25	31	57	57	57
Blitar	28	235	107	150	136	123	230	162
Kota Blitar	16	21	20	20	19	21	21	21
Tulungagung	27	219	80	134	152	165	175	76
Trenggalek	12	140	28	104	74	49	113	40
Kediri	27	260	67	104	147	106	270	66
Kota Kediri	6	31	18	16	15	22	37	14
Nganjuk	17	202	33	74	91	75	168	28
Jombang	73	234	81	68	117	109	171	64
Mojokerto	58	218	50	61	116	98	194	58
Kota Mojokerto	10	6	4	3	-	10	18	2
Sidoarjo	118	206	89	47	26	110	215	73
Gresik	64	211	51	73	45	178	211	61
Kota Surabaya	65	81	37	25	18	90	109	43

[44] Interviews, DLH Jatim (September 2022), DLH Surabaya (31 May 2021), DLH Sidoarjo (27 May 2021)

Source: Statistics of Village Potential of East Java Province, BPS 2018

Industrial development in the Brantas is likely to increase pollution unless accompanied by support for wastewater treatment. National and East Java development plans call for the development of select regions for Regional Activity Centers (PKW), Special Economic Zones (KEK), and Industrial Areas (KI); the Selingkar Wilis area for agricultural industry; and commodities and processing industries in the Singhasari Special Economic Zone in Kabupaten Malang.[45] Such developments should be made with a focus on encouraging new industries to internalize the costs of pollution through investments in sufficient wastewater management.

PP 22 of 2021 builds upon an extensive body of environmental law that lays out terms and requirements for pollution control, wastewater discharge standards, permitting and licensing, and monitoring and oversight. While this legislation reaffirms the "polluter pays" principle, industrial polluters in the Brantas, as in the rest of Indonesia, rarely pay for the costs of pollution. While some larger industries follow environmental regulations, especially those that participate in the Program for Pollution Control, Evaluation, and Rating (PROPER), most small companies have no wastewater treatment facilities. Moreover, enforcement of wastewater discharge standards is insufficient to bring the costs of compliance below the costs of non-compliance.

IV.2.1. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

The following table summarizes the recommended strategies related to domestic wastewater and water quality management in the Brantas.

[45] Republic of Indonesia Government Regulation no. 68 of 2019 concerning the Singhasari Special Economic Zone

Table 34. Agency strategies and actions to reduce industrial wastewater contamination

Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	189, 258	BBWS Brantas	Monitor water quality and enforce laws against industries that dispose waste below permitted standards	-	-	Improve water quality throughout WS Brantas	DLH (Prov / Kab / Kota), BBWS Brantas ; Prov / Kab / Kota Government, PU SDA (Prov / Kab / Kota)
	189, 258		Monitor processing and disposal of waste, especially in industrial and densely populated areas	-	-		
	260		Manufacture WWTP for factories in downstream Brantas WS (ST), middle- and downstream (MT), all industrial areas (LT); Require industries to construct IPAL (WWTP)	-	-	Construction of IPALs in the industrial and livestock sectors	DLH (Prov / Kab / Kota), Bappeda (Prov / Kab / Kota), BPPW Prov. East Java, Private industries
	262		Increase supervision of industrial activities that have the potential to cause waste pollution; Enforce law on illegal waste dumping	-	-	Enforce law on waste disposal in all sectors	DLH Prov / Kab / Kota, BBWS Brantas, Prov / Kab / Kota Government , PU SDA (Prov / Kab / Kota)
	260, 262		Enforce law on river waste disposal (pollution) in all sectors (industry, household and public facilities) in a coordinated manner; Enforce law on waste disposal	-	-		
	259		Implement Prokasih activities intensively throughout WS Brantas by involving Government, private sector, and BUMN through CSR	-	-	Implement PROKASIH is all WS Brantas.	DLH (Prov / Kab / Kota), BBWS Brantas, Bappeda (Prov / Kab / Kota), PU SDA (Prov / Kab / Kota), PJT I, Environmental NGOs
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	419	BBWS Brantas	Monitoring, evaluation and supervision of water quality and law enforcement against industries that dispose of waste that exceeds permitted quality standards	-	-	-	DLH (Prov/Kab/Kota), BBWS Brantas, PJT I
	420		Law enforcement against waste disposers (polluters) of rivers/water sources (reservoirs, reservoirs, springs and others) in all sectors (industry, households and public facilities) in a coordinated manner.	-	-	-	DLH (Prov/Kab/Kota), BBWS Brantas, PJT I
	421		Construction of IPAL for factories/industrial areas in WS Brantas	-	-	-	Pemerintah Daerah Provinsi Jawa Timur, Pemerintah Daerah Kab/Kota, BPPW Jatim

	421		Monitoring, evaluation and supervision and law enforcement against violations of water pollution/waste disposal in all sectors (industry, household, public facilities)				DLH (Prov/Kab/Kota), BBWS Brantas, PJT I
	421		Follow-up on legal aspects and implementation for Liquid Waste Disposal Fees (IPLC). Application of liquid waste disposal fees (IPLC) for industrial activities, hotels, restaurants and hospitals.				DLH (Prov/Kab/Kota), Pemerintah Daerah (Prov/Kab/Kota)
Rencana Strategis 2019-2024, Dinas Linkungan Hidup, Provinsi Jawa Timur (2019)	51	DLH Jatim	Improve environmental supervision of industry	-	-	-	DLH Jatim
	52		Increase the number of institutions that receive environmental training	Number of institutions and non-institutional who receive education and training on environmental protection and management	-	200 (2024 target)	
	48		Application of Environmental Impact Assessment and instruments for prevention of environmental pollution and/or destruction	Number of districts/cities that have KLHS documents (documents)	15	27 (2024 target)	
	58		Environmental protection and management	Application of environmental documents (Amdal, UKL/UPL, SPPL) in line with regulation	60	85 (2024 target)	
	59		Legal compliance and environmental capacity building program	Number of business actors/activities supervised (businesses/activities)	195	270 per year (2024 target)	
	59		Legal compliance and environmental capacity building program	Percentage of public complaints handled that are followed up (%)	90	100 (2024 target)	
	51		Legal compliance and environmental capacity building program	Number of awards in the environmental sector (Adiwiyata; Kalpataru)	110	125 per year (2024 target)	
	62		Supervision of the implementation of environmental permits and environmental management and monitoring efforts	Number of businesses/activities supervised directly and indirectly (businesses/activities)	-	200 per year (2024 target)	
	51		Provision of industrial waste processing facilities and infrastructure (DBHCHT) Implementation of environmental management systems for communities in industrial environments (DBHCHT)	Number of Industrial Waste Processing Facilities and Infrastructure built (Package)	-	-	

Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	166	PJT I	Optimize industrial and domestic communal WWTPs (MCK) that already exist	-	-	-	-
	166		Construct WWTPs for small and medium industries	-	-	-	-
	170		Legal compliance in meeting water quality standards for industrial waste	-	-	-	-
	170		Law enforcement against various parties who violate discharge regulations	-	-	-	-
KLHK Rencana Strategis 2020-2024 (2019)	105	KLHK	Improve supervision of businesses regarding environmental regulations	-	-	-	-
	133		Increase industry compliance with wastewater standards	-	1688 (national)	3750 (national)	-
	105		Increase supervision of WWTP effluent in business units and / or activities on polluting sources (Prevention of pollution and damage to natural resources)	-	-	-	-
Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	33	Bappenas	Determine 'assimilative capacity' for all water bodies and apply systematically for licensing and monitoring	-			-
	34		Expand real-time water quality monitoring (SPARING) to all potentially harmful industries	-	117 in development; 8 operational (national, 2020)		-

IV.2.2. ADDITIONAL RECOMMENDATIONS

IMPROVING DATA ON INDUSTRIAL POLLUTION SOURCES

Efforts to control industrial pollution should focus on strengthened regulatory enforcement and support for scaling up wastewater treatment and environmental management practices. Without improved data on pollution contributions by industry and location, however, deciding specific targets (industries or areas) is difficult. As such, improving the availability of information on industrial pollution is key.

Currently, there is no unified inventory or common data set on industry emissions, though a large amount of data on industries with environmental license is available in KLHK's Online Single Submission (OSS) system.[46] The OSS is a gateway application that allows companies to submit licensing applications to KLHK and subordinate agencies (e.g., DLH Jatim or DLH kota / kabupaten) and requires applicant companies to supply information on estimated wastewater discharges. The lack of an available inventory of industrial pollution source would thus be resolved with **increased transparency of submitted licensing data**. **Building an inventory of industrial pollution sources** may also be supported by communities and academia. Crowd-sourced mapping and academic or community-based research can help fill gaps and inform government agencies of the locations of potentially polluting industries.

Permen KLHK number 93 of 2018 Concerning Continuous Online Wastewater Quality Monitoring for Business and/or Activities stipulates that certain industrial sectors are to install continuous online wastewater monitoring systems, called Sistem Pemantauan Kualitas Air Limbah secara Terus Menerus dan Dalam Jaringan (SPARING), to monitor pH, COD, TSS, and other select parameters per industry. These industries include rayon, upstream petrochemical, oil refineries, mining, and large textile manufacturers (the pulp and fertilizer industries were originally included but later removed in a revision of law). Zoned industrial areas with point source effluents are also required to implement SPARING. The expansion of the SPARING program is an important opportunity to control industrial pollution, inform enforcement, and trigger rapid response in the event of a contamination incident, but very few companies are successfully outfitted with continuous monitoring devices and connected to the centralized reporting system. As such, **coverage of SPARING should be extended to designated high-concern industries** and online continuous monitoring systems must be regularly checked by the relevant environmental authority. Additionally, Permen LHK 23 of 2020 Concerning Environmental Laboratories requires that certain companies submit effluent data based on accredited laboratory analysis monthly.[47] Increasing the number of non-SPARING companies with effective analysis and monthly reporting of discharge should be an additional focus. For medium and small businesses, development of effective wastewater monitoring has been minimal. In the absence of strong oversight and enforcement, there are limited incentives for companies to invest in costly monitoring technologies.

INDUSTRY SUPPORT: PROPER, LICENSING, BEST PRACTICE

For pollution control associated with larger industries, the PROPER program marks and important available tool for scaling up compliance. PROPER utilizes a color-coded rating system to classify factories based on their environmental performance. This system not only encourages environmentally responsible practices but has also demonstrated success in reducing pollution emissions, particularly among companies that engage in global

[46] Interview, DLH Jatim, October 2023

[47] https://peraturan.bpk.go.id/Details/163452/permen-lhk-no-23-tahun-2020; https://peraturan.bpk.go.id/Details/164071/permen-lhk-no-93-tahun-2018

commerce and supply chains. The transparency and accountability provided by PROPER also contribute to informed public opinion (Abedalrazq et al., 2021).

Most manufacturers have yet to achieve a green or higher PROPER rating or comply with established environmental standards (KLHK Renstra 2019-2026). KLHK formulates targets for increasing the number of companies with green PROPER ratings, and both KLHK and DLH Jatim offer support by way of programs such as Pusaka, introduced in 2021, which helps prepare industries to meet PROPER standards. Fifty industries have been counseled in the Pusaka program between 2021-2023.[48] **Expansion of the PROPER program with support from Pusaka** can play a pivotal role in steering industries towards more sustainable practices and garnering public support for broader policy improvements, but this depends on additional support for industry and improved availability of public information regarding industry compliance with standards. For large companies, **additional standards systems, such as the Alliance for Water Stewardship (AWS), the UN Global Compact, the GRI and other similar programs should be promoted** – and potentially included in awards and CSR programs - to encourage companies to adopt improved environmental management.

At present, industries, particularly those with older licenses, do not receive active counseling or support to adopt wastewater treatment technologies in order to meet revised emissions standards. Wastewater discharge limits, based on per-segment carrying capacity, are used to make decisions about issuing new environmental permits. Companies that attained permits prior to 2014, however, are not currently required to meet new standards or to reduce effluent levels; older permits' granted effluent levels are acceptable until any significant changes to the business processes are made (e.g., if production capacity is increased). As such, there is no incentive for older companies to reduce emissions. Moreover, there is no program to assist older industries to meet revised standards.[49]

One potential area of additional support would be the **dissemination of Best Environmental Practices (BEPs) and BAPs (Best Available Practices)** for industrial wastewater management, which emphasize the adoption of environmental management practices and treatment technologies. BEPs encompass strategies that minimize the environmental impact of wastewater management, considering factors such as energy efficiency, reduced emissions, and the conservation of water resources. On the other hand, BAPs involve the implementation of the most advanced and effective technologies currently available for wastewater treatment and disposal. BEPs and BAPs are already published by a number of organizations worldwide, with detailed support for different types of industries.

INCREASED DEVELOPMENT AND ADOPTION OF WASTEWATER TREATMENT TECHNOLOGY

With respect to wastewater treatment for medium and small enterprises, coverage is extremely low (including for domestic wastewater from factories). Even for larger companies, operational cost-cutting has led to reduced treatment practices and sporadic operation of established facilities. For smaller manufacturers with limited resources and space, low-cost decentralized systems are potentially interesting options. A number of Indonesian universities, local and multinational water technology companies, and development institutions have developed low-cost decentralized systems that should be piloted for scaling up, with a particular focus on the institutional and financial support systems that would be required for sustainable use. One such system, for example, is the Tauw containerized wastewater treatment system currently undergoing piloting in tofu industries in Jombang; another is a Universitas Gadjah Mada micro-scale drum treatment system for restaurants. **Increased dissemination and**

[48] Interview, DLH Jatim, October 2023

[49] Interview, DLH Jatim, October 2023

resources to socialize small-scale decentralized technologies, coupled with incentives such as **award programs or financial incentives (e.g., tax breaks, subsidies) for adopters** could potentially support technology adoption amongst small businesses.

Recognizing that many small- and medium-sized companies cannot afford to adopt wastewater treatment technologies, **cooperative and shared wastewater treatment facilities in industry clusters** could be facilitated by DLH kota / kabupaten and Bappeda with the support of Dinas Perindustrian dan Perdagangan, who is actively pursuing a policy to cluster small industries together in areas zoned for commercial production.[50] The Rencana Induk Pembangunan Industri Nasional (RIPIN), RPJMD Jawa Timur, Rencana Pembangunan Industri Provinsi (RPIP), and RPIK (where available for select kota / kabupaten) can inform selection of industry targets and locations for potential cooperative installations based on planned developments. The RPIP for East Java proposes focused developments for meat and milk processing, coffee and cocoa processing industry, seafood processing, wood processing, basic chemical industry, basic metal industry, non-metallic minerals industry, capital goods and auxiliary material components, food and beverage, textile and footwear, and paper. The RPIP also stipulates support for supervision of industry installation and operation of wastewater treatment systems (IPAL) for East Java industries.[51]

Another opportunity to promote cooperative wastewater treatment is Indonesia's policy of mandatory **corporate social responsibility (CSR) in the area of environmental protection**, set out in Indonesia's Company Law Undang-Undang Number 40 of 2007. This law also encourages voluntary corporate activity in the areas of social and community development and provision of basic services. Through a coordinated effort of DLH Jatim, DLH kota / kabupaten, and Disperindag, a **match-making service could link larger companies with excess wastewater treatment capacity to smaller companies lacking wastewater management capabilities**.[52]

SUPERVISION AND ENFORCEMENT

Supervision and enforcement of discharge standards is extremely insufficient due to financial and human resource limitations; political and social constraints; and lingering confusion over supervisory responsibilities across levels of government and use of available enforcement tools. UU 17 of 2019 concerning Water Resources clearly stipulates administrative and criminal provisions for violators of water law.[53] As laid out in Article 68, actors that deliberately damage water resources or cause water pollution may be subject to imprisonment for three years to nine years and a fine of IDR 5-15 billion, whereas actors that cause harm to water resources due to negligence may be imprisoned for six to eighteen months and issued fines of IDR 1-3 billion (Article 71). Actors who use water resources for business needs without acceptable licensing (including for wastewater disposal) may imprisoned for three months to six years and issued fines of IDR 300 million – 1 billion. Punishments are steeper for actors who cause damage in nature reserve and conservation areas (Articles 69 and 72). In relation to the above, corporations who

[50] Interview with Dinas Perindustrian, 14 March 2023

[51] RPIP Jawa Timur is included in Peraturan Gubernur (PERGUB) Provinsi Jawa Timur Nomor 58 Tahun 2019 tentang Peraturan Pelaksanaan Peraturan Daerah Provinsi Jawa Timur Nomor 3 Tahun 2019 tentang Rencana Pembangunan Industri Provinsi Jawa Timur Tahun 2019-2039, https://peraturan.bpk.go.id/Download/157419/Pergub_No._58_Tahun_2019_tentang_juklak_Perda_No._3_Tahun_2019_tentang_RPIP.pdf

[52] Interviews, DLH Jatim, June 2022

[53] https://peraturan.bpk.go.id/Download/113525/UU%20Nomor%2017%20Tahun%202019.pdf

commit such offenses are issued fines twice those of individuals, and managers who order the criminal offenses or business owners may be imprisoned on individual terms (Article 74).

Chapter XI of PP 22 of 2021 lays out terms for the use of administrative sanctions in case of violations related to environmental approvals, which may be administered by the KLHK, the governor (via DLH Jatim) or the kota and kabupaten governments, depending on the source of the permit. These are triggered by results of supervision reports or monitoring reports. Administrative sanctions include written warnings and government coercion (e.g., forced cessation of operations, facility closures, or other disruptions to business). Ministers, governors, and regents and mayors are also allowed to hire third parties to restore environmental functions due environmental pollution, at the expense of the violating individual or industry.

While these and earlier administrative and criminal sanctions have been available for use by government, they are rarely imposed. A number of warning letters have been issued over the past years, but no fines or criminal offense sanctions have been issued by DLH Jatim.[54] Low enforcement is due to insufficient oversight because of human resource constraints, cultural and political hesitation to incite discord between government and business, and lack of local government knowledge on the proper application of and authority over sanctions. With respect to human resources, **there are too few trained and certified environmental supervisors** (Pejabat Pengawas Lingkungan Hidup, PPLH) who are authorized to impose sanctions. Over the past three years, there have been zero to three on staff at DLH Jatim at any given time, tasked with oversight of the full province.[55] Similarly, in 2022, DLH Surabaya had only one PPLH on staff.[56] While environmental supervisors are afforded high levels of authority PP 19 of 2021, budget limitations generally constrain the number of personnel that can fill these positions. Moreover, supervisors face increased risks and social backlash; thus, the positions are of lower interest to staff in selection of new rotations in the environmental service (Abedalrazq et al., 2021).

Monitoring is also too infrequent to ensure a credible threat of detection to violators. While KLHK, DLH Jatim, and DLH kota / kabupaten spot check wastewater discharges intermittently and collect reported effluent data regularly (e.g., monthly to every six months), inspections are often predictable, and producers can time discharge and monitoring to avoid detection.[57] The Patroli Air program, a joint oversight activity of water and environmental organizations including DLH Jatim, BBWS Brantas, PJT I, also involves intermittent monitoring of industrial wastewater discharge points along waterways by boat. While the Patroli Air program is effective with respect to building public support for industrial oversight, the program operates only monthly, and information regarding locations and schedule is often leaked in advance, allowing industries to plan their discharges well before or after spot checks.[58]

Second, in the context of East Java, DLH Jatim and local governments grapple with the intricate challenge of balancing economic advancement and environmental preservation, against the backdrop of a deeply rooted cultural value emphasizing harmony. This cultural ethos, which stands in contrast to the conventional rigidity of environmental enforcement, adds complexity to the regulatory landscape. The imposition of administrative sanctions, while serving the objective of environmental control, exacts a toll on local communities by disrupting business operations and livelihoods. Furthermore, East Java's cultural values related to preserving harmony make

[54] Interviews, March 2022 and October 2023

[55] Interview, DLH Jatim PPKL, 30 May 2022

[56] Inverview, DLH Surabaya, 8 June 2022

[57] Interview, DLH Jatim, March 2022

[58] Interview, DLH Jatim, 17 November 2021

stringent enforcement measures difficult for agency staff.[59] In the face of detected violations, regulatory bodies often opt for negotiation as a means of resolution, aiming to minimize conflict and align with the prevailing cultural disposition of concordance.

Third, there is **lingering confusion over application of sanctions, particularly in the form of fines. While water law allows use of financial disincentives for polluting, there are no guidelines available to support this tool**.[60] **A credible enforcement regime requires that sanctions (e.g., fines and other penalties) are more costly than compliance**. This, in turn, requires that the costs of sanctions are sufficiently high and consistently and fairly enforced. In the absence of regular enforcement, businesses do not have clear financial incentives to follow discharge rules and treat the risk of penalties as a standard cost.

PRIVATE SECTOR PARTICIPATION AND ADDITIONAL TOOLS FOR INDUSTRIAL POLLUTION CONTROL

In terms of planning and targeting interventions, manufacturers and other private sector representatives should be involved in TKPSDA and other related coordination and consultation bodies related to water pollution control and water quality management. As key water users, they should be more actively engaged in consultations related to IWRM.

Moreover, private sector participation can help develop guidelines for newly emerging tools for pollution mitigation, including the newly developed water quality trading system and guarantee funds for restoration introduced in PP 19 of 2021. The success of these policy innovations will depend on close inputs from manufacturers to understand demand-side factors that might affect implementation.

IV.2.3. SUMMARY OF RECOMMENDED ACTIONS

The long-term goals of industrial pollution control will be attained when large industries and SMEs in the Brantas meet effluent discharge standards and when chemical parameter class limits are met. The following table summarizes medium-term recommended actions to strengthen industrial wastewater management.

[59] Interview, DLH Jatim, 20 May 2022

[60] Interview DLH Surabaya, 8 June 2022

Table 35 Summary of recommended actions to reduce contamination from industrial wastewater

Program	Prioritized Measures	Progress Indicators	Implementing Agencies
Development of and increased adoption of industrial WWTP (IPAL)	Develop shared IPALs in industrial clusters	% Large industries and SMEs with compliant IPAL	DLH Prov/Kab/Kota, KLHK
	Provide technical support for remediated / non-operational / substandard IPAL	% Large industries and SMEs with compliant IPAL	DLH Prov/Kab/Kota, PJT I, KLHK
	Develop simplified construction plans and resources for low-cost IPAL	Number of small-scale, on-site IPAL for MSMEs	DLH Prov/Kab/Kota, PJT I, KLHK
	Extend SIMBALING to support wastewater conveyance to industrial IPAL facilities	Volume of conveyed wastewater to IPAL	DLH Prov/Kab/Kota, KLHK
MSME wastewater management	Develop green certification / award program for MSMEs based on wastewater and waste management	Number of certified "green" MSMEs	DLH Prov/Kab/Kota, KLHK
Pollution control: Licensing and planning	Increase the number of companies with discharge permits registered in SIMPEL database	% of companies with discharge permits included in SIMPEL database	DLH Prov/Kab/Kota, KLHK
	Update inventory and mapping of polluting industries based on information in SIMPEL database	Availability of updated map and inventory of industries discharging to DAS Brantas waterways	DLH Prov/Kab/Kota, KLHK
	Update estimated pollution load contributions per industry and administrative region based on available data in KLHK / DLH Jatim SIMPEL database	Availability of updated pollution load contribution data per industry and administrative region	DLH Jatim, KLHK
	Increase application of EIA, preparation of KLHS, and use of other planning documents for pollution control	Number of kota / kabupaten with KLHS documents	KLHK, DLH Prov/Kab/Kota
	Determine carrying capacity for all river segments	Number of administrative segments with calculated TMDL	
	Build agency and local university capacity for calculation of carrying capacity (e.g., cooperative government-academia program on TMDL)		
	Improve online / direct guidance for submission of license documents, based on Pusaka	Number of industries that comply with environmental approval standards Evaluation of quality of existing licensing documents Number of industries whose environmental documents (Amdal, UKP/UPL, SPPL) are compliant	
Pollution control: Support for environmental regulatory compliance and innovation	Increase the number of industries that receive environmental training	Number of industries that comply with wastewater management standards	KLHK, DLH Jatim
	Publish best available practice (BAP) guidance for key polluting industries	Number of industries that comply with wastewater management standards	
	Increase the number of industries that receive PROPER coaching	Number of industries with PROPER rating green and gold	KLHK, DLH Jatim, PJT I

	Develop award program for CSR and river health	Number of CSR programs with waste or wastewater management compontents	DLH Jatim, KLHK
	Provide match-making for CSR and community river health programs, including provision of IPAL and waste management services	Number of awards in the environmental sector (Adiwiyata, Kalpataru)	DLH Jatim, PJT I
	Include pollution control as an obligation of CSR	Number of companies with CSR programs that incorporate pollution control or water-related environmental services	Governor
Pollution control: Response	Develop and publish standard operating procedure for accidental spillage response, in coordination with industries	Public availability of standard operating procedures in case of accidental spillage	KLHK, DLH Jatim, DLH Kota/Kabupaten
Industry monitoring and enforcement	Improve environmental supervision of industry through SOP (program guide) for regular and random inspection (who, when, how) Provide clear guidance on oversight responsibility (list of industries under the authority of DLH Jatim, kota/kabupaten, etc.) Create clear response protocol for reported violations (who, when, how)	% Industries regularly and randomly (spot-) monitored for compliance	DLH Prov/Kab/Kota, KLHK
	Increase follow-up of environmental complaints Train additional staff as environmental officers Create clear response protocol for reported violations (who, when, how)	Number of cases successfully handled	
	Improve use of available enforcement instruments, including administrative and financial sanctions	Number of administrative sanctions issued in response to reported complaints	
	Expand on-site (and real-time) effluent monitoring	% Industries with WQ monitoring systems Number of companies in SPARING	
Private sector participation	Engage private sector representatives in TKPSDA, Dewan Air, and other consultative bodies related to wastewater management	Inclusion of private sector representatives	TKPSDA, Dewan Air, DLH Jatim

IV.3. CHALLENGE 3. REDUCING POLLUTION FROM AGRICULTURE AND LIVESTOCK

Runoff from agriculture and aquaculture introduces nutrients like nitrogen and phosphorus into water bodies, promoting algal blooms and disturbing the natural balance. Agricultural pesticides, herbicides, and fertilizers further compound the issue, while livestock runoff introduces pathogens, sediments, and nutrients to waterways. Pollution from aquaculture, agriculture, and livestock can be detected in higher measures of parameters such as BOD, Total Nitrates, Total Phosphates, ammonia, and coliforms.

Because the agencies formulating Brantas Harmoni do not have direct control over any of these pollution sources, this document includes only general guidance based on modeled impacts of terrestrial sources of agricultural and livestock runoff and proposes several indicators by which reduction of agriculture, livestock, and fisheries emissions might be measured. Moreover, while aquaculture is a known concern for water quality and has been recognized as a stressor in other Indonesian river basins, data regarding impacts on the Brantas are limited. As such, *Brantas Harmoni* does not attend to fisheries waste management. Rather, the impact of fisheries waste is suggested to be a topic for further analysis in collaboration with Dinas Perikanan.

In contrast with some analyses, the Deltares water quality model suggests that total BOD loads from agriculture (farms and plantations) are similar to loads from domestic wastewater in the Brantas River basin, with both accounting for an estimated total BOD load per day of 800-870,000 kg (Table 36). BOD loads from agriculture are also much higher than those from livestock runoff (Figure 23).[61] Total nitrate (TN) loads are significantly lower for agriculture, however, than TN loads from domestic wastewater or livestock runoff (Figure 24). Agricultural waste runoffs are highest during the rainy season and are noted to cause eutrophication in reservoirs, especially the Sutami (Pola 2020). As would be expected, agricultural emissions are small or absent in cities but important and high sources of BOD pollution in more rural areas. Water quality modeling suggests that agricultural BOD loads are highest from Nganjuk, Tulungagung, Jombang, Kediri, Blitar and Malang kabupaten, which all have large agricultural areas.

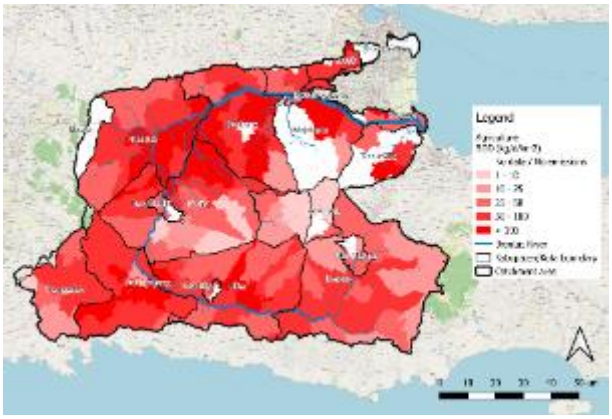
Table 36. Summary of BOD and TN loads per source (average kg/day)

	Total estimated load by source	
Source	BOD (kg/d)	TN (kg/d)
Domestic wastewater	802,855	372,747
Agriculture	870,675	75,355
Livestock	307,860	108,943
Total	1,981,390	557,045

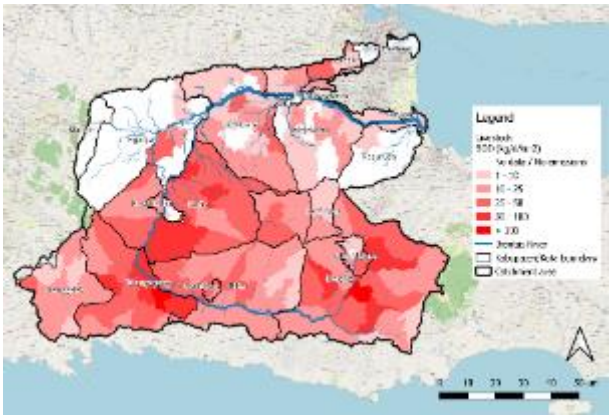
[61] Livestock runoff estimations are based on recorded populations of cows, goats, and pigs.

Figure 23. Estimated load concentrations of BOD (kg/day/Ha) from agricultural and livestock

BOD (kg/day/Ha) from Agriculture



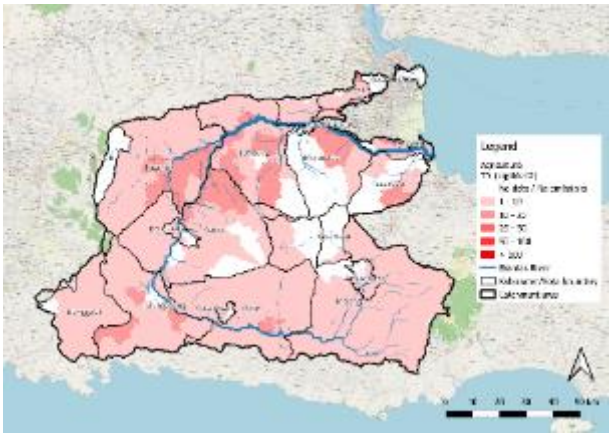
BOD (kg/day/Ha) from Livestock



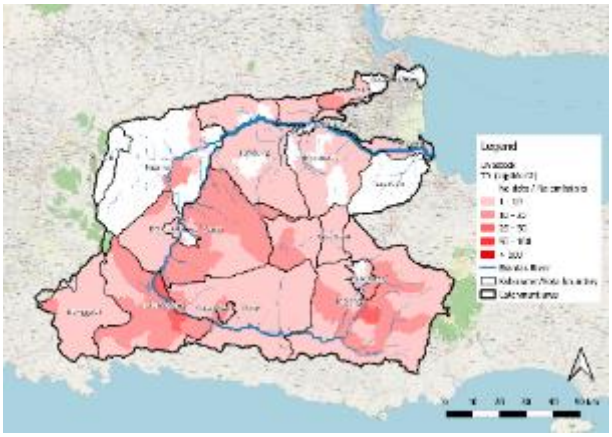
Source: Deltares, 2023

Figure 24. Estimated load concentrations of TN (kg/day/Ha) from agriculture and livestock

TN (kg/day/Ha) from Agriculture



TN (kg/day/Ha) from Livestock



Livestock runoff produces significantly lower levels of BOD than both domestic wastewater or agriculture, and TN levels higher than agriculture. While BOD is generally lower, livestock runoff can have deleterious local effects in areas with higher concentrations of livestock, such as in Tulungagung, Kediri, Blitar, Jombang and Malang.[62] A January 2023 TKPSDA Pokja Kualitas Air visit to Kediri focused on the issue of livestock runoff, where concentrations are particularly high on the Sungai Konto. This meeting brought together stakeholders with interests in livestock management and water quality to discuss local issues in relation to the full watershed. As a result of consultations, the recommendations of TKPSDA and local stakeholders included:

a. Further analysis of pollution loads from livestock,
b. Inventory and map of livestock production hotspots,
c. Programs integrated into village government to offer guidance and support for managing livestock wastes,
d. Strengthened dissemination of environmental management techniques for livestock management for cow farmers.

Long-term gains in associated with reducing the impacts of agricultural waste will be reflected in reduced total nitrate and phosphate loads. In the case of livestock waste, emission reductions should also lead to lower levels of total coli and ammonia. Dealing with agricultural runoff may be more challenging in the case of small-scale

[62] It is noted that Nganjuk data may be incomplete, so no conclusions can be drawn.

farming due to the transaction costs of engagement with large numbers of small-holder farmers and due to the political costs of targeting the same group. As such, policy makers should consider the most effective targets for agricultural interventions with considerations of efficiency, effectiveness, and political feasibility.

IV.3.1. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

In terms of the strategic plans considered as inputs to Brantas Harmoni, few actions are specified to reduce agricultural or livestock runoff to waterways. The 2020 Pola does include a general proposed action to require livestock facilities to construct IPAL, designating responsibility to DLH (province, kota / kabupaten), Bappeda (province, kota / kabupaten), BPPW, and the private sector, in combination. The Bappenas Vision 2045 document also references a need to manage upstream developments, including unlawful agricultural developments, but as a measure to reduce erosion.

While *Brantas Harmoni* input plans do not address runoff from agriculture, general measures can include:

- Planting cover crops and promoting agroforestry to reduce soil erosion and runoff,
- Development of buffer strips (e.g., with grasses or other vegetation) along waterways to filter pollutants,
- Promoting integrated pest management to minimize the use of chemical pesticides,
- Promoting conservation tillage to minimize erosion and improve water retention, and
- Provide support for nutrient management and proper application of fertilizers.

General measures to prevent and reduce water pollution from livestock requires implementation of best management practices, regulatory measures, and sustainable techniques. General measures include:

- Manure management, including regular removal and appropriate storage and land application,
- Adoption of composting practices and anaerobic digestion technologies to treat manure,
- Development of vegetative buffers to trap nutrients and pollutants before they enter waterways,
- Establish Livestock Exclusion Zones between water bodies and livestock operations,
- Employ subsidy programs to incentivize farmers to utilize less-polluting fertilizers (e.g., slow-release, controlled-release, and organic fertilizers), and
- Explore innovations such as waste-to-energy (e.g., biodigesters) and water recycling and reuse within livestock operations.

IV.3.2. POTENTIAL PROGRESS INDICATORS

Table 37 includes a brief list of progress indicators to track progress on measures to reduce pollution from agricultural and livestock in the Brantas.

Table 37. Potential progress indicators for reduction of agricultural, livestock, and fisheries waste

Program	Progress Indicators	Implementing Agencies
General	Availability of up-to-date inventory of agricultural, livestock, and fisheries pollution sources	Kota / Kabupaten DLH, Dinas Pertanian dan Ketahanan Pangan, Dinas Peternakan
Pesticide management	Reduced pesticide use	Dinas Pertanian dan Ketahanan Pangan, Dinas Peternakan
	Ha of agricultural buffer zone	
Livestock waste management	% Industrial livestock farms with waste treatment facilities	
	% Livestock whose waste is managed	
	Number of small-scale farms using on-site livestock waste management systems (e.g., biodigesters)	

IV.4. CHALLENGE 4. CONTROLLING EROSION AND RESTORING RIPARIAN AREAS

While the Brantas River basin is naturally sedimentary due to its geology and volcanic activity, levels of erosion and sedimentation have increased significantly due to anthropogenic activity, including intensive agricultural development, deforestation, and sand mining. As a result, the basin has suffered significant damage and functional decline due to river shallowing and silting of reservoirs, particularly the Sengguruh Reservoir, which is suffering significant decline in storage capacity. Sedimentation is also particularly problematic in the Brantas Hulu, Lekso, Konto Hulu, and Brangkal sub-basins, which have thus been designated as priority areas in a Watershed Conservation Master Plan developed in 2005 (BBWS Brantas, 2020b).

Erosion and sedimentation can have significant impacts on water quality, leading to various environmental and ecological issues, reducing the utility of reservoirs, and limiting river transportation due to shallowing. With respect to water quality, suspended sediments increase turbidity and absorb and retain heat. Sediments can also carry nutrients such as phosphorus and nitrogen and other various pollutants, including heavy metals and pesticides. When these sediments are transported into water bodies, they can release these pollutants, negatively impacting water quality and aquatic life. Excessive sedimentation also poses additional challenges for water treatment for water supply.

The elevated danger of erosion and sedimentation, especially in upstream and middle sections with steep slopes, contrasts with the relatively stable downstream conditions. Excessive sand mining, notably in the middle section of the Brantas from Tulungagung to Mojokerto, further contributes to riverbed degradation. River damage throughout various midstream regions, including Kediri, Nganjuk, Jombang, and Mojokerto, have resulted in cliff landslides and heavy sediment contributions (BBWS Brantas, 2020b). Upstream mineral mining, often unlicensed and uncontrolled, also exacerbates degradation, necessitating government regulations, sanctions, and better control measures.

To mitigate the impacts of erosion and sedimentation on water quality in the Brantas, effective land management practices and erosion control measures are essential. These efforts include **spatial planning and enforcement of land use rules; increased vegetative cover; erosion control in riparian areas, including strengthened enforcement of mining practices, particularly in midstream regions; and best management practices in agriculture and construction to reduce soil erosion**. Many of these initiatives can also offer land and watershed rehabilitation benefits. Brantas Harmoni focuses limitedly on these measures and suggests some limited guidance on the inclusion of spatial planning and zoning enforcement and green area development in water quality management, as well as more concrete proposals related to riparian control, conservation, and restoration, since these fall within the direct remit of BBWS Brantas.

IV.4.1. REFORESTATION AND LAND USE CONTROL

According to 2023 data from KLHK, coverage of non-cultivated green areas in the Brantas basin accounts for approximately 30% of land cover. Forests, however, account for somewhere between 8% (KLHK data from 2023, including jungle and mangrove) and 13% (2015 data in BBWS Brantas Pola, 2020). This forest coverage is important to note, because Indonesian law requires that each regional administration unit preserve at least 30% of forest cover. While coverage increased steadily over a period from 1970 to 1993, it subsequently declined to around 10% in 2004 (Adi et al., 2013). BBWS Brantas has noted the **benefit of reforestation efforts at the beginning of the rainy season to reduce erosion** (Pola, 2020). Integrating trees and shrubs into agricultural landscapes through agroforestry practices also provides multiple benefits to control erosion from agricultural areas.

IV.4.2. GREEN RIPARIAN AND EKORIPARIAN DEVELOPMENT

Reduction of erosion and sedimentation can be supported by "green infrastructure" solutions and planting of vegetation reduce erosion and support water infiltration. **Planting of low-growing vegetation, cover crops, and grasses, particularly in riparian buffers, can act as a protective layer, reducing surface runoff, and filtering sediments and pollutants. Other green infrastructure such as permeable surfaces, rain gardens, bio-retention basins, vegetated swales, and constructed wetlands can slow and filter stormwater to prevent sediment runoff to the river**.

The concept of Green Open Space, or Ruang Terbuka Hijau (RTH) is supported by legislation, set out in UU 26 of 2007 concerning Spatial Planning. This policy supports development of green areas to provide critical ecological, sociocultural, economic, and aesthetic functions. Promoting awareness and understanding of the importance of green infrastructure for erosion control and water infiltration encourages individuals and communities to adopt sustainable practices. Such efforts could be also incorporated into existing awards programs such as Desa Berserih (Berish dan Lestari). Communities can also be engaged to develop community green corridors. **The Community Green Corridor concept is development of planned networks of green spaces woven into urban or suburban landscapes to connect and enhance communities**. These corridors serve as multi-functional pathways, integrating elements such as parks, walking and biking trails, recreational areas, and stormwater management features. Designed to foster connectivity, biodiversity, and social interaction, green corridors offering opportunities for active transportation, community engagement, and appreciation of nature. Moreover, Community Green Corridor programs that allow organized LSMs and communities to utilize green areas for environmentally friendly cultivation can offer a business case for sustainable corridor development. This concept could be particularly interesting for riparian buffer zones, developed in collaboration with BBWS Brantas and local communities.

KLHK's Ekoriparian program is another opportunity to extend developments along the Brantas that combine water management and filtration features with public recreation. Such developments serve multiple purposes, as they expand absorption capacity, can be developed to include filtration features and even water treatment facilities, and also develop public value for clean water resources.

IV.4.3. CONTROL OF RIPARIAN AREAS, INCLUDING ILLEGAL DEVELOPMENT AND MINING ACTIVITIES

Increased supervision and control of riparian areas will also reduce impacts of illegal development and sand mining. Riparian areas under the control of BBWS Brantas are specified in Permen PUPR 28 of 2015.[63] These areas can be used on a limited basis. **Increased enforcement of illegal use, particularly associated with construction and mining, is important to controlling riparian erosion**.

Moreover, mineral mining and sand mining is commonplace upstream. While excavation is allowed with permits, many upstream sand mining operations are unlicensed and uncontrolled. High demand for sand, a key resource in construction and development, has led to extraction of sand without proper licensing. This also destabilizes riverbanks with steep grades, many of which are also serving as informal dumps. Thus, landslides deposit both sediments and solid wastes into waterways.[64] Efforts to address this issue involve implementing and enforcing stricter

[63] https://peraturan.bpk.go.id/Download/152556/PermenPUPR28-2015.pdf

[64] Findings of TKPSDA Pokja Kualitas Air, Tulungagung site visit and working group meeting, June 2023

regulations, promoting sustainable mining practices, and raising awareness about environmental consequences of illegal mining.

IV.4.4. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

While sedimentation is recognized as a critical issue for reservoir and river capacity, reducing erosion and sedimentation has not been addressed extensively in standing plans. The RTRW and RPJMD Jatim also contain a number of reforestation initiatives intended to increase the protective and restorative functions of land and improve soil retention. Table 38 summarizes the referenced actions to reduce erosion included in inputs to Brantas Harmoni. The RTRW and RPJMD Jatim also contain a number of reforestation initiatives intended to increase the protective and restorative functions of land and improve soil retention.

Table 38. Agency strategies and actions to reduce erosion and sedimentation

Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	219	BBWS Brantas	Supervision and law enforcement of law against violation of land use regulations not in accordance with RTH	-	-	-	Pemerintah Prov. Jatim, Bappeda (Prov/Kab/Kota), DLH (Prov/Kab/Kota), BPDASHL; Dinas Kehutanan (Prov/Kab/Kota), Kemen. ATR/BPN; Kantor ATR/BPN (Prov/Kab/Kota)
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	56, 167	BBWS Brantas	Recognizes impact of sand mining on erosion and sedimentation in the middle and lower Brantas	-	-	-	-
Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	166	PJT I	Development of river border (protection zone) as a barrier that prevent the entry of pollutants into rivers - including channel for non-point sources directed to WWTP	-	-	-	-
	167		Regular dredging of sediment at the riverbed	-	-	-	-
Peraturan Daerah Provinsi Jawa Timur Nomor 5 Tahun 2012 Tentang Rencana Tata Ruang Wilayah Provinsi (RTRW) 2011-2031	80	Province of East Java	Protection around lakes or reservoirs from activities that cause conversion of protected functions and cause damage to the quality of water sources	-	-	-	-
	80		Development of shrubs, tall standing plants, and ground cover to protect water pollution and erosion	-	-	-	-
Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	43	Bappenas	Manage upstream development (including unlawful agriculture developments) to reduce erosion that undermines rehabilitation programs	-	-	-	-

IV.4.5. SUMMARY OF RECOMMENDED ACTIONS

Table 39. Summary of recommended actions to control erosion and reduce sedimentation

Program	Prioritized Measures	Progress Indicators	Implementing Agencies
Control of riparian areas, including illegal development and mining activities	Regular (e.g. monthly) inspection / inventory of mining operations monthly and cross-check with permissions; enforce violations	Number of cases successfully handled	Kab/Kota government Bappeda, BBWS Brantas, Dinas Energi dan Sumber Daya Mineral (ESDM) Jatim
	Develop river border areas as protected barrier zones to prevent entrance of pollutants into the river	Ha of protected border areas	PUPR Kab/Kota government Bappeda, BBWS Brantas
Reforestation	Defer to Bappeda, KLHK, DLH Jatim	Ha of reforested area	Bappeda, DLH Jatim
Green Open Space / Ruang Terbuka Hijau (RTH) development and maintenance	Defer to Bappeda, Kab/Kota governments	% RTH in kota / kabupaten Number of RTH with retention ponds or other relevant pollution-absorbing features (by type) Km of riverside area dedicated as RTH	Bappeda, Kab/Kota government
Green riparian and Ekoriparian development	Develop additional Ekoriparian areas in DAS Brantas	Number of Ekoriparian projects initiated and maintained	BBWS Brantas, KLHK, DLH Jatim, Kab/Kota government
	Develop Community Green Corridor program to promote approved green economy uses of riparian areas	Km / Ha of riparian area dedicated to green development or river barrier protection area	Kab/Kota government, PJT I, LSMs

IV.5. CHALLENGE 5. REDUCING SOLID WASTE

Due to insufficient garbage management in the region and prevalence of direct dumping and disposal to uncontrolled dumpsites and landfills, high volumes of solid waste enter the Brantas River and its tributaries each year. Nationally over 70% of mismanaged waste is estimated to come from direct dumping (World Bank, 2021). While specific estimates are unavailable for the Brantas, directly dumping is widely observed, particularly from bridges, and **a large number of uncontrolled informal dumpsites and temporary processing facilities (TPS) line the main river and its tributaries**. These illegal dumpsites and uncontrolled and controlled (i.e., not sanitary) landfills are subject to high risk of runoff to water resources, particularly during the rainy season.

These practices and conditions contribute to three major problems: high BOD levels due to high concentrations of organic matter and food waste loads; high levels of plastic waste, including microplastics and larger plastics; and increased operational costs associated with maintaining water infrastructure. First, **an estimated 50% of the waste generated in the Brantas River basin is organic food waste** (see

Table 42). The degradation of this organic waste contributes to elevated BOD levels. Moreover, management of organic food waste – especially in rural areas – is more efficient via composting programs than through traditional municipal solid waste management and may additionally be developed into a circular economy solution via production of organic fertilizers (Rashid & Shahzad, 2021; World Bank, 2021).

Secondly, more than 80% of the plastic waste entering the marine environment from Indonesia is conveyed by rivers, of which the Brantas is one of the highest contributors, accounting for 3.65-7.68 kilo-tons of marine plastic waste (MPW) each year (World Bank, 2021). Marine plastics have been shown to impair the long-term functioning of aquatic systems and threaten water species and communities that depend on rivers as a raw source for drinking water supply. While microplastics and other measures of solid waste are not currently included in government water quality monitoring programs, numerous academic studies report high microplastic and macro-plastic levels in the Brantas, particularly in the lower reaches, where accumulated plastics advance the deterioration of critical mangrove systems (Buwono et al., 2021; van Bijsterveldt et al., 2021).

Third, solid waste has significant implications for the efficient management of water resources infrastructure, as **solid waste accumulation disrupts the effective functioning reservoirs and dams**. PJT I incurs high operational and maintenance costs associated with mechanical removal of waste and subsequent transport, necessary activities to maintain basic functionality of river infrastructure. The Bendungan Sengguruh near Malang alone captures an estimated 40,000m^3 of plastic waste from upstream each year. The costs of removal are compounded by the need to dry waste before further transport to terminal landfill facilities.[65]

In the Brantas River basin, approximately 57.1% of solid waste is generated by households, followed by approximately 12.3% from markets.[66] **Uncollected waste is the highest contributor to marine waste, followed by runoff from unsanitary landfills** that leak wastes to the environment. Importantly, there is a **significant difference in waste collection rates between rural areas (15 percent) and urban areas (64 percent)** (World Bank, 2021). Moreover, only four sanitary landfills serve the entire region; some areas have only open dumping (Kediri and parts

[65] https://jasatirta1.co.id/2021/09/17/pjt-i-optimalkan-penanganan-sampah-bendungan-sengguruh-secara-mekanis/

[66] Estimated based on data from SIPSN National Waste Management Information System, 2023 for kota / kabupaten in the Brantas River basin, excluding Kota Batu and Kota Surabaya (for which data is unavailable).

of Malang and Blitar), and most of the terminal disposal sites (TPA) of all kinds are at full or near-full capacity (Table 40).

With respect to plastics, the highest contributing kota and kabupaten in the Brantas to uncollected plastic wastes are Kediri, Mojokerto, Malang, and Kota Surabaya, who produce approximately 48% of the total. Nevertheless, high loads also run off from controlled landfills, many of which are located near waterways. 64% of plastic load subject to wash-off from unsanitary disposal sites comes from Sidoarjo and Kota Malang (World Bank, 2021). Rural areas, where collection rates are particularly low, are also major contributors to solid waste in water resources.

Table 40. Waste Management System in TPA by Regency/City (2017)

Kota / Kabupaten	Location	Management System
Kota Batu	Tlekung	Controlled landfill
Malang	Paras Poncokusumo	Controlled landfill
	Talangagung	Controlled landfill
	Randuagung	Open dumping
	Rejosari	Open dumping
Kota Malang	Supit Urang	Sanitary landfill
Blitar	Tegal Asri	Controlled landfill
	Pagerwojo	Open dumping
	Jingglong	Controlled landfill
	Sumberjo	Controlled landfill
	Kendalrejo	Open dumping
Kota Blitar	Ngegong	Sanitary landfill
Tulungagung	Segawe	Sanitary landfill
Trenggalek	Srabah	Controlled landfill
Kediri	Sekoto	Open dumping
Kota Kediri	Klotok	Controlled landfill
Nganjuk	Kedung Dowo	Controlled landfill
	Padantoyo	Controlled landfill
	Brendil Brebek	Controlled landfill
Jombang	Banjardowo	Sanitary landfill
Mojokerto	Belahan Tengah	Controlled landfill
Kota Mojokerto	Randegan	Controlled landfill
Sidoarjo	Griyo Mulyo	Controlled landfill
Gresik	Ngipik	Controlled landfill
Kota Surabaya	Benowo	Controlled landfill

Source: IKPLHD Provinsi Jawa Timur Tahun 2017

Table 41. Solid Waste Production Volume (tons) and by Source (% total), 2022

	Solid Waste Generation (tons, 2022)		Solid Waste Generation by Source (%, 2022)						
Regency/City	Daily	Annual	Household (tons)	Office (tons)	Market (tons)	Business (tons)	Public Facilities (tons)	Kawasan / Area (tons)	Other (tons)
Kota Batu	135.23	49,359.46	-	-	-	-	-	-	-
Malang	960.59	350,614.09	76.92%	3.14%	11.04%	2.32%	2.17%	3.30%	1.11%
Kota Malang	764.79	279,148.37	47.69%	0.31%	3.01%	14.44%	6.34%	24.01%	4.20%
Kota Blitar	75.98	27,732.70	90.66%	0.92%	2.76%	1.84%	1.45%	0.53%	1.84%
Tulungagung	553.83	202,148.86	58.14%	2.20%	10.92%	8.46%	3.25%	6.46%	10.56%
Trenggalek	305.48	111,498.74	42.23%	6.72%	15.26%	19.11%	6.71%	6.42%	3.55%
Kediri	657.76	240,082.40	-	-	-	-	-	-	-
Kota Kediri	178.59	65,183.70	44.89%	0.44%	21.82%	15.15%	5.11%	12.16%	0.44%
Nganjuk	444.13	162,107.74	40.85%	5.17%	21.40%	2.00%	5.25%	10.73%	14.60%
Jombang	530.37	193,583.44	72.26%	0.44%	21.20%	0.87%	3.05%	0.87%	1.31%
Mojokerto	461.16	168,322.61	57.14%	3.00%	19.28%	8.57%	3.43%	6.43%	2.14%
Kota Mojokerto	66.91	24,420.33	77.50%	4.50%	7.50%	3.90%	2.10%	4.50%	0.00%
Gresik	391.33	142,835.43	40.00%	17.00%	2.00%	20.00%	9.00%	7.00%	5.00%
Kota Surabaya	1,783.68	651,043.42	-	-	-	-	-	-	-
Jawa Timur	13,573.42	4,954,299.38	-	-	-	-	-	-	-

Source: SIPSN National Waste Management Information System, 2023

Table 42. Solid Waste Production, by Type (% total), 2022

	Food Waste (%)	Wood (%)	Paper/Board (%)	Plastic (%)	Metal (%)	Fabric (%)	Rubber- Leather (%)	Glass (%)	Others (%)
Kota Batu	4.00	2.00	6.00	4.00	1.00			1.00	
Malang	60.64	6.51	13.20	15.26	0.27	1.12	0.40	0.67	1.93
Kota Malang	54.39	13.60	4.47	13.66	0.98	0.52	0.21	1.78	10.39
Blitar	-	-	-	-	-	-	-	-	-
Kota Blitar	53.00	13.60	5.20	9.10	0.80	2.90	3.00	3.40	9.00
Tulungagung	46.00	15.60	7.50	12.50	5.00	4.80	2.00	2.00	4.60
Trenggalek	67.48	3.55	10.77	11.62	1.00	1.05	1.14	1.60	1.79
Kediri	46.40	22.47	4.28	11.31	0.20	2.02	0.63	4.75	7.94
Kota Kediri	56.40	8.20	12.80	12.00	4.50	2.40	1.40	0.90	1.40
Nganjuk	61.50	2.00	13.10	12.30	6.00	1.00	1.00	1.00	2.10
Jombang	48.85	7.27	7.93	12.50	1.24	2.71	1.33	1.24	16.93
Mojokerto	47.88	1.91	19.54	21.07	0.53	0.47	0.17	0.24	8.19
Kota Mojokerto	73.10	0.02	9.51	13.45	0.32	0.90	0.11	0.49	2.10
Sidoarjo	-	-	-	-	-	-	-	-	-
Gresik	55.29	10.29	4.47	11.58	0.47	4.84	2.02	1.37	9.67
Kota Surabaya	-	-	-	-	-	-	-	-	-

IV.5.1. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

The East Java RPJMD lays out targets and priority activities (assigned to DLH Jatim) focused on increasing the percentage of solid waste effectively managed in the region to 96.6% in 2024. The Brantas Pola refers only generally

to a need to improve law enforcement for violations on solid waste disposal. This is indicated as a joint responsibility of DLH units at the kota and kabupaten levels, as well as BBWS Brantas and PU SDA (provincial and kota / kabupaten), presumably in cases where violations involve riparian areas and direct dumping to waterways. The other plans under review include actions to remove garbage from infrastructure and riparian areas, increase waste handling capacity, develop award programs, and develop facilities and services for waste management.

In addition to these agency strategies, the Province of East Java strategy for solid waste management ("Jakstrada") is set out in Regulation of the Governor of East Java Number 106 of 2018 on Regional Waste Management.[67] This strategy document outlines provincial goals for improved waste management in detail, including the activities to reduce generated waste and increase the coverage and effectiveness of waste collection and management. Key activities include, for example, increasing the availability of recycling facilities, waste banks, and integrated waste management facilities; developing TPS and TPA facilities; and increasing community-based actions to improve waste collection and management.

More importantly, each kota and kabupaten are required to formulate plans for waste management, since most functions of waste management are devolved to the district and municipal government levels. These kota / kabupaten Jakstrada may be used to further formulate specific targets for solid waste management.

[67] https://peraturan.bpk.go.id/Home/Details/104827/pergub-prov-jawa-timur-no-106-tahun-2018

Table 43. Agency strategies and actions to reduce solid waste

Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	65, 168	BBWS Brantas	Recognizes large volumes of waste in waterways and acknowledges solid waste management as a non-structural measure of flood control	-	-	-	-
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	63	BBWS Brantas	Dredge and pick up rubbish regularly; prohibit the disposal of waste/garbage; impose sanctions on violators (operational policy for natural resources conservation)	-	-	-	-
	250		Controlling waste discharge into rivers by developing organic waste processing for communities around the river into compost, biogas and waste recycling (3R/Re)				
Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	167	PJT I	Clean garbage in the river regularly	-	-	-	-
Rencana Strategis Tahun 2020-2024 Kementerian Pekerjaan Umum dan Perumahan Rakyat (2020) Rencana Strategis Tahun 2020-2024 Kementerian Pekerjaan Umum dan Perumahan Rakyat (2020) Rencana Strategis 2020-2024 Direktorat Jenderal Sumber Daya Air Kementerian PUPR (2020)	62	PUPR	-	Percentage of households with access to well-managed waste in urban areas (%) Rumah Tangga yang menempati hunian dengan akses sampah yang terkelola dengan baik di perkotaan (%)	59.45% (2019 national)	80% (national target, 2024)	
	195	PUPR	-	Percentage of households with access to managed waste in urban areas Persentase rumah tangga dengan akses sampah yang terkelola di perkotaan	60.64% (2019 national)	80.07% (national target, 2022)	
KLHK Rencana Strategis 2020-2024 (2019)	132	KLHK	Increase waste handling capacity	Waste handling capacity	19.26 million tons (national)	95.6 million tons (national target)	-
	106, 195		Assess fulfillment of waste handling targets based on Jakstranas	Number of kota / kabupaten waste targets fulfilled (national target)	-	400 (national target)	-

	106		Extend ADIPURA program	Number of kota / kabupaten with an environmental quality index value in the good category (ADIPURA score > 71)	-	350 (national target)	-
	106		Strengthen waste processing for reuse of raw materials or use as energy source	-	-	-	-
	106		Develop integrated waste management systems (communal and regional) using the 3R (Reuse, Reduce and Recycle) method or other modern technologies	Number of kota / kabupaten integrated waste management programs	-	50 kota / kab. (national target)	-
2022 Status Lingkungan Hidup, KLHK (2022)	58	KLHK	Develop waste management performance index (IKPS) program to encourage city/district governments in waste management efforts	-	-	-	KLHK
Rencana Strategis 2019-2024, Dinas Linkungan Hidup, Provinsi Jawa Timur (2019)	66	DLH Jatim	Waste and B3 waste management	Percentage of Waste managed	95.5	96.6 (2024 target)	DLH Jatim
	61		Implementation and strengthening activities for waste management and processing	Percentage increase in TPST and TPS 3R facilities (%)	100	99 (2024 target)	DLH Jatim
	61		Activities to strengthen technical facilities, investment and infrastructure for waste and B3 waste processing	Number of Waste and B3 Waste Processing Facilities and Infrastructure	10	31 (2024 target)	DLH Jatim

IV.5.2. ADDITIONAL RECOMMENDATIONS

Brantas Harmoni does not aim to resolve all issues of solid waste management in the basin. The focus, rather, is to suggest additional support for waste management in certain administrative segments, based on current provision levels and load volumes. The following recommendations additionally focus on how agencies can support efforts to remove waste from waterways, promote community-based activities for waste reduction and management, and improve the availability of data and information to track progress on prevention of solid waste contamination in water resources.

PROVISION

First, with respect to provision of waste management service, additional support for waste management is needed in Kediri, Mojokerto, Malang, Sidoarjo, and Kota Surabaya due to high contributions of mismanaged waste to waterways in those segments. Rural areas should be an additional focus for developing community-based collection services and composting programs, as collection levels are significantly lower in rural areas.

With a focus on reducing the volumes of waste entering waterways, efforts should also be made to improve management of unsanitary dumpsites and TPSs near waterways, including side channels. The **success of these services depends critically, however, on the availability of terminal disposal sites (TPAs)** or other large-scale processing facilities (e.g., waste-to-energy facilities) that have available capacity and are sufficiently close to communities, in order to minimize transportation costs. These efforts will require combined support across levels of government to identify suitable land and financing. At all levels of administration from the RT/RW to the province, it is recognized that **identification of land for development of waste management sites (TPS, TPA, integrated waste management and recycling centers, etc.) is a critical bottleneck** (Interviews, 2022-2023). Provincial and national planners, including Bappenas and Bappeda, must make terminal disposal a priority in order to foster the success of community-based and local government collection efforts.

COMMUNITY PARTICIPATION IN WASTE REDUCTION AND MANAGEMENT

Waste reduction and management efforts depend largely on behavioral change and household valuation of garbage management services. Public information campaigns may be undertaken to address key issues such as organic wastes and plastics. Such campaign could promote, for example, reduced use of sachets and on options to manage high loads of household organic waste. For rural areas, in particular, composting may be promoted as a lower-cost option for managing organic waste than standard solid waste management (World Bank, 2021).

Community mapping and participatory policy analysis can support improved planning, implementation, and data collection, as local residents are most familiar with patterns of disposal and barriers to effective management of household waste. Established community mapping and participatory planning mechanisms can be socialized to local governments and environmental LSMs as helpful tools to general local solutions and identify specific locations for transfer sites. Moreover, communities can facilitate

mapping of critical and uncontrolled dumpsite to assist government planners with the selection of locations for development of transfer stations and landfills.

While the further development of Bank Sampah may be beneficial, it should be noted that **a large number of established Bank Sampah in East Java are non-operational and struggle to remain financially solvent** (project interviews, 2021-2023). Government support currently focuses only on capital expenditures and new developments, as opposed to financial plans that address ongoing operations and maintenance. Nevertheless, examples of financially healthy Bank Sampah programs exist in the region (e.g., Bank Santri in Jombang); these should be inventoried, and lessons and models that promote sustainable operations should be socialized.

These efforts depend on behavioral change in communities and the provision of resources to promote composting and community-based recycling. Such efforts could be coupled with existing sanitation and family health campaigns that target the household level (Abedalrazq et al., 2021). Particular attention should be paid to the role of gender in household waste management, as women bear the overwhelming burden of managing household waste and also express confidence in their capacities to offer workable community solutions to waste (project survey, 2023). **The active participation of women in local-level planning is important** to strengthen community actions to improve waste management and support effective decisions regarding investments in services.

INCENTIVES FOR LOCAL GOVERNMENT

Because local government are responsible for most functions of waste management, creating incentives for local development is important. A Bappeda-World Bank study recommended the **inclusion of solid waste management in award program criteria** (e.g., for the Adipura Award program) as well as inclusion of criteria related to waste collection and management in decisions related to allocation of provincial and national funding. Strengthened requirements could be applied, for example, in decisions related to allocations of Dana Insentif Daerah (DID) (Regional Incentive Funds) and Dana Alokasi Khusus (DAK) (Regional Allocation Funds) (World Bank, 2021).

RIVER AND RIPARIAN WASTE REMOVAL AND REMEDIATION

While waste management and reduction efforts aim to reduce direct dumping and run-off, water resource managers will inevitably face ongoing challenges related to removing solid waste from riparian areas and waterways. Several actions are recommended. First, BBWS Brantas, PJT I, DLH Jatim, and local governments can increase signage and other measures (e.g., bridge caging) to discourage direct dumping and socialize potential punishments for violations of law.

A number of additional infrastructural efforts may be considered, such as simplified urban drainage solid waste capture and removal systems (e.g., nets on urban drainage channels) to capture solid waste from side channels before it enters the main rivers and extended installation of river trash barriers at locations of high accumulation. Identifying these areas requires further analysis of accumulation points and consultation to resolve confusion over responsibilities for installing and maintaining infrastructure and for

managing collection.[68] A third recommendation is to **develop improved access paths for mechanized waste removal at critical river infrastructure points** (select weirs and dams). Mechanized removal depends on better transport access to riverside areas.

IV.5.3. SUMMARY OF RECOMMENDED ACTIONS

See Table 44 below for a summary of recommended priority actions to reduce solid waste in the Brantas.

[68] Interview, DLH Surabaya, 8 June 2022

Table 44.Summary of recommended actions for reducing solid waste

Program	Medium-term Priority Actions	Progress Indicators	Implementing Agencies
Solid waste management	Focused development of improved collection in riverside desa/kelurahan	% Solid waste collected in riverside desas	DLH (Prov/Kab/Kota), Bappeda, Desa, LSMs
	Focused development of improved collection in Kediri, Mojokerto, Kota Malang, Surabaya, and rural areas	% Solid waste collected in select areas	
	Identify and develop additional provincial TPA Develop additional TPS3R facilities, with focus on Sidoarjo and Malang	% Solid waste safely processed and transported to appropriate final disposal site	KLHK, DLH (Prov/Kab/Kota), Bappeda
	Increase oversight and enforcement of illegal dumping	% Reduction of illegal dumpsites per region	DLH Prov/Kab/Kota
	Provide knowledge resources and financial advisory for existing (non-operational) bank sampah Facilitate annual knowledge exchange and training for bank sampah via showcases and roadshows Develop online exchange platform for bank sampah operators	Number of operational Bank Sampah	DLH Prov/Kab/Kota
	Create incentives for local government provision via awards (e.g., Adipura, Prokasih, IKPS) and special funds	Demonstrated inclusion of SWM criteria in special fund transfer and award criteria	Governor, DLH (Prov/Kab/Kota),
Community engagement for waste reduction and management	Develop resources and materials for on-site composting, with a focus on rural communities and applications to circular economy / small business and agriculture Promote bulk shops (e.g. through subsidy programs or contribution of land and property) and community-led waste reduction programs (e.g., Zero Waste Cities)	% Reduction in solid waste production	DLH Jatim, LSMs
	Develop resources and materials for on-site composting, with a focus on rural communities and applications to circular economy / small business and agriculture Provide support for local circular economy initiatives through subsidy and tax programs, dissemination of guidance, and knowledge sharing events	Number of circular economy enterprises	Communities, LSMs, Governor
River and riparian waste removal and remediation	Pilot simplified urban drainage solid waste capture and removal systems (e.g., drain nets) to prevent transport of channel waste into larger waterways	Tons of garbage per year removed from urban drainage systems	DLH (Prov/Kab/Kota),, LSMs
	Develop improved access paths for mechanized waste removal at infrastructure accumulation points (weirs and dams) Develop additional river trash barrier installations at locations of high accumulation (location selection dependent on further analysis)	Tons of garbage per year removed from riverways, river infrastructure, and riparian areas	PJT I, DLH (Prov/Kab/Kota), LSMs
	Inventory critical waste dumpsites in riparian areas (location, waste type, volume) Facilitate community mapping to identify illegal waste dumps	Number of waste sites remediated (contaminated areas)	

IV.6. CHALLENGE 6. PROMOTING EQUITABLE, EFFICIENT, AND EFFECTIVE WATER QUALITY MANAGEMENT

Effective and coordinated management across sectors, levels of government, and society is pivotal to improving water quality within a large river basin, since many actors perform the activities and subfunctions of pollution mitigation and control, planning, service provision, rehabilitation, standard-setting, and enforcement. Successful management hinges on coordinated effort, clear delineation of roles, robust monitoring and information management systems, informed and participatory planning, capacity building to support core functions, and active community participation. Coordination among various stakeholders is essential to align strategies and actions, ensuring a cohesive response to the factors influencing water quality and preventing the potential for actions that conflict. The following section address management in seven sections:

a. Clear roles, responsibilities, and authority in water quality management,
b. Planning for water quality,
c. Coordination, and
d. Water quality monitoring and data management.
e. Monitoring and evaluating water quality management.

Each key feature of strengthened water quality management is described in turn, along with the opportunities and challenges in the context of Brantas River management.

IV.6.1. CLEAR ROLES, RESPONSIBILITIES, AND AUTHORITY

The clear delineation of roles, responsibilities, and authority fosters accountability and reduces inefficiencies from duplicated efforts or activity conflict. As described in Chapter III, water quality management in the Brantas River basin involves numerous agencies across levels of government who must collectively deliver IWRM and IWQM under complex institutional arrangements and regulatory settings. An extensive body of legislation lays out the tasks and functions (tupoksi) related to water quality management. While many tasks at the agency levels are quite clearly understood and specifically described, some confusion over particular responsibilities persists.

Most importantly, and at the broadest level, **it is unclear who is ultimately responsible as lead agency to coordinate water quality management in the Brantas River basin**, particularly because addressing water quality means addressing pollution sources. This is noted to be the case across Indonesia in National Strategic River DAS located entirely within one jurisdiction (province, kota, kabupaten) (Abedalrazq et al., 2021). While PP 22 of 2021 clarifies that water quality management and planning is based on the river basin area, it is **unclear whether KLHK or the province holds overarching responsibility for water quality management**. This lack of clarity has resulted in unclear responsibility for such activities as determining carrying capacity, river rehabilitation, and oversight of water pollution reduction from all sources.

There is also an observed **hesitance to assume leadership for water quality management**, since BBWS Brantas holds overarching authority over water resources management but little oversight of pollution control. By law, WRM under the general remit of BBWS includes conservation and control of damage from water (both related directly to water quality), but the agency's specific tuposkis related to water quality management are limited to water quality monitoring, control of riparian areas, and authority to enforce water-related violations. In practice, agencies in the Brantas are hesitant to assume authority functions of water quality management in deference to BBWS'

"ownership" of the Brantas River.[69] This is the case, even for water quality monitoring in the main river area.[70] This leaves a noted vacuum in leadership for water quality management that needs to be addressed.

The *Indonesia Vision 45: Toward Water Security* recognizes similar issues at the national level and proposes that one agency such as Bappenas take on a role of "creating an overarching blueprint for the water sector – considering other sectors – while the Ministries act as implementors of this blueprint based on their responsibilities." A similar model could be considered in the Brantas, whereby Bappeda and the Governor, who oversees many of the agencies involved in water quality management, facilitate coordination and ensure alignment of the Pola, RPPMA, RPJMD, RTRW, and agency work plans. This could alternatively be facilitated by KLHK (as formulator of the RPPMA) or under the umbrella of another planning coordination mechanism.

LEGAL SOURCES OF INSTITUTIONAL OVERLAP

There are also a number of noted overlaps (across levels or sectors) and several missing mandates for water quality management in the Brantas. An extensive doctrinal legal review of water and environmental law performed by TU Delft in 2021 and 2022 examined water quality management roles and responsibilities in terms of the tupoksis assigned to agencies within law and regulation. To evaluate legally designed overlap, 177 pieces of national, ministerial, provincial, and district / municipal regulation that affect river water quality management were reviewed to identify tasks, functions, and responsibilities for water quality management. The list of 177 laws was reduced to 24 that specifically assign responsibilities to the primary agencies involved in water quality management or specify the functions in water quality and water pollution management in the Brantas (see Table 58 in Appendix B). Responsibilities for water quality management are set out in two types of law:

- Organizational statues that stipulate the specific responsibilities and tasks (tugas pokok dan fungsi or "tupoksi") assigned to agencies, and
- Functional statutes that stipulate the rules for and processes of water quality management (e.g., laws on environmental management, pollution control, planning, permitting, water quality management) and ascribe responsibilities for component tasks to specific organizations.

The tupoksis extracted from these laws were limited to those related to water quality management and assigned to one of the following:

- National level: Kementerian Lingkungan Hidup dan Kehutanan (KLHK), Kementerian Pekerjaan Umum dan Perumahan Rakyat, Direktorat Jenderal Sumber Daya Air (PUPR Ditjen SDA), Directorate Kementerian Pekerjaan Umum dan Perumahan Rakyat, Jenderal Cipta Karya (PUPR Ditjen Cipta Karya), Dewan Sumber Daya Air Nasional
- Basin level: BBWS Brantas, TKPSDA Brantas, PJT I
- Provincial level: Gubernur Jawa Timur, Dinas Lingkungan Hidup Jawa Timur (DLH Jatim), Dinas Pekerjaan Umum Sumber Daya Air Provinsi Jawa Timur (Dinas PUSDA), Dinas Cipta Karya Jawa Timur (Dinas CK), and Dewan Sumber Daya Air Jawa Timur (Dewan SDA Jatim)
- Kota / Kabupaten level: Kota / Kabupaten governments, including regional DLH and PUSDA units

[69] Interviews, DLH Jatim, DLH Surabaya, DLH Gresik, DLH Mojokerto, 2022, 2023

[70] Interview, DLH Mojokerto, 30 May 2021

Details of the review are included in Appendix B. In summary, functions where **legislatively designed overlaps are most readily observed include the following**:

1. **Water quality monitoring and information systems management**: At least twenty agencies routinely monitor water quality in the Brantas River basin (BBWS Brantas, KLHK, DLH Jatim, PJT I, and sixteen DLH kota / kabupaten). Each manages their own data (see the section below on water quality monitoring) in a variety of formats.
2. **Water quality planning and program evaluation**: Many plans attend to various components of water quality management and program evaluation. This overlap is not necessarily a problem, as long as individual strategies and work plans are aligned with the RPPMA and based on a shared understanding of the problems facing the Brantas watershed.
3. **Enforcement of environmental law related to water pollution**: A number of agencies are empowered to enforce environmental law related to water pollution. In practice, there is very little enforcement. In addition to the issues laid out in the section above on industrial pollution control, low enforcement is exacerbated by accountability issues and due to the overlap in duties for enforcement, i.e., it is easier for an enforcing agency to defer responsibility for oversight and the imposition of sanctions.
4. **Community engagement and public information**: All agencies are tasked with community engagement and public information. As with planning, this is not a negative overlap, but some efficiencies and effectiveness in public communication and outreach programs could be gained with (a) information and program-sharing across communities and across agencies (related to community engagement), (b) coordinated programs focused on community mapping, data collection, etc. to gather more data across the watershed, and (c) joint commitments to strengthen public communication and participation.

ADMINISTRATIVE SOURCES OF INSTITUTIONAL OVERLAP OR LACK OF CLARITY OF RESPONSIBILITIES

In some cases, responsibilities are clearly defined in law but unclear in practice due to:

- Limited understanding at the local level regarding spheres of authority or jurisdictions, especially for enforcement,
- Dependence on higher levels of government for implementation support due to capacity and financial limitations at local levels of government, and
- Common practice of joint provision to deal with budget constraints within individual agencies.

These **administrative sources of overlap** or lack of clarity are noted especially for:

- **Industrial wastewater oversight and enforcement,**
- **Enforcement of riparian laws,**
- **Maintenance of conservation areas,**
- **Removal of solid waste from river resources, and**
- **Provision of domestic wastewater management infrastructure**.

While permitting and oversight authority over various types of businesses are clearly delineated in law (allocated to KLHK, DLH Jatim, or kota / kabupaten DLH based on facility investment size, risk characteristics, etc.) and understood by most agency staff, in practice, local units sometimes rely on higher levels for support. Also, responses to reported incidents often depend on which agency the reports were made to. The modes of channeling public

complaints to the relevant enforcement bodies are inconsistent, and some kota / kabupaten DLH agencies reported lingering confusion regarding enforcement responsibilities. There is a need for socializing **clear and simplified SOPs to make authorities and responsibilities for particular issues and industries clearer**.[71]

Confusion over responsibilities for infrastructure provision, particularly for domestic wastewater treatment, stem from the practice of combining limited agency funds from multiple agencies to enable construction. While these cooperative arrangements are helpful to overcome budgeting limitations, they can also confuse responsibilities for future provision.

Last, in planning for water quality management, the Pola and Rencana often indicate a number of implementing agencies for activities and program without sufficient detail regarding specific responsibilities. Strategic and work plans for water quality management should further specified when multiple agencies are indicated as responsible parties to allow for effective coordination and evaluation.

TASK CLARITY

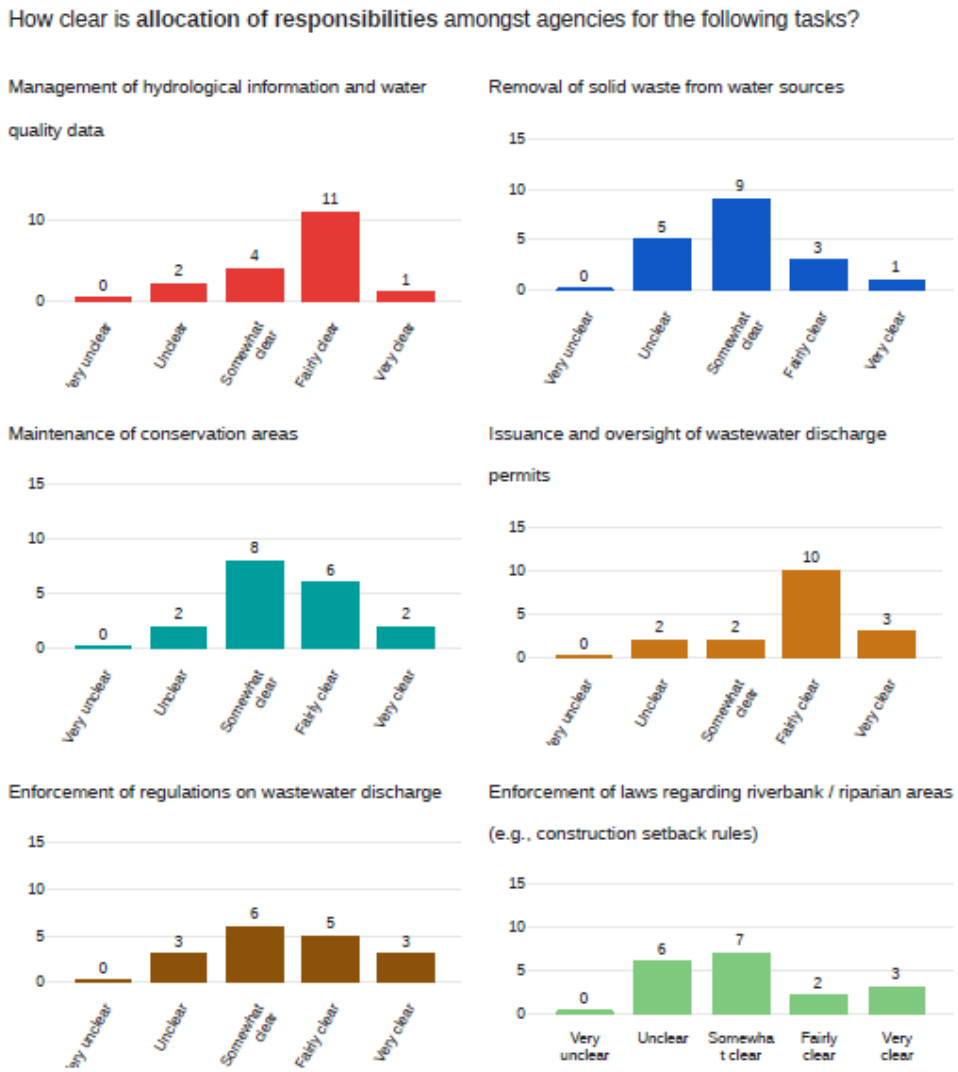
TU Delft facilitated a survey of water managers in the Brantas in May 2022 (n=25) and a follow-up survey to a smaller group of water managers (n=15) in October 2022. While the survey sample was limited to 40 respondents, the indicative data is included here for further discussion. The May survey indicated fair results regarding the clarity of law, with the exception of law regarding riparian development and construction. Results also suggested that allocation of responsibilities amongst agencies is fairly clear with respect to managing data and issuance and oversight of wastewater discharge permits, but less clear with respect to responsibilities for:

- Enforcement of wastewater discharge regulations,
- Enforcement of riparian laws,
- Maintenance of conservation areas, and
- Removal of solid waste from river resources.

Results also indicated that water quality-related conflicts often or sometimes arise due to overlapping jurisdictions (between agencies or levels of government or areas of designated responsibility).

[71] Interviews with BBWS Brantas, 31 May 2022, DLH Kota Gresik, May 2022

Figure 25. Results on perceived clarity of responsibilities in WQM



In line with the May survey, the October survey indicated generally good evaluations of task clarity for permitting and enforcement of wastewater regulations but lower evaluations for managing water quality data, removing garbage from the river, conservation, and enforcement of riparian developments.

IV.6.2. PLANNING, MONITORING, AND EVALUATION

A large number of plans guide components of water quality management or pollution source management. While some of these are well-aligned, there is a need to strengthen coordination of water resources, environmental, regional development, and spatial plans, as well as plans that guide pollution source management (e.g., for Cipta Karya, Dinas Pertanian, Disperindag, etc.). There is also a need to improve the specificity of current plans so that they are more readily actionable and promote accountability amongst the many agencies involved in water quality management.

The *Brantas Harmoni* exercise, which directly compared many of the plans related to water quality management, yielded several important findings:

- **Plans often utilize different data, different administrative divisions, or different definitions of the watershed itself, leading to different problem analyses**;

- The **Pola and Rencana are recommendatory and implementing agencies are neither involved in formulation nor required to perform the activities or tasks in the plan**;
- The Pola and Rencana are not directly integrated into the RPJMD or spatial plans (or vice versa);
- **Many agencies are designated to implement strategies without specifying their specific roles or contributions**;
- **Gender mainstreaming in planning is extremely limited** for all agencies with respect to plans for water quality management.

The RPPMA process is an important opportunity to address these planning coordination challenges and formulation issues. Involving key stakeholders in formulation will improve the likelihood that proposed interventions are actually implemented and will take account of important knowledge in different sectors, administrative units at the local levels of government, and from communities themselves. Moreover, sustained alignment of plans requires processes and mechanisms to share information during formulation, review, and evaluation.

Planning coordination across sectoral lines can be supported by regularized interagency coordination forums, such as the pilot working group on water quality (Pokja Kualitas Air) in TKPSDA WS Brantas or in a coordination forum led by KLHK or Bappeda (see more below). Key to aligning plans, however, is the appropriate nomination of representatives to these planning groups to ensure that staff with sufficient knowledge and authority are engaged in formulating commitments. These plans should also be aligned with plans at the kota / kabupaten levels, where many of the function of water quality management are performed.

SPATIAL PLANNING (INCLUDING DEVELOPMENT LICENSING AND ZONING)

An important area of strengthened planning coordination is between the regional spatial plan (RTRW), river basin plan (Rencana), and RPPMA. The East Java Provincial Regional Spatial Plan (RTRW) for 2011-2031[72] includes water resource planning for energy development (e.g., hydropower), irrigation network development (including dam infrastructure), raw water network development, and water damage control (largely flood control), but makes no special arrangements for water quality management or the identification of protected conservation regions associated with water resources.

Improved land use planning and enforcement of the spatial plan is important to reducing erosion, increasing potential to absorb and naturally filter pollutants, and reduce anthropogenic activities in areas with high pollution loads. The 2019 Water Law requires that ground- and surface water be considered in development of spatial plans, but it is not clear how this is to be done (Abedalrazq et al., 2021). Problem analysis in the RPPMA, Pola, and Rencana and water quality data should be used to take spatial planning decisions related to the allowed development of urban areas, industrial zones, and agricultural regions, as well as conservation areas. While spatial planning is performed, managed, and regulated by the province and kotas and kabupatens independently, a joint planning forum could help upstream regions to understand the downstream impacts of current and planned land use.

DEVELOPMENT PLANNING AND MUSRENBANG

An important part of development planning is the Musyawarah Perencanaan Pembangunan (Musrenbang) participatory planning system. Musrenbang involves a series of meetings and discussions at various administrative levels, including the village (Desa), sub-district (Kecamatan), district (Kabupaten/Kota), and province, wherein

[72] Regional Regulation Number 5 of 2012 concerning East Java Province Regional Spatial Planning for 2011 – 2031 (Peraturan Daerah Provinsi Jawa Timur Nomor 5 Tahun 2012 tentang Rencana Tata Ruang Wilayah Provinsi Jawa Timur Tahun 2011 – 2031)

local communities, government officials, and other stakeholders come together to discuss and prioritize development plans for their areas. Musrenbang emphasizes a bottom-up and participatory approach to development planning. The process starts at the village level, where communities identify their development needs and priorities. After village meetings (usually in January), proposals are submitted to higher levels of government, moving up the administrative hierarchy. Proposals from various levels are then consolidated into a comprehensive development plan, and budget allocations are made based on outcomes.

While the process starts at the local level, it is guided by these set out at higher levels of government, including National and Provincial government. The **inclusion of wastewater and waste management, green space development, riparian rehabilitation, and other general supports for water quality management as Musrenbang themes** may be an opportunity to promote local pollution projects for budgeting. Moreover, because village-level Musrenbang meetings have limited female attendance, demand for community services that tend to be more valued by women because of their domestic roles (e.g., sanitation, waste management, etc.) is underrepresented. **Fostering higher levels of participation from women at the local level** can also build support for adopting waste and wastewater treatment projects. Last, environmental and water management issues can be socialized in advance of local planning decisions to educate participants on the links between environmental health and local pollution sources and to gather important local-level knowledge regarding such issues.

SMART ACTIONS AND INDICATORS

The use of SMART indicators attached to key activities will support effected planning and implementation. The acronym SMART stands for Specific, Measurable, Achievable, Relevant, and Time-bound, reflecting the characteristics that indicators should possess for optimal performance (Chand, 2021; Perrings et al., 2011). Specificity ensures that indicators precisely target a particular aspect of the project or goal. Measurability emphasizes the need for metrics that enable objective assessment of progress. Achievability ensures that the indicator's goals are realistic and attainable within the given resources and constraints. Relevance underscores the importance of indicators aligning with the overall objectives and priorities of the project. Lastly, Time-bound establishes a clear timeframe for achieving the indicator, promoting accountability and facilitating monitoring and evaluation. **Employing SMART indicators enhances clarity, accountability, and effectiveness in tracking and assessing project outcomes, contributing to more successful and impactful planning, implementation, and evaluation processes**.

EVALUATION AND ADJUSTMENT

Evaluation also plays a crucial role in the planning process as it serves as a systematic and reflective assessment of the effectiveness and impact of planned initiatives to improve water quality. Evaluation helps identify areas of improvement, refine strategies, and making informed decisions for future planning efforts. Evaluation also contributes to accountability by offering a means of assessing the allocation and utilization of resources and delivery of intended outputs and services. This is particularly important for water quality management, which relies on large amounts of information.

All of the input plans have accompanying evaluation processes. That said, in-house resources for evaluation are often limited, and in some cases (e.g., for BBWS' Renstra), evaluators must travel to the field to gather data from respondents. As such, evaluations are often based on binary (yes-no) input or output evaluations that indicate whether a planned activity was performed or not, without more detailed information on the outputs or effectiveness of the measure. There is also a role for coordinated evaluation of water quality management,

potentially for TKPSDA or some other coordinating body. As such, evaluation is an area for targeted capacity building. TKPSDA Brantas considers progress on the Pola, but not for issues related to water quality.[73] An approach to evaluating the RPPMA that involves cross-sector participation must be determined.

IV.6.3. GENDER MAINSTREAMING (PUG) IN WATER QUALITY MANAGEMENT

Gender mainstreaming (Pengarusutamaan Gender, PUG) is an obligation of all government agencies in Indonesia, in accordance with a number of regulations at the national, provincial, and local levels.[74] In the context of Indonesian law, Gender Mainstreaming is defined in as a "strategy built to integrate gender as a dimension of planning, formulating, implementing, monitoring, and evaluating national development policies and programs" (Inpres 9/2000) and, thus, integrates the problems, experiences, and needs of women and men in all policies and programs across all fields and levels of government (PermenLHK 31/2017). This well-developed body of regulation lays out terms for Gender-Responsive Planning and Budgeting (PPRG) and Gender-Responsive Budgets (ARG, Anggaran Responsif Gender) and mandates gender-responsive formulation of policy plans, including regional long-term and medium-term development plans, annual regional work plans, and regional working unit strategic and work plans. Ministerial circulars and East Java's Provincial Regulation Number 9 of 2019 concerning Gender Mainstreaming also require that agencies designate staff as PUG Focal Points to implement PUG and provide and maintain relevant gender-disaggregated data to support gender analysis.

PUG is further institutionalized for water and the environment via Ministerial regulations issued by KLHK and PUPR that lay out guidelines for implementing gender mainstreaming in their respective fields. Permen LHK 31 / 2017 outlines Guidelines for Implementing Gender Mainstreaming in the Field of Environment and Forestry, following on from a 2016 MoU between KLHK and Ministry of Women's Empowerment and Children. The guidelines cover the application of PUG in planning, project preparation, implementation, and monitoring and evaluation in the environmental sector. The guidelines also acknowledge gender-differentiated dependence on natural resources, including rivers; gendered differences in activities related to and knowledge about natural resources; and gender-differentiated impacts of pollution, particularly in informal settlements subject to high exposure to pollution. Specific to waste management, the document highlights that 85% of the participation in Waste Bank (Bank Sampah) programs is female and that women bear the overwhelming burden of waste management in communities due to low understanding and valuation of waste management amongst men, limited opportunities for income generation, dependence on women's groups such as PKK for implementation and expansion, and prevailing social practices that put women in charge of managing waste at the household level.

Similarly, PUPR issued the Decree of the Minister of Public Works and Public Number 1515/KPTS/M/2020 concerning the Formation of a Gender Mainstreaming Team for the Ministry of Public Works and Human Settlements and a plan for gender mainstreaming outlined in the Implementation Road Map for Gender Mainstreaming (PUG) (Road Map Pelaksanaan Pengarusutamaan Gender) in the Ministry of Public Works and Public Housing 2020-2024, including guidance for the Directorate General of Water Resources (Ditjen SDA) (Appendix 2.3). Specific actions for gender mainstreaming in Ditjen SDA include incorporating PUG in the background study and strategic plan

[73] Interview, BBWS Brantas, 4 February 2021

[74] These include Presidential Instruction Number 9 of 2000 on Gender Mainstreaming (INPRES 9/2000) (Instruksi Presiden No. 9 Tahun 2000 tentang Pengarusutamaan Gender (PUG) dalam Pembangunan Nasional; joint Ministerial circulars 270/M.PPN/11/2012; SE-33/MK.02/2012; 050/4379A/SJ; and SE-46/MPPPA/11/2012; Minister of Home Affairs Regulation Number 15 of 2008 concerning General Guidelines for the Implementation of Gender Mainstreaming in the Regions and its 2011 amendments (Regulation of the Minister of Home Affairs Number 67 of 2011); and East Java Provincial Regulation Number 9 of 2019 concerning Gender Mainstreaming

(Renstra) for Ditjen SDA 2025-2020; capacity building for focal points in water agencies, including BBWS; updating disaggregated data; GAP preparation and application of GBS in each BBWS; news and documentation of PUG activities on website; and evaluation of gender-responsive activities and implementation of PPRG in PUPR.

While Guidelines for Gender Mainstreaming are already in place, implementation of gender-responsive planning and application of gender analysis for water resource management is limited. Implementation of PUG at the kabupaten / kota level in the field of water resource management is low, and gender is often relegated to status as a secondary issue in planning. Moreover, there is **limited guidance to support application of gender analysis specifically for water, waste, and wastewater management.** It is additionally observed that women's concerns, activities, knowledge, and capacities to manage water quality are lost due to low levels of participation in public planning mechanisms such as Musrenbang.

As such, the Brantas Water Quality project developed a set of policy recommendations for strengthening gender mainstreaming for water quality management, titled "Untapped Potential: Eight Opportunities for Mainstreaming Gender in Water Quality Management in the Brantas River Basin," which can be referred to for further information on challenges facing PUG and opportunities to strengthen PUG in water quality management.[75] *Brantas Harmoni* includes a select set of these recommendations which are discussed here and in Challenge 7 (recommendations for strengthening women's participation). Recommendations related to strengthening PUG in government activities include the following:

- Replicate the Musrenbang Perempuan model with accompanying capacity-building for women at the village level,
- Include gender-responsive programming and management as a criterion for selection of communities for Clean Village status and other village environmental awards,
- Develop capacities of Gender Focal Points in DLH Jatim, BBWS Brantas, DLH kota / kabupaten, including:
    - Facilitate periodic (annual or semi-annual) training sessions on Gender Analysis Pathways and requirements of PUG for water and the environment,
    - Construct clear Terms of Reference for Gender Focal Points,
    - Require Gender Focal Point participation in planning processes for Renstra and Annual Work Plans for water and environmental agencies,
- Create simplified GAP guidance and an example analysis for distribution to district-level environmental and water agencies,
- Identify and socialize specific and measurable gender-disaggregated indicators for water quality management (see Appendix E), and
- Require distributed F/M village representation in Cipta Karya, DLH kota / kabupaten, DLH Jatim, and desa-level planning for solid waste management.

IV.6.4. COORDINATION

Clear and formalized coordination mechanisms for water quality management need to be established or strengthened for various aspects of water quality management. While TKPSDA WS Brantas has played a strong role in coordinating utilization, conservation, and flood control, coordination for water quality management remains an important area of development. In addition to planning coordination, stakeholders need clear approaches to

[75] Report available upon request: r.s.houser@tudelft.nl

coordinate response in the event of pollution incidents; enforcement when multiple jurisdictions are involved; implementation some public services (e.g., removal of waste from the river); and data integration and management.

As laid out in the 2019 Water Law (UU 17 of 2019, Chapter XII) coordination at the river basin level is to be carried out by a river basin level coordination forum (TKPSDA) tasked with harmonizing interests, providing advice to central and regional governments on WRM implementation, and monitoring and evaluating the program and activity plans for water resources management (Article 66). Over the past two years, the Water Quality Working Group (Pokja Kualitas Air) of TKPSDA WS Brantas and the Brantas Water Quality project have held meetings to discuss coordinated responses to water pollution and options to strengthen coordination in planning, monitoring and evaluation for river health. Recognizing this need for coordination across agencies and sectors to improve river health in the Brantas, a Pokja Kualitas Air was established in TKPSDA WS Brantas in 2019, with the operational support of the Brantas Water Quality Project. The Pokja is chaired by the head of DLH Jawa Timur and deputy chaired by the head of BBWS Brantas. The head of Perum Jasa Tirta I serves as the Secretary, and the body includes additional members from government and civil society (Table 45). The duties and functions of Pokja Kualitas Air are described in Box 3.

Box 3. Tupoksi of TKPSDA WS Brantas Pokja Kualitas Air

- Carry out harmonization and synchronization of various stakeholder activity programs in the Protection and Management of Water Quality in WS Brantas;
- Discuss action plans for water quality control and restoration;
- Discuss the water quality information system management plan to achieve integrated water quality information system management among water quality monitoring stakeholders;
- Discuss community participation in the protection and management of water quality;
- Coordinate integration of Water Quality Protection and Management policies in WS Brantas;
- Carry out monitoring and evaluation activities on the implementation of the Water Quality Protection and Management policy in the Brantas River Basin;
- Monitor and evaluate plans for water quality control and restoration; and
- Provide input to the Ministers of PUPR and KLHK and the Governor of Jawa Timur and relevant regents and mayors regarding Water Quality Protection and Management.

Source: Results of TKPSDA Pokja Kualitas Air meeting, 20-21 September, 2022

The Brantas Water Quality project team and TKPSDA Pokja Kualitas Air jointly recommend **continuation of the Pokja Kualitas Air's efforts, either in the current form or as a separate coordinating body facilitated by Bappeda, KLHK, or DLH Jatim**. Continuation depends upon (a) identifying a source (or shared mechanism) of funding for ongoing activities; and (b) confirming commitment and leadership (including convening responsibility) to facilitate the coordinating body. Moreover, there should be careful review of membership to ensure participation of key stakeholders in water resources management and water pollution source control who have the relevant knowledge and authority to provide meaningful inputs.

Several areas of development should be noted. First, while TKPSDA's recommendations are formalized resolutions, they are non-binding and recipients are not bound to follow coordinating advice. Second, there has been a noted problem of limited follow-up to TKPSDA recommendations and no evaluation of how much TKPSDA feedback is taken up by recipient agencies.[76] Issues that are brought up and discussed on an ad hoc or responsive basis are

[76] Interview, BBWS Brantas, 4 February 2021

also out of sync with the budget and planning cycles, so they are almost never taken into account for planning.[77] Third, there is low awareness both within and outside of government about TKPSDA or its activities. Staff from various sectors and levels of government reported either not having heard of TKPSDA or not knowing whether they were operational after the COVID pandemic.[78] TKPSDA also does not include private sector representatives who may offer important contributions with respect to advancing industrial wastewater management.

Table 45. Membership of TKPSDA Pokja Kualitas Air, 2023

Current Pokja Kualitas Air	Additional Stakeholders to Consider
1. Kepala DLH Provinsi Jawa Timur (Ketua) 2. Kepala BBWS Brantas (Wakil Ketua) 3. Direktur Utama PJT I (Sekretaris) 4. Anggota: Kepala Dinas Pekerjaan Umum Sumber Daya Air Provinsi Jawa Timur Kepala Dinas Pertanian dan Ketahanan Pangan Provinsi Jawa Timur Kepala Dinas Energi Sumber Daya Mineral Provinsi Jawa Timur Kepala Divisi Regional Perum Perhutani Provinsi jawa Timur Ketua Komisi Nasional Lingkungan Hidup Indonesia, Kabupaten Malang Ketua Kelompok Budi Daya Ikan Air Payau, Kabupaten Sidoarjo Ketua Lembaga Brantas Berdaya, Kabupaten Jombang Ketua Yayasan Formula Lingkungan, Kota Surabaya	Dinas Perumahan Rakyat, Kawasan Permukiman dan Cipta Karya Jatim (Cipta Karya) Representatives of DLH Kota / Kabupaten (2-3) Dinas Pertanian dan Ketahanan Pangan Jatim Dinas Peternakan Jatim Dinas Perindustrian Jatim Additional private sector and community representatives

There is also a need for further horizontal coordination across DLH units at the kota / kabupaten levels, particularly to coordinate response to cross-region pollution. One potential model could be more regular meetings of kota and kabupaten DLH agencies specifically focused on coordinated response to water quality problems. Another proposed model is an independent environmental Pokja (working group and coordination body) including BBWS, DLH Jatim, PJT I, PU SDA, and all sixteen kota / kabupaten DLH agencies under the office of the Governor.[79]

IV.6.5. WATER QUALITY MONITORING AND DATA MANAGEMENT

The establishment of robust water quality monitoring and information management provides the necessary data for informed decision-making, improved oversight, and effective response in the event of a contamination. As in the rest of Indonesia, there is much room to extend, modernize, and strengthen monitoring and water analysis in the Brantas River basin. As importantly, **there is a need to reconcile available data in an open-source information management system that allows for the use of water quality monitoring data to planning, enforcement, and response**. Strengthening the water quality monitoring and data management system requires careful consideration of user needs – i.e., how government can meaningfully utilized collected data for planning, enforcement, provision, industry self-regulation. While some interventions will require significant investments (e.g., to improve technologies, increase spatial and temporal coverage, accredit labs, and support dissemination via online platforms), some **"easy wins" are available by way of (a) standardizing data collection plans across agencies (parameters, instrumentation, sampling plan, institutional responsibilities) and (b) standardizing reporting**. These actions will both support development of a Data Management System (DMS) that fosters increased use of data to support decision-making.

BBWS Brantas, DLH Jatim, KLHK, PU SDA Jatim, and all sixteen kota / kabupaten DLH agencies in the river basin collect water quality data regularly across the watershed (Figure 26). BBWS Brantas, DLH Jatim, PJT I, and KLHK

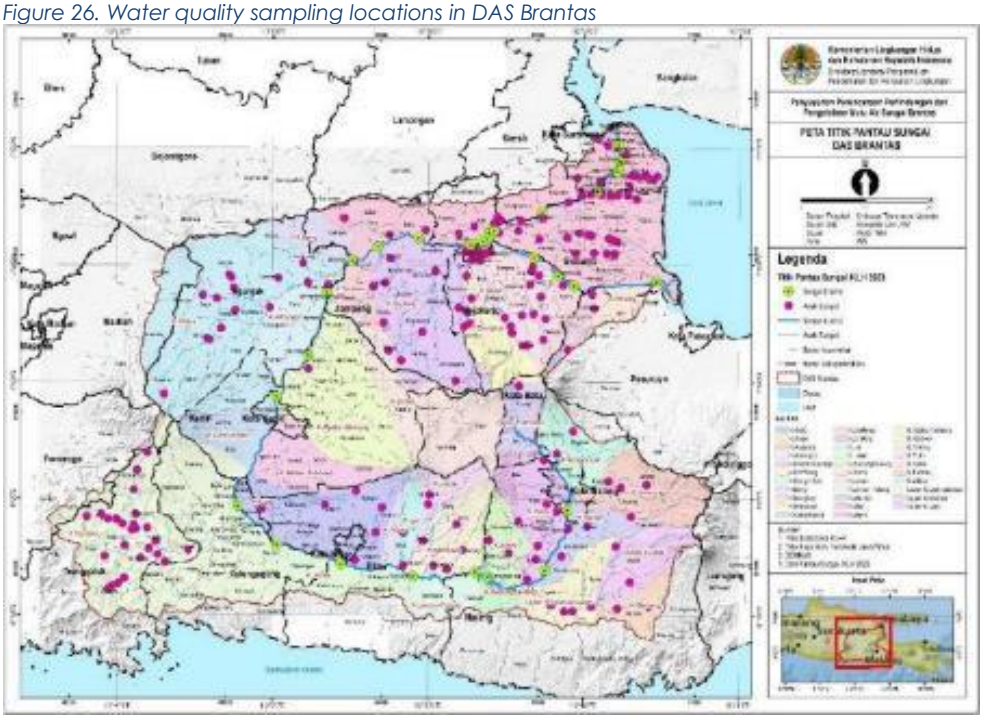
[77] Ibid.

[78] Interviews, DLH Surabaya, 8 June 2022, DLH Gresik, May 2022.

[79] Interview with DLH Surabaya, 8 June 2022)

focus primarily on the mainstem of the Brantas (Figure 27). Assuming that sampling procedures (including personnel and sample representation) are in accordance to national standard, some water quality monitoring data challenges persist, including notable inconsistencies in data formats (see below). Data is also yet to be reconciled into a common data set, though KLHK's recent efforts to establish a common data bank is a notable step forward. The May 2022 Water Managers' Survey and interviews with DLH Jatim, BBWS Brantas, and DLH Tulungagung, Gresik, and Surabaya indicated that water quality data was "somewhat coordinated" (survey) but that data was not readily accessible across agencies for use in planning or to support implementation decisions, aside from the five-year calculations of carrying capacity.[80]

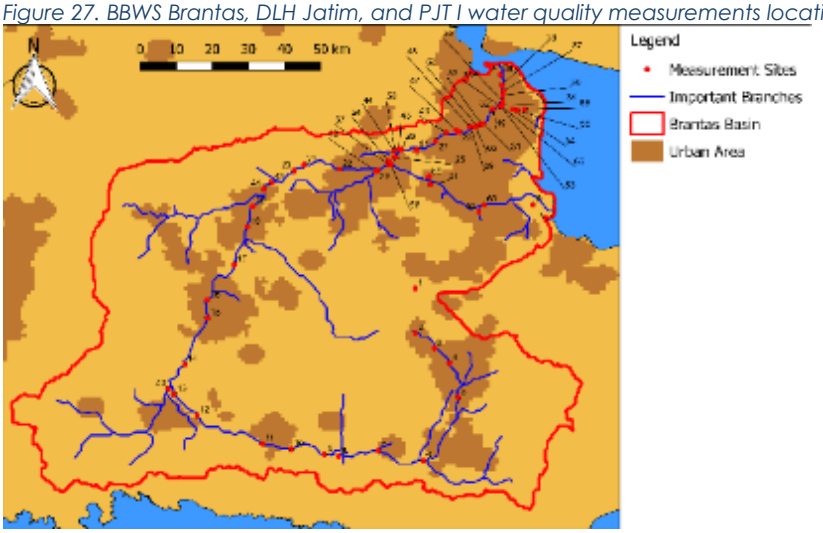
Figure 26. Water quality sampling locations in DAS Brantas



Source: KLHK RPPMA Brantas Study, 2023

[80] Discussions, project consortium meeting, May 2022

Figure 27. BBWS Brantas, DLH Jatim, and PJT I water quality measurements locations in the main Brantas River



Source: Willard (2022)

As such, the following section outlays issues and corresponding recommendations to strengthen water quality monitoring.

SAMPLING: EXTENDING THE WATER QUALITY MONITORING SYSTEM

The water quality monitoring system in place should be extended to provide a more reliable and complete picture of water quality conditions in the Brantas. This includes further development of real-time monitoring, strengthening of the current manual sampling regime, and prioritization of select parameters in certain locations to support response in the case of industrial contamination.

REAL-TIME, AUTOMATED, ONLINE MONITORING

Ideally, water quality could be monitored with automated, continuous sampling providing real-time data for key water pollution hotspots. ONLIMO in Brantas from 2015-2021 included three installations at Intake PDAM Tawangsari Kabupaten Sidoarjo, Intake PDAM Kota Surabaya, and Lokasi DAS Brantas Sidomoro Pasinan Lemah Putih Kecamatan Wringinanom Kabupaten Gresik. As of 2022, the station locations were extended to seven.

Table 46. ONLIMO station locations (2022 data)

1	KLHK71 Station, Tulungrejo Village
2	KLHK72 Station, PDAM Kanjuruhan
3	Tulung Agung-1 Station, ONLIMO Sungai Bodeng Station
4	KLHK73 Station, Ngantru Village, Kali Bagong
5	KLHK70 Station, Kali Sadar, Mojokerto Regency
6	SIDOARJO-1 Station, ONLIMO INTAKE STATION PDAM KEDUNGULING DLH, Kedunguling River, Sidoarjo Regency
7	KLHK61 Station, Sidomoro Wringinanom, Gresik Regency

Source: 2021 Laporan Kinerja, Direktorat Jenderal Pengendalian Pencemaran dan Kerusakan Lingkungan

KLHK's online, continuous, real-time water quality monitoring program (ONLIMO) is an important technical step to support more extensive and continuous monitoring in the basin. Because resources are limited, however, extensions of the ONLIMO system should follow a systematic approach to prioritization to site additional monitoring points where early response may be most important (e.g., downstream of industrial clusters or areas with dangerous wastewater emissions profiles) or where there are noted gaps in spatial coverage.

INCREASE TEMPORAL FREQUENCY AND SPATIAL COVERAGE

The predominant approach to collection in the Brantas is manual sampling. Concurrent to extending ONLIMO, efforts may be made to improve temporal and spatial coverage of water quality sampling. Further, water quality sampling does not show a temporal consistency across stations—some stations only sample once a year, others up to four times—and the timing of the sample (pre or post monsoon) is mostly not recorded. It is particularly important to ensure coverage across seasons since rainfall distinctly affects pollution load fluxes. It would be noted that current monitoring sites are primarily in urban areas. In rural areas with concentrated agricultural industries or located downstream of industrial parks or mining operations, more frequent monitoring is recommended.

REVIEW OF PARAMETERS

The list of regularly collected water quality parameters needs to be evaluated to prioritize extensions to the monitoring system. Not all parameters need to be collected at all sites. Simple and lower-cost measurements can be employed where risks are low or where they can be used as "red flag" indicators that suggest a need for more extensive monitoring. Electrical conductivity may, for example, be an effective and efficient first-round indicator of problems. Adding online continuous sensors for an alert parameter could allow environmental officers to follow up with additional sampling where potential problems are suggested by spikes in conductivity.

Parameters that are regularly reported as exceeding standards or identified as priority measures by local stakeholders should be prioritized for more frequent monitoring. Parameters that consistently fall below Class II standards should be more closely and frequently monitored, particularly in areas where pollutants are notably high (see Chapter III). Key local stakeholders, such as environmental agencies, industries, and community groups, can also help agencies to gather insights into specific concerns or areas of interest and address local priorities.

Last, industrial wastewater data should be analyzed to identify understand whether more samples in areas downstream of industry may be needed for harmful pollutions such as heavy metals, POP, and other substances with significant human health impacts. More samples on macro- and micro-plastics should also be considered.

ANALYSIS: CAPACITY-BUILDING AND ACCREDITATION FOR DATA COLLECTION AND ANALYSIS

Increased sampling must go hand in hand with efforts to strengthen laboratory analytical capabilities. It is recognized that in Indonesia generally, capacities to analyze data are limited (Abedalrazq et al., 2021). These capacity limitations are associated with the availability of trained staff, equipment, and accredited laboratory services. In the Brantas, only seventeen laboratories are accredited and registered with KLHK, and only seven of these are government laboratories (Table 47). Notably, the BBWS Brantas laboratory is not accredited and registered. As such, the data collected from BBWS (and other DLH / Balai Lingkungan Hidup whose utilized labs are unaccredited) cannot be used in calculations of carrying capacity and official reporting on water quality.[81] Moreover, the process of attaining KLHK registration is long. Even with sufficient accreditation (ISO/IEC 17025), the process of achieving official registration with KLHK can take months to years. Finally, there have been observed inconsistencies in analytical outputs elsewhere in Indonesia, whereby analysis by different institutions from the same samples yield different results (Ibid.). **Comparative analysis of same water samples should be performed to test the consistency of analytical approaches and detect specific targets for analytical capacity building**.

[81] Interview, DLH Jatim, 20 May 2022

Table 47. Registered laboratories (with KLHK) in DAS Brantas kota and kabupaten

Location	#	Laboratory Name	Materials / Products Tested (water only)	Expiration
Kota Batu	0			
Malang	1	Laboratorium Perum Jasa Tirta I		19-jul-25
Kota Malang	0			
Kota Blitar	0			
Tulungagung	0			
Trenggalek	0			
Kediri	0			
Kota Kediri	0			
Nganjuk	0			
Jombang	1	UPT Labling DLH Kabupaten Jombang	Air Limbah, Air Sungai	2-nov-26
Mojokerto	2	Balai Lingkungan Hidup Mojokerto	Air Sungai, Air Limbah, Mikrobiologi	
		PT. Graha Mutu Persada	Air Limbah, Air Sungai, Air Laut, Air Permukaan, Air Tanah, Air Limbah	24-apr-26
Kota Mojokerto	0			
Gresik	2	Laboratorium PT. Envilab Indonesia	Air, Sedimen, Air Limbah , Air Laut Lingkungan, Air Bersih, Air Permukaan	4-jun-27
Gresik		UPTD Lab DLH Kab Gresik	Air Limbah, Air Danau, Air Sungai, Air Sumur, Sampling air limbah, air sungai, air danau, air sumur	20-feb-27
Kota Surabaya	11	Balai Besar Teknik Kesehatan Lingkungan dan Pemberantasan Penyakit Menular, Surabaya		
		Laboratorium BLH Provinsi Jawa Timur	Air Tanah, Air Permukaan, Air Limbah	24-sep-24
		Laboratorium Cabang Surabaya, PT. Sucofindo (PERSERO)	Air Permukaan, Air Sungai , Air Limbah	20-sep-25
		Laboratorium PT. Mitralab Buana Surabaya	Air Limbah, Air Sungai, Air Muara, Air Waduk, Air Sumur, Air Laut, Perparasi logam terlarut, logam terlarut	13-jun-26
		Laboratorium Penguji Baristand Industri Surabaya	Air dan Air Limbah	26-feb-28
		PT. Axo Green Laboratory	Air Permukaan; Air Limbah	27-okt-24
		PT. Genau Loka Gantari	Air Limbah, Air Sungai, Air Laut dan Udara Ambien, Sampling Air Permukaan, Air Tanah, Air Limbah, Air Laut	29-des-2025
		UPT Keselamatan dan Kesehatan Kerja Provinsi Jawa Timur	Air dan Air Limbah	24-sep-25
		PDAM Surya Sembada Kota Surabaya	Air Sungai, Air Limbah, pengambilan contoh uji Air Limbah, Tanah, Sungai dan Mikrobiologi	29-mei-25
		PT. Angler Biochem Lab	Air Limbah	17-des-2024
		PT. Unilab Perdana Cabang Surabaya	Air Limbah, Air Sungai, Permukaan, Air Tanah, Air Limbah	22-feb-27

REPORTING: STANDARDIZE REPORTING AND OPEN DATA

The reporting of water quality data must be more standardized, and data input systems should be made as "error-proof" as possible to deal by way of using technical controls to reduce data entry errors, use of different units in reporting, and other inconsistencies. A extensive review of available water quality data in the Brantas River basin by researchers at TU Delft revealed the following issues:

- Different parameters are collected in different measuring campaigns over time,
- While some locations are reported as measurement stations, there is consistently missing data for those locations,
- Monitoring is generally infrequent (e.g., twice yearly, quarterly, in some cases monthly),
- Exact dates and, sometimes, months are missing from data entries,
- Templates for data reporting change from year to year, even within one Excel worksheet,
- Number formats in Excel sheets are inconsistent (e.g., a number may be formatted / tagged as a date or text),
- Unit errors are noted (e.g., reporting a unit in L where realistic measurements ranges suggest the until should actually be mL),
- Lack of clarity in reporting between "non-detectable" versus missing data, and
- Locations do not exactly match from year to year (either names or geographic coordinates, which are similar but not the same) (Willard, 2022).

Different agencies record dates, locations, and units differently (both across and within agencies) and use different styles of punctuation. Much of the recorded data is entered into Excel, often as text rather than in number format. These inconsistencies make it difficult to readily use data sets for analysis. Also, some data points indicate exceedingly high concentrations. These recorded observations may, indeed, reflect elevated levels of those parameters. However, challenges during the interpretation process, errors in noting concentration values, or issues with technical and laboratory detection methods could also contribute to such observations. In some cases, decimal points are recorded incorrectly, or incorrect units are applied (e.g., mg versus µg), leading to potential errors in orders of magnitude. Sampling coverage and frequencies are also limited, likely due to budget constraints, which mean that important fluctuations in concentrations may be missed over time and space.

Willard's 2022 Master's thesis analyzing data from DLH Jatim, BBWS Brantas, and PJT I describes these reporting issues in detail. Willard also proposes a number of simply approaches to strengthen manual reporting. First, **agencies should add informative metadata to observations in data sets, including time (date and time of day), location, and method of sampling / analysis**. With respect to locations, a standard and agreed set of **sampling sites should be published with an agreed naming protocol**. Willard's findings and subsequent project review of available agency data revealed that reported locations indicated several where the specific details (name, coordinates) differed slightly but are likely from the same measurement point. Moreover, plotted GPS coordinates sometimes resulted in mapped measurement points on land, sometimes tens of meters from a waterway (Ibid.). Last, the **instruments and methods used to sample and analyze water quality should be recorded for each observation** to better deal with the possibility of inconsistencies due simply to a difference in methodology.

OPEN AND INTEGRATED WATER QUALITY DATA

Brantas Harmoni and the RPPMA are also opportunities to promote the Brantas as a leading example for integrating water data in cooperation with all levels of government, as well as with academia and communities. As laid out in the 2019 Water Law, **Indonesia has adopted a "One Data Policy" that needs to be institutionalized and enforced**. Efforts to integrate data are similarly being taken up by PUPR, PJT I, and KLHK, via ONLIMO and the "Environmental Quality Data Center" program. At a Ministerial level, consultations and cooperation between PUPR and KLHK should focus on an agreed format and data reporting approach to ensure commensurability of multiple data management systems in order to improve available data and reduce data submission workloads on sub-national agencies (i.e., increased time and costs when different formats or submissions systems are required).

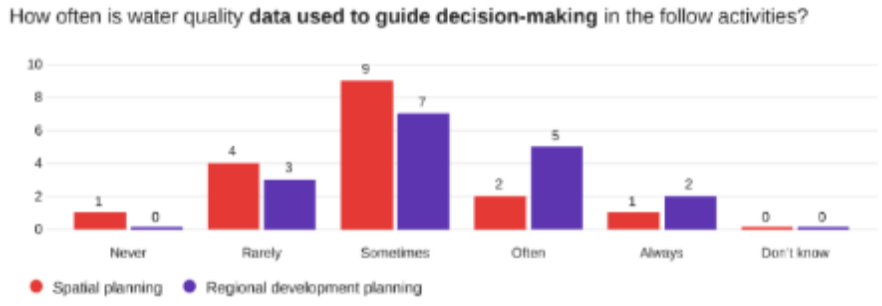
As efforts progress toward developing national water information and environmental information systems, the demonstrated cooperation of BBWS Brantas, PJT I, and DLH Jatim in the Brantas Water Quality project is an opportunity to pilot a program for integrated water data management at a basin level that grants stakeholder agencies online and open access to water quality data (e.g., through the data set currently collated and managed by KLHK). **Such cooperative activities can be supported by MoUs that lay out terms for data sharing and processes for data management**.

Currently, **even within agencies (e.g., across work units in KLHK), the administrative processes and permissions required to gather data are extremely cumbersome**. Moreover, transmitted data is typically send in graphic-file formats that are not easily searchable or transferrable to data analysis programs (or even Excel). As such, recipients must manually re-enter scanned data. This requires a heavy administrative burden, increases the costs of analysis, and introduces potential data entry errors.

Effective use of the data set also depends on capacity building and socialization programs to demonstrate the use of data for planning, evaluation, and incidence response. Such programs can be supported by trainers from government and local universities with policy analysis and water resources management faculty. At present, water quality data is very limitedly used in planning (Figure 28). Once data is made available, staff at planning agencies should be trained on how to apply it in planning, permitting, and other decisions to strengthen river pollution control.

Efforts to increase the availability of digitized water quality data can and should also involve participation from academia and communities involved in citizen science. **Government should continue to promote efforts such as BrantaSae, which offers a locally managed crowd-sourced online water quality data platform**. The platform also helps support problem analysis and solution-finding by mapping and offering information on water quality problems (e.g. waste hotspots, illegal dumpsites, etc.) as case demonstration of water quality solutions.

Figure 28. Project survey results on frequency of use of water quality data to support planning



IV.6.6. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

The table below summarizes actions and strategies proposed in standing plans that relate to functions of water quality management outside of targeted pollution control by source. Because the number of measures drawn from input plans is higher than for other sections, these are reported in sections corresponding to general functions of water quality management.

Table 48. Agency strategies and actions to strengthen water quality monitoring and information management

	Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Water Quality Monitoring	Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	258	BBWS Brantas	Construct permanent river water quality monitoring stations in the upstream, middle and downstream areas of the basin; periodic maintenance of water quality monitoring stations	-	-	-	DLH (Prov/Kab/ Kota); BBWS Brantas, PU SDA (Prov/ Kab/ Kota), PJT I
		258		Map and rationalize water quality monitoring stations.	-	-	-	DLH (Prov /Kab/ Kota), BBWS Brantas, PU SDA (Prov/ Kab/ Kota), PJT I
	Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	419	BBWS Brantas	Identification and inventory study of permanent river water quality monitoring stations in the upstream, middle and downstream areas of the Brantas WS	-	-	-	DLH (Prov/Kab/Kota) BBWS Brantas, PJT I
		419		Facilitation/development of facilities and infrastructure for permanent river water quality monitoring stations in upstream, middle and downstream areas of the Brantas WS	-	-	-	DLH (Prov/Kab/Kota) BBWS Brantas, PJT I
	Rencana Strategis 2019-2024, Dinas Linkungan Hidup, Provinsi Jawa Timur (2019)	61	DLH Jatim	Pollution prevention and quality monitoring activities (general)	Number of water quality monitoring points (points)	27	27 (2024 target)	DLH Jatim
		52		Environmental Laboratory Development Program (general)	Community/Customer Satisfaction Index (IKM) towards environmental quality testing services	76	81 (2024 target)	DLH Jatim
		52		Environmental Laboratory Development Program (general)	PAD or Regional Levy (Billions)	1,8	2 (2024 target)	DLH Jatim
		52		Increase quality of environmental quality testing services and follow-up on customer complaints/complaints	Number of environmental quality test samples (samples)	3600	3600 (2024 target)	DLH Jatim
		53		Activities to strengthen the capacity, competency and quality management system of environmental laboratories, as well as the Environmental Quality Data Monitoring and Presentation network	Percentage of laboratory accreditation compliance according to ISO 17025 (%)	100	100 (2024 target)	DLH Jatim
		53		Activities to develop and/or strengthen environmental laboratory infrastructure in East Java (DAK)	Number of procurements of environmental quality testing equipment	-	-	DLH Jatim

	Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	167	PJT I	Development of online and real time water quality and discharge monitoring (Surabaya River)	-	-	-	-
		167		Regular monitoring of water quality in the canals	-	-	-	-
		167		Evaluate the location of water quality and discharge monitoring points	-	-		-
	KLHK Rencana Strategis 2020-2024 (2019)	105	KLHK	Extend the online continuous monitoring program (ONLIMO)	Number of automatic water quality monitoring stations	71 (national, 2019)	579 (national, 2024)	KLHK
Information Management	Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	293	BBWS Brantas	Develop an integrated Inter Agency Information Management System for WS Brantas; further detailed actions for DATIN SDA, e.g. establishment of standards and a coordination forum, implementation of a web-based SISDA, etc.) but no clear determination on whether this would include water quality data	-	-	-	Ministry of PUPR; Ministry of Energy and Mineral Resources; KLHK; Ministry of Agriculture; BMKG; BBWS Brantas; PJT I; BAPPEDA (Prov/Kab/Kota), PSDA (Prov/Kab/Kota), Department of Agriculture; BPDAS; DLH (Prov/Kab/Kota),.
	Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	520	BBWS Brantas	Implementation SISDA, hydrology, water quality, and environmental natural resource management	-	-	-	-
	Rencana Strategis 2019-2024, Dinas Linkungan Hidup, Provinsi Jawa Timur (2019)	58	DLH Jatim	Environmental pollution and damage control program	Monthly publication of data from water quality monitoring of water bodies (times)	-	-	-
		56		Preparation, development, maintenance and implementation of Data Information Systems	Number of regional apparatus database updates (packages)	-	-	-
	PUPR Rencana Strategis 2020-2024 (2020)	141	PUPR	Implementation SISDA, hydrology, water quality, and environmental natural resource management	-	-	-	-
	KLHK Rencana Strategis 2020-2024 (2019)	122	KLHK	Mainstream digital transformation / promote Environmental Data Center	-	-	-	-

Table 49. Agency strategies and actions to strengthen coordination

	Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Coordination	Rencana Strategis BBWS Brantas 2020-2024	66	BBWS Brantas	The Water Resources Council institution needs to be immediately established and strengthened, which is intended not only as an institutional instrument to control various potential water conflicts, but also to strengthen coordination mechanisms *(2024 update: already complete)*	-	-	-	-
		67		Establish a Water Resources Council at the Provincial/District/City level in stages	-	-	-	-
		66		Institutional restructuring through reorganizing the authority and responsibilities of each stakeholder; TKPSDA WS Brantas, National Water Resources Council Institutions and Provincial/Regency Water Resources Councils, can be used to strengthen coordination between government institutions and between government and community institutions.	-	-	-	-
	Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	525	BBWS Brantas	Make regulations for forming water resources Council (Dewan Sumber Daya Air) at the Provincial/District/City level; train Dewan SDAs on conservation	-	-	-	Kementerian PUPR, Pemerintah Daerah (Prov/Kab/Kota)
		421		MoU between institutions and agencies in managing water quality and controlling water pollution.	-	-	-	Pemerintah Daerah (Prov/Kab/Kota), DLH (Prov/Kab/Kota), BBWS Brantas, PJT I
	Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (2019)	55	DLH Jatim	Regional apparatus Institutional Consultation Activities	Number of consultations	-	-	-
		56		Activities to Synchronize Development and Implementation of Government Affairs in the Environmental Sector	Number of reports on the results of the implementation of Mandatory Government Affairs in the Environmental Sector (documents)	-	-	-
		56		Activities to Synchronize Development and Implementation of Government Affairs in the Environmental Sector	Number of regional work meetings to synchronize development in the Environmental Sector (activities)	-	-	-
		57		Activities to Synchronize Development and Implementation of Government Affairs in the Environmental Sector	Number of reports on the results of regional work meetings on	-	-	-

					environmental development synchronization (documents)			
	Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	170	PJT I	Study the organizational structure and job descriptions of each agencies in accordance with their authority over the river	-	-	-	-
		170		Improved inter-agency coordination (PJT I, Provincial Government, and Government Regency/City)	-	-	-	-

Table 50. Agency strategies and actions to strengthen planning, monitoring, and evaluation

	Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Planning	Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	245	BBWS	Strive for the area of protected forests, nature reserves and nature reserves in the Brantas watershed to be equal to or greater than 30% of the Brantas watershed area	Percentage of land in WS Brantas that is protected forest or nature reserve	-	-	BPDASHL Kementerian Kehutanan; KLHK; DLH (Prov/Kab/Kota), Kantor ATR/BPN
	Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (2019)	60	DLH Jatim	Inventory activities and implement environmental protection and management plan policies (RPPLH)	Number of East Java Environmental Protection and Maintenance Plan (RPPLH) documents	1	1	-
		60		Inventory activities and implement environmental protection and management plan policies (RPPLH)	Percentage of the number of districts/cities that have RPPLH documents	8	35	-
		60		Inventory activities and implement environmental protection and management plan policies (DIKPLHD)	Percentage of Number of Regencies/Cities that Prepare Environmental Management Performance Information Documents (DIKPLHD) (%)	50	75	-
		58		Environmental protection and management planning (KLHS - RPJMD - RTRW)	% of cities/regencies who use Kajian Lingkungan Hidup Strategis (KLHS) in their RPJMD and RTRW	55	80	-
		58		Planning document preparation	Number of regional apparatus planning documents compiled (documents)	-	-	-
	Penyusunan Studi Rencana Induk Pengelolaan Kualitas	165-166	PJT I	Spatial planning in the Surabaya River watershed is linked with the results of the calculation of the carrying capacity	-	-	-	-

	Air Sistem Sungai Surabaya (2018)	167		Evaluation and determination of carrying capacity and capacity accommodate the burden of water pollution	-	-	-	-
		167		Comprehensive inventory of pollution sources along the river	-	-	-	-
		170		Synchronization of development programs and activities and administration of government affairs in the field of environment	-	-	-	-
	KLHK Rencana Strategis 2020-2024 (2019)	132	KLHK	Strengthen provincial environmental planning	-	-	-	-
		105		Improve data collection and assessment to determine the water quality index profile (considered a part of "Prevention of pollution and damage to natural resources")	-	-	-	-
	Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	78	Bappenas	Clarify responsibilities, strengthen the coordination framework, and align multiple planning processes so that water resources management genuinely integrates all interests within each basin				
		34		Develop a model to assess and manage nonpoint source pollution	-	-	-	-
	2022 Status Lingkungan Hidup, KLHK (2022)	60	KLHK	Increase preparation of RPPLH and KLHS documents to help regions deal with important environmental issues in the development planning process	-	-	-	-
Spatial Planning	Rencana Tata Ruang Wilayah (RTRW) Provinsi Jawa Timur Tahun 2011-2033	132	Province of East Java	Manage river borders by determining the delineation of river border areas and controlling riverbank areas	-	-	-	Bappeda Provinsi Jawa Timur, Dinas Kelautan dan Dinas PU Pengairan
		111		Development of buffer zones to separate protected areas and cultivation activities.	-	-	-	Dept. PU, Dept Kehutanan, Dept Kelautan dan Perikanan, Dinas PU Cipta Karya dan Tata Ruang (Prov/Kab/Kota), Bappeda (Prov/Kab/Kota), Dinas Kehutanan (Prov/Kab/Kota), Dinas Kelautan dan Perikanan (Prov/Kab/Kota), Dinas Kebudayaan dan Pariwisata (Prov/Kab/Kota), Dinas SDA (Prov/Kab/Kota),

	Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	209	BBWS Brantas	Regulate conformity of RTRW (kota / kabupaten and provincial) and land use	-	-	-	DPRKPCK; Bappeda (Prov/Kab/Kota), TKPSDA; BBWS Brantas; Provincial Government, Related Districts / Cities; BKPRN; BKPRD
		215		Restore function of protected forests and nature reserves and extend protected forest areas to 30% of the Brantas watershed; implement government rules regarding protected forests and nature reserves	-		30% protected green area	BPDASHL Ministry Forestry; Ministry Environment Life; DLH (Prov/Kab/Kota), ATR / BPN office Prov. East Java
	Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	43	Bappenas	Improve land use management and enforcement of land use plans	-	-	-	-
Monitoring and Evaluation	Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	296	BBWS Brantas	Improved function of TKPSDA in monitoring and evaluating implementation of planning programs and activities for the Management of Natural Resources at the Brantas WS	-	-	-	Bappeda (Prov/Kab/Kota); BBWS Brantas; PJT I, PU SDA (Prov/Kab/Kota), TKPSDA
	Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (2019)	55	DLH Jatim	Activities for Preparing Reports on the Results of Implementation of Program Plans and Budgets	Number of compiled reporting documents (documents)	-	-	-
		56		Activities for Preparing Financial Management Reports	Number of financial management report documents compiled (documents)	-	-	-
	Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	170	PJT I	Improved the role and function of the results report water quality monitoring as a PDCA cycle (Plan-Do-Check-Act)	-	-	-	-

Table 51. Agency strategies and actions to strengthen general administration and capacity building

	Source	Page	Formulating Agency	Measure / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
General Administration and Capacity Building	Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (2019)	62	DLH Jatim	Activities for Implementing Office Administration, as well as Strengthening Facilities and Infrastructure for Apparatus.	Number of documents for Implementing Office Administration, as well as Strengthening Facilities and Infrastructure for Apparatus (documents)	6	6	-
		62		Program for Preparation, Control and Evaluation of Government Administration Documents	Percentage of government administration documents prepared on time (%)	-	-	-
		55		Regional Government Institutional Capacity Building Program	Percentage of institutions that function properly (%)	-	-	-
		56		Synchronization Program for Development and Implementation of Government Affairs in the Environmental Sector	Percentage of implementation of Mandatory Government Affairs in the Environmental Sector (%)	-	-	-
		55		Regional Apparatus Resource Development Activities	Number of employees who have attended formal education/training (people)	-	-	-
		55		Regional Apparatus Resource Development Activities	Number of employees who took part in training to increase HR capacity (people)	-	-	-
	Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	170	PJT I	Human resource capacity-building for pollution control, water laboratory analysis and data processing, and information system management for water quality	-	-	-	-
	Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	33	Bappenas	Human resource capacity and incentives to monitor the compliance with technical approvals for wastewater need to be enhanced (PPLH)	-	-	-	-
	PUPR Rencana Strategis 2020-2024 (2020)	141	PUPR	Perform services to manage hydrology, water quality, and the natural resources environment	-	-	-	-
	KLHK Rencana Strategis 2020-2024 (2019)	121-122	KLHK	Reduce the gap between men and women in accessing and controlling resources, participating in development and decision-making processes; coordinate implementation of gender mainstreaming (PUG); provide and utilize gender-disaggregated data	-	-	-	-
	Indonesia Vision 2045: Toward Water Security, Bappenas and The World Bank (2021)	34	Bappenas	Enhance capacity and allocate sufficient budget for water pollution monitoring and control	-	-	-	-

IV.6.7. SUMMARY OF RECOMMENDED ACTIONS

Long-term progress on water quality management practices will be reflected in general water quality conditions and adherence to class standards; adherence of development permits to zoning; alignment of water quality management and pollution control strategies; public availability of water quality data and evaluations; effective use of water quality data for planning, monitoring, and evaluation; and the facilitation of participatory and gender-responsive planning and implementation programs. The following table summarizes a list of proposed measures and indicators for inclusion in the RPPMA that relate to efficient and effective water quality management.

Table 52. Summary of recommended actions to strengthen water quality management

General Measure	Prioritized Measures	Progress Indicators	Implementing Agencies
Water quality governance (clear roles and responsibilities)	Clarify roles and responsibilities in WQM, particularly related to industrial enforcement, enforcement of riparian laws, conservation, removal of solid waste from waterways, and provision of domestic wastewater infrastructure	Reported clarity of roles and responsibilities for key functions of WQM	KLHK, PUPR (BBWS Brantas), DLH Jatim, PU SDA, Bappeda, TKPSDA
	Socialize results of meetings, reports, planning processes (e.g. meeting, publicly available tupoksi inventory document)		
Integrated water quality planning	Establish an interagency coordination forum to support RPPMA formulation, implementation, and evaluation	Demonstrated contribution of forum to planning; alignment of agency plans on water quality management	KLHK, Bappenas, PUPR
	Facilitate participating agency inputs for (re)formulation of RPPMA for WS Brantas	Joint formulation meeting or alternative mode of gathering input	BBWS Brantas, Bappeda, DLH Jatim, PJT I, TKPSDA Brantas / Dewan Air, Academia
	Develop a model to assess and manage non-point sources of pollution	Model developed (with responsibilities assigned to party with sufficient technical capacity	KLHK, DLH Jatim, Academia
	Create an inventory of pollution sources on DAS Brantas waterways	Inventory in place (with responsibilities assigned for inventory management)	KLHK, DLH Jatim, PJT I, Academia
Spatial planning	Increase availability of zoning / land use information	Public availability of spatial plans at provincial and kabupaten / kota level	Bappeda
	Increase availability of information / mapping of river boundary zones	Public availability of river boundary zones	BBWS Brantas
	Improve alignment of spatial and environmental planning	% of cities/regencies who use Kajian Lingkungan Hidup Strategis (KLHS) in their RPJMD and RTRW	Bappeda (Prov/Kab/Kota), DLH Jatim
	Improve oversight of zoning planning in RTRW	Number of zoning violations detected and successfully handled Number of conservation area violations detected and successfully handled	Bappeda (Prov/Kab/Kota)
	Develop buffer zones to separate waterways from non-point sources of pollution	Km of waterway protected by buffer zone	Bappeda (Prov/Kab/Kota)
Development planning and Musrenbang	Develop a mechanism to include environmental issues in thematic process for Musrenbang	% village level proposed allocations for waste and wastewater management	KLHK, DLH Jatim, Bappenas, Bappeda
	Support increased attendance of women in development planning at the local level (e.g., through Musrenbang Perempuan, targeted inclusion)	% M/F participation in Musrebang	Bappenas, Bappeda, Pemerintah Kab/Kota
Environmental planning	Strengthen preparation and publication of environmental planning documents, including RPPLH and DIKPLHD	% districts/cities that have Environmental Protection and Maintenance Plan (RPPLH) and KLHS documents	DLH (Prov/Kab/Kota)

		Number of kota/kabupaten that Environmental Management Performance Information Documents (DIKPLHD)	
Joint monitoring and evaluation (e.g., TKPSDA Pokja Kualitas Air, Dewan Air, etc.)	Develop and publish a 5-year water quality management evaluation report	Public availability of evaluation report	KLHK, DLH (Prov)
	Generate and publicly disseminate an annual Brantas Health Check (report card) with key measures of river health and information on pollution source loads	Public availability of regular reporting on water quality management	KLHK, DLH Jatim
	Improve mechanism for joint evaluation of water quality progress as a function of TKPSDA or alternative coordination body for evaluation	Mechanism in place for joint evaluation	KLHK, BBWS Brantas, DLH Jatim, PJT I, TKPSDA Brantas / Dewan Air
Gender mainstreaming (PUG)	Engage women at desa/kelurahan and kecamatan levels in water- and waste-related public consultations and planning processes	% (F/M) participation in public consultations and planning meetings	DLH (Prov/Kab/Kota), BBWS Brantas
	Replicate the Musrenbang Perempuan model with accompanying capacity-building for women at the village level	% desa / kelurahan / kecamatan in each kota / kabupaten with Musrenbang Perempuan programs	Kota / Kabupaten government
	Include gender-responsive programming and management as a criterion for selection of communities for Clean Village status and other village environmental awards	Number of awards programs that include implementation of PUG as a criterion	KLHK, BBWS Brantas, DLH Jatim
	Develop capacities of Gender Focal Points in DLH Jatim, BBWS Brantas, DLH kota / kabupaten, including: Facilitate periodic (annual or semi-annual) training sessions on Gender Analysis Pathways and requirements of PUG Construct clear Terms of Reference for Gender Focal Points Require Gender Focal Point participation in planning processes for Renstra and Annual Work Plans for water and environmental agencies	Number of agencies with trained Gender Focal Points Demonstrated participation of Gender Focal Points in planning and evaluation processes	BBWS Brantas, DLH Jatim, DLH Kota / Kab.
	Develop capacity for gender analysis by creating simplified GAP guidance and an example GAP analysis for distribution to district-level environmental and water agencies	Number of water and environmental plans that apply gender analysis	DLH Jatim, BBWS Brantas, DP3AK, Kota / Kabupaten
	Identify and socialize specific and measurable gender-disaggregated indicators for water quality management	Number of water and environmental plans that include gender-disaggregated data and indicators	BBWS Brantas, DLH Jatim, DLH Kota / Kab.
Coordination	Establish an ongoing coordination body(ies) for water quality planning and implementation of pollution control	Coordination mechanisms in place for planning and implementation of pollution control	KLHK, DLH (Prov/Kab/Kota)
Water quality monitoring and information management	Produce comprehensive inventory of pollution sources along the river	Public availability of regularly updated pollution source data	DLH Jatim, Dinas Cipta Karya, DLH Kota / Kab.
	Extend ONLIMO system, with prioritized development downstream of industrial areas and upstream of concentrated residential areas	Number of continuous online monitoring points (ONLIMO)	KLHK
	Increase temporal frequency and spatial coverage	Number of additional measurements	KLHK, DLH (Prov/Kab/Kota), BBWS Brantas, PJT I, Dinas PUSDA Jatim

	Implement standardized sampling, analysis, and reporting of water quality data from the Brantas River basin and adjacent / connecting side- and irrigation channels	Number of water quality observations recorded in a combined and standardized dataset	KLHK, DLH (Prov/Kab/Kota), BBWS Brantas, PJT I, Dinas PUSDA Jatim
	Increase number of KLHK registered water laboratories in DAS Brants	% laboratory accreditation compliance according to ISO 17025	KLHK
	Publish water quality data monthly	Public availability of regularly updated water quality data	KLHK, DLH (Prov/Kab/Kota), PJT I
Watershed revitalization and restoration		Area of revitalized river and riparian areas (Ha)	BBWS Brantas, DLH Jatim, Bappeda

IV.7. CHALLENGE 7. STRENGTHENING COMMUNITY PARTICIPATION

Community participation and outreach is well-established in the context of Indonesian village, environmental, and water resources management. Chapter 9 of UU 17 of 2019 regarding Water Resources reaffirms community roles, obligations, rights, and responsibilities to participate in Water Resources Management via public consultations and discussions, partnerships, guidance, and oversight (Article 63). The law also lays out community obligations to protect water resources, carry out efforts to control and prevent water pollution, and repair environmental damage caused by community and individual activities (Article 62). Similarly, PP 22 of 2021 regarding Environmental Protection and Management also states that communities are to participate in water quality protection and management through:

- Monitoring water independently in their local areas,
- Making efforts to reduce water pollutants in their respective areas,
- Conveying correct and accurate monitoring results information,
- Promoting the movement to reduce water pollution,
- Carrying out partnerships to reduce water pollution, and
- Carrying out ekoriparian programs for the restoration of water body ecosystems.

Through "kemitraan antara masyarakat" (community partnerships), local governments are incentivized to engage community stakeholders in collaborative efforts to improve water quality.[82] In this light, all agencies engaged in water quality management have standing programs to facilitate community education, outreach, and participation in planning and implementation. These programs include community river and environmental management programs supported financially by government agencies, awards programs that promote village environmental management; educational programs, either supported by government or independently operated by NGOs; community-led waste management programs (e.g., bank sampah), and citizen science initiatives. A sample of programs is included in Table 53. While a large number of programs have been founded across the basin, a number are non-operational, largely due to resource limitations or leadership changes.[83] As such, there is a need to revitalize inactive communities and reinforce existing programs.

Table 53. Example community programs focused on water quality management and river health

Program Name	Type	Description	Partner Organizations
Jaringan Komunikasi Pemantauan Kualitas Air (JKPKA)	Citizen science and water education	Nearly 100 middle and high schools in the Brantas and an additional 18-20 elsewhere in Indonesia; program focused on water enquiry based on collection and analysis of water quality data	PJT I, State University of Malang, regional schools
Komunitas Peduli Sungai (KPS) (River Care Communities)	Community education and river clean-up	Program that has supported approximately 15 communities (partnered with government) to implement river management and riparian conservation	BBWS Brantas, PUSDA Jatim
SaberS Pungli	Community education and river clean-up	Program focused on weekly river clean-ups in 40+ desa in Kota Batu, followed by river education and discussion sessions	BBWS Brantas, DLH Kota Batu, SaberS Pungli LSM (Kota Batu)
Gerakan Bersih Sungai	River clean-up and fishery program	Multi-stakeholder initiative to organize river clean-ups and spread fish seeds	DRPD Provinsi Jawa Timur

[82] KLHK presentation (Bu Lucki) to TKPSDA WS Brantas, November 2021

[83] Interview, BBWS Brantas,, 31 May 2022

Patroli Air	River monitoring / oversight	Collaborative river patrol program focused on monitoring river conditions, identifying pollution sources, and making recommendations for water pollution control	BBWS Brantas, PJT I, DLH Jatim, PUSDA Jatim, BPBD Jatim, DLH (Kab/Kota), environmental LSMs, Satpol
Relawan Jatim Jogo Kali	Community	Community group focused on maintaining the ecological function of the Brantas watershed in partnership with government, private sector (CSR), academia, environmental care institutions, and media; activities include development of Ekoriparian and ecotourism projects, environmental education, and river clean-up	DLH Jatim, DLH Kota Malang
Sekolah Sungai	Community education and advocacy	Community-based "river schools"	BBWS Brantas, Brantas Berdaya LSM, organized locally in partnership with additional LSMs and stakeholders in Blitar, Mojokerto, Trenggalek, and Kediri
Environmental Expeditions (Perjalanan Ekspedisi Lingkungan)	Community education	Educational river expeditions	BBWS Brantas, PJT I, LSMs
Aksi Brantas	Community advocacy and citizen science	Group of 16 environmental community groups focused on citizen science, local environmental advocacy, and green business development	LSMs (independent)
Sekar Mulyo Community	Community advocacy and citizen science	Local community that monitors water quality and gathers local community groups and leaders to discuss river restoration efforts	LSM (independent)
Mapala Jalwira, Surabaya	Student river action group	University student group focused on water quality testing, river conservation, and community environmental advocacy	Student group

This Brantas Harmoni report does not make detailed recommendations related to the content of community education or outreach programs and recognizes that the most successful initiatives are bottom-up. As such, additional resources from LSMs, local communities, and academia should be consulted to derive specific recommendations for community actions. Rather, Brantas Harmoni limits recommendations to three types of *government* action to promote participation and community engagement in water quality management in partnership with communities, academia, LSMs, the private sector (particularly via CSR), and the media. These are:

- Supporting community programs for river action and education,
- Providing public information and channels for communication,
- Facilitating participatory planning, monitoring, and evaluation, and
- Empowering women to participate more actively in water resources management.

All of the above should include efforts to promote gender-responsiveness and inclusive participation.

IV.7.1. SUPPORT COMMUNITY RIVER ACTION, EDUCATION, AND CITIZEN SCIENCE

As noted above, a large number of River Care Communities (KPS), watershed restoration, reforestation, and other community-led conservation, rehabilitation, waste management, and river clean-up programs are operational in the Brantas River basin. Many of these programs are robust and have enjoyed ongoing support of the local

community, but many have also become non-operational. Government can further support such programs, not only by offering funding support, but also by playing convening, information-sharing, and recognition-giving roles. First, government can support the proliferation, revitalization, and strengthening of river care communities by publicly documenting and disseminating program information and lessons learned from successful programs; promoting knowledge-sharing platforms; fostering knowledge and action networks, in partnership with LSMs, academia, and the private sector; and rewarding demonstrated river stewardship with recognition and awards programs.

FOSTER KNOWLEDGE AND ACTION NETWORKS TO PROMOTE SUCCESSFUL COMMUNITY PROGRAMS

While many community groups are operating in the Brantas, connections between community groups are largely informal and/or missing. Government – particularly DLH Jatim and BBWS Brantas – can play an important convening role by bringing groups together via online or social media knowledge-sharing platforms and by sharing case studies, guidance documents, and other informational resources. **The large number of environmental movements; village-level riparian conservation, watershed restoration, and land rehabilitation programs; and community development programs like Kotaku (slum upgrading) represent an available pool of knowledge that, with a more robust network, may be leveraged to share lessons learned and disseminate effective community models**.

Moreover, it is important to note that there is a robust network of non-environmental community groups and associations that represent a social network available for communicating public information regarding river stewardship. One such example is the efforts of Brantas Berdaya, a Jombang LSM that successfully engaged a women's exercise group and a women's onion-cutting cooperative to become involved in waste management activities.[84] In addition to initiating new river care communities, government may also focus on revitalizing inactive groups and leveraging existing community groups to join the river care network.

A **key target community to consider is the large network of pesantren and religious universities** operating in the Brantas River basin. In 2022, some 151,500 students were enrolled in religious higher education institutions in DAS Brantas.[85] A much larger population of students is enrolled in pesantren, which number 6,745 in East Java.[86] Considering tenets of Islam that support environmental stewardship, the close physical relationship between pesantren and waterways, and the developing Green Pesantren (Pesantren Hijau) and Ekopesantren programs, this network of young people represents an important target group for fostering lifelong river stewardship and sustainable household waste management.[87]

GOVERNMENT SUPPORT FOR GREEN BUSINESS AND RIPARIAN DEVELOPMENT

Riparian areas can be considered for designated use as community green spaces available for environmentally sustainable cultivation. The efforts of Wadulink Sumengko in Gresik to develop a Green Belt Movement that promotes riparian conservation by employing a financially-sustainable green business model is one such

[84] Workshop proceedings, Workshop on Gender and Water Quality in the Brantas, Surabaya, June 2022

[85] Ministry of Religious Affairs semester report, BPS Jatim

[86] Ministry of Religious Affairs data, 2023, https://emispendis.kemenag.go.id/pdpontrenv2/Statistik/Pp

[87] https://ekopesantren.com/, https://www.nu.or.id/nasional/pesantren-hijau-diharapkan-jadi-titik-pijak-nu-untuk-aktif-membangun-lingkungan-TbcTO

example.[88] The form of public-private partnership (PPP) can be used to grant organized communities valued land for cultivation in return for responsibility to maintain riparian areas in an environmentally-sustainable manner. Such a program could be developed in partnership with agricultural agencies and university faculties in the region.

COMMUNITY AWARDS AND SHOWCASE AREAS / PROGRAMS

Available village awards programs represent another important opportunity to strengthen and promote desa-level conservation efforts, waste reduction programs, other efforts to improve river health, as well as to recognize and encourage village investments in domestic waste and solid management. Government **awards programs should include water pollution control and waste reduction measures in selection criteria**. Moreover, **demonstration clean river segments where conditions are good and/or have been successfully revitalized should be recognized and socialized** (e.g., mapped, marked with signage, formally designated). This could be done, for example, through a Clean Brantas awards or certification program that celebrates riverside communities that have revitalized riverbanks, made efforts to reduce river litter, etc. Experiences from the SaberS Pungli program, Gresik fish sanctuary program show that clean river segments can be further developed as recreational, fishing, or ecotourism areas to encourage community engagement and participation in river conservation and generate income.

Similarly, some campaigns have gained attention because of their simplified focus on one target issue. This is the case, for example, for diaper waste. Ecoton in Gresik has reported a successful response to community programs that offer diaper disposal bins specifically.

LEVERAGING CITIZEN SCIENCE AS A TOOL FOR RESEARCH, ACTION, AND ADVOCACY

Citizen science, the collection and analysis of data by members of the general public, is another useful tool to (a) generate additional water quality data, (b) promote citizen interest in clean water and river conservation, and (c) foster community-led action to reduce pollution. Citizen science has been actively undertaken by a number of groups in the region. Jaringan Komunikasi Pemantauan Kualitas Air (JKPKA) is the most long-standing program, having launched its water enquiry program in 1997. At present, nearly 100 middle and high schools in the Brantas and an additional 18-20 elsewhere in Indonesia collect water quality data in the JKPKA program, with support from PJT I and other partners.[89] More recently, a network of community groups linked with Aksi Brantas have been undertaking water quality monitoring and microplastics analysis to increase public awareness of water quality and inspire community efforts to reduce water pollution. The **BrantaSae online platform managed by Brawijaya University should be further supported and socialized to promote dissemination of citizen-generated and crowd sources water quality data and information**. The BrantaSae site (https://brantasae.ub.ac.id) includes citizen-generated water quality data sets, as well as geo-tagged information on water quality pollution sources, technical solutions, and community programs associated with river health, environmental stewardship, and waste management.

IV.7.2. PROVIDE PUBLIC INFORMATION AND CHANNELS FOR COMMUNICATION

Public communication is key to raising awareness regarding water quality and water pollution, building public support for local investment and action to reduce water pollution, and gathering local information and feedback. Such information exchanges include public campaigns to promote behavioral change and river action, provision

[88] Wadulink Sumengko cultivates moringa leaves in riverside gardens for use in food products in an environmentally sustainable manner, with an additional commitment to support desa river conservation

[89] https://jkpka.com

of reliable water quality data, and provision of effective channels for information-sharing between government and communities.

ENGAGE SOCIAL MEDIA AND POLITICAL COMMUNICATION EXPERTISE IN A UNIFIED PUBLIC CAMPAIGN

Social-political communication experts (e.g., from regional universities or media companies) should be engaged to help design a unified public campaign to inspire behavioral change and increase citizen valuation of river health. Such a campaign should be built on an informed understanding of the target audience's values, beliefs, and motivations, as well as the factors that drive current behavior. Linking water quality to standing concerns (e.g., about household health, groundwater safety, or community pride) may be more effective than trying to generate concern for water quality in isolation of other issues.

Messaging should also be carefully and positively framed and delivered by a credible messenger or social influencer. Moreover, the campaign should utilized various communication channels and platforms, including social media, traditional media, community events, etc. to reach a wide and varied audience.

Socialize reporting opportunities and rights

Citizens also have the right and obligation to report water pollution incidents and violations of water law. All government agencies have reporting systems in place, and there is a general national complaint management system (SP4N-LAPOR!) intended to funnel complaints to relevant agencies.[90] Nevertheless, awareness of rights to file reports is generally low (Figure 30), as is awareness of the channels for filing grievances.[91] Moreover, there is often either a lack of follow-up to filed complaints or limited public communication regarding responses to lodged complaints. As such, efforts to promote transparency in reporting and follow-up action are needed. These could include, for example, a requirement to publicly report filed grievances and follow-up actions online or in local desa or agency offices. Moreover, agency websites and offices should publicly post available channels for filing grievances.

IV.7.3. FACILITATE PARTICIPATORY PLANNING FOR WATER AND THE ENVIRONMENT

Active community participation not only enhances awareness but also ensures that local perspectives are considered, fostering a sense of shared responsibility for the preservation of the river basin's water quality and introducing important local-level information to the processes of policy formulation, implementation, and adjustment. Wide public participation offers important informational and legitimizing functions. Experiences from the SaberS Pungli program demonstrated that dialogues with desa residents were useful to understand the unique spatial and operational challenges faced by residents in managing waste and to tailor location-specific solutions.[92]

A 2022 survey of water managers in the Brantas suggested, however, that water management decisions are only somewhat responsive to stakeholder inputs (Figure 29). Project observations of public meetings also indicated a tendency towards one-way communication from government to community with lesser inputs from general participants. Moreover, water managers' expressed concern that public awareness regarding rights to participate in public planning and budgeting is generally low (Figure 31). As noted in the section on Challenge 6, more inclusive

[90] See Presidential Regulation (Perpres) No 76/2013 on Public Service Management System

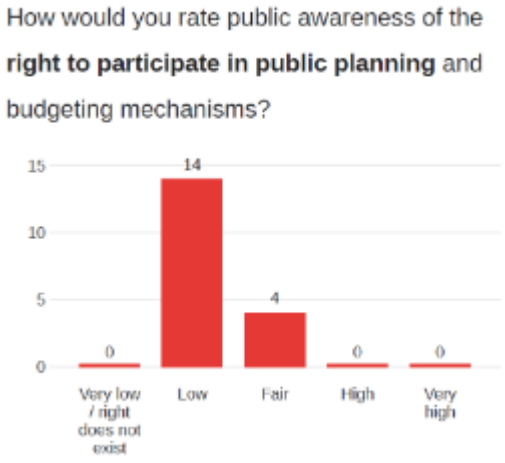
[91] Results from project water managers' survey, May 2022

[92] SaberS Pungli PowerPoint, 2023

engagement of riverside desa members and women in Musrenbang and public consultations on water resources and waste management are recommended to promote more informed planning related to management of household waste and riparian areas. Increase participation also depends on empowering communities through education on river issues and political advocacy. Many citizens self-select with respect to participation when they do not feel capable of understanding or contributing to planning processes.

Figure 29. Perceived responsiveness of water decisions to stakeholder inputs

Figure 30. Perceived awareness of rights to participate in public planning



Source: Project water managers' survey, 2022

IV.7.4. STRENGTHEN WOMEN'S PARTICIPATION IN WATER QUALITY PLANNING AND MANAGEMENT AT THE VILLAGE LEVEL

Many of the domestic activities of waste and wastewater management are controlled by women, who also possess important knowledge regarding local-level practices and conditions that may influence the effectiveness and feasibility of proposed solutions. **Survey and qualitative data shows that women have highest capacities to manage household pollution and confidence in their abilities to problem-solve for water quality and water pollution problems at the village level, including management of solid waste and use of riparian areas.[93] Women are grossly underrepresented, however, in formal government planning mechanisms (e.g. Musrenbang and village meetings)**, where community decisions are made regarding investments in services and infrastructure. As such, gendered local knowledge regarding waste and water management options are under-represented. Some important efforts have been made to empower women to participate more actively, however, including training on river health and advocacy via LSMs and select Sekolah Perempuan programs (e.g., in Jombang and Gresik) and implementation of "Musrenbang Perempuan" sessions to specifically target women's participation in development planning. These are important opportunities for further development, and government agencies can collaboratively support such efforts by **developing training materials and programs related to advocacy and environmental management, best practices for household management of pollution sources, and rights to information and reporting, particularly targeting women's groups**. DLH Jatim and BBWS Brantas should work together with DP3AK to explore how standing programs for PUG and women's empowerment can be leveraged to strengthen women's participation in environmental decision-making.

[93] Project survey and interview research (forthcoming) by TU Delft and Universitas Airlangga, 2023-2024

Moreover, government agencies involved in environmental and water resources management should **ensure active attendance and participation of women in consultations and meetings through targeted invitations and meeting opportunities that suit women's needs, with support of appointed Gender Focal Points**. This will require paying particular attention to the information and communication channels and informal networks most utilized by women at the village level and should go beyond only the PKK organization, which typically does not include marginalized women likelier to be vulnerable to water pollution. Moreover, **public consultation meetings must be scheduled at times and locations that are socially and culturally appropriate for women** and are responsive to household and childcare obligations.

IV.7.5. REVIEW OF ACTIONS AND STRATEGIES IN STANDING PLANS

Table 54 summarizes the actions related to community participation and engagement stated in plans of BBWS Brantas, DLH Jatim, and PJT I. While the remaining input documents include a large number of general community engagement actions, this section summarizes only those of the above institutions, since the proposed actions for all agencies are largely stated in general terms (e.g., implement community engagement, promote positive attitudes, increase public understanding). Brantas Harmoni proposes to add value by proposing key actions related to community engagement and participation in terms facilitating community river action and education; providing public information and channels for communication; and facilitating participatory planning, monitoring, and evaluation.

Table 54. Agency strategies and actions to strengthen community participation

Source	Page	Formulating Agency	Strategy / Action / Objective	Indicator	Baseline	Target	Implementing Agencies
Pola Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2020)	202, 296	BBWS Brantas	Implement community engagement with socialization, PKM, and the like in WRM	-	-	All agency water resource managers carry out community engagement in WRM	Bappeda (Prov/Kab/Kota), BBWS Brantas; PJT I, PU SDA (Prov/Kab/Kota), TKPSDA
	220		Socialization activities regarding the importance of river environmental management and water conservation.	-	-	Public has a high understanding of the importance of river environmental management and water conservation in the Brantas River Basin.	Pemerintah Prov. Jatim, TKPSDA, BBWS Brantas, BPDASHL, Bappeda (Prov/Kab/Kota), DLH (Prov/Kab/Kota)
	296		Strive to achieve a positive attitude from the community officials and agencies towards water conservation throughout the Brantas River.	Positive attitude within communities and agencies regarding water conservation	-	Positive attitudes amongst communities and agencies, with achievement of 25% (ST) / 75% (MT) / 100%(LT)	BBWS Brantas; Bappeda (Prov/Kab./Kota), PJT I, PU SDA (Prov/Kab/Kota), TKPSDA
	296		Socialize the importance of river environmental management and conservation.		-	-	BBWS Brantas, PJT I, PU SDA (Prov.Kab./Kota), TKPSDA
	297		Implement community socialization programs, especially in communities living near the river and upstream communities.		-	-	BBWS Brantas, PJT I, PU SDA (Prov/Kab/Kota)), TKPSDA
	297		Facilitate formation of river care communities		-	-	BBWS Brantas, PJT I, PU SDA (Prov/Kab/Kota)
	297		Increase community involvement in water quality monitoring; upgrade Water Quality Monitoring Communication Network (JKPKA) outreach / education activity to a function of SDA training	-	-	-	PJT I, BBWS Brantas; DLH (Prov/Kab/Kota)
	297		Implement assistance for poor people and underprivileged communities affected by WRM	-	-	-	Prov./Kab./Kota Government
	298		Implement community assistance by government to natural resources users and environmental communities	-	-	-	BBWS Brantas, BPPW Prov., PU SDA (Prov/Kab/Kota)

	298		Facilitate / assist / provide guidance to community groups and kelompok masyarakat through technical guidance related to WRM	-	-	-	BBWS Brantas, BPPW Prov., PU SDA (Prov/Kab/Kota)
	261		Increase public understanding of river environmental management and conservation; outreach activities regarding the importance of river environmental management and conservation	Increase understanding the importance of environmental management	-	-	Governor, Bappeda (Prov/Kab/Kota)), BBWS Brantas, PU SDA (Prov./ Kab./Kota), TKPSDA, BUMN / company through CSR, Universities, NGOs
	259		Socialize the importance of maintaining water quality; involve the community in all activities related to maintaining water quality	-	-	-	DLH (Prov/Kab/Kota); Bappeda (Prov/Kab/Kota), BBWS Brantas, PU SDA (Prov/Kab/Kota), PJT I, NGOs
	259		Implement Prokasih activities intensively throughout WS Brantas by involving Government, private sector, and BUMN through CSR	-	-	Implement PROKASIH in all WS Brantas.	DLH (Prov / Kab / Kota), BBWS Brantas, Bappeda (Prov / Kab / Kota), PU SDA (Prov / Kab / Kota), PJT I, NGOs
	258		Involving the community in environmental conservation, such as Prokasih activities.	-	-	-	DLH Prov./Kab./Kota, BBWS Brantas, Pemerintah Prov./Kab./Kota, Dinas PU SDA Prov./Kab./Kota.
Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas (2021)	420	BBWS Brantas	Arranging/maintain/carry out nroutine PROKASIH activities at WS Brantas Periodic monitoring, evaluation and supervision of PROKASIH activities on rivers in the region densely populated districts/cities.	-	-	-	Pemerintah Daerah Provinsi Jawa Timur, Pemerintah Daerah Kab/Kota, BBWS Brantas, PJT I
	525		Establish community institutions around WS Brantas as control in natural resource management	-	-	-	Kementerian PUPR; Pemerintah Daerah Prov./Kab./Kota.
Rencana Strategis BBWS 2019-2024	63	BBWS Brantas	Provide education to the public and industry about the importance of conservation, use of fertilizer in accordance with regulations, and land management procedures that do not interfere with conservation	-	-	-	-
	67		Carrying out the dissemination of an integrated natural resources information system to all stakeholders in stages and creating a database and utility system	-	-	-	-

			for information services and consistent provision of accountable information				
	67		Increasing community support in river area management and providing costs for planning activities, construction implementation, supervision, O&M (all Brantas WS)	-	-	-	-
Rencana Strategis 2019-2024, Dinas Lingkungan Hidup, Provinsi Jawa Timur (2019)	62	DLH Jatim	Community complaint follow-up activities and environmental law compliance	Percentage of public complaint cases that are followed up	85	95 (2024)	DLH Jatim
	62		Activities for implementing efforts and policies to strengthen the capacity of environmental community institutions	Number of institutions receiving education and training on environmental protection and management	-	200 per year (2024)	DLH Jatim
	31		Increase institutional capacity and community participation in environmental management	-	-	-	-
Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya (2018)	167-168	PJT I	Outreach to the local community and businessmen	-	-	-	-
	167-168		Giving awards to entrepreneurs who always obey in environmental management	-	-	-	-
	167-168		Giving awards to active entrepreneurs empowering communities in watersheds to maintain WQ	-	-	-	-
	167-168		Empowerment of Non-Governmental Organizations (NGOs)	-	-	-	-
	167-168		Increasing the role of mass media in efforts to socialization and monitoring of river water pollution	-	-	-	-
	170		Dissemination to community and entrepreneurs about applicable laws and regulations related to water management and waste management	-	-	-	-

IV.7.6. SUMMARY OF RECOMMENDED ACTIONS

Program	Prioritized Measures	Progress Indicators	Implementing Agencies
Community river action and education (Clean River, Gerakan Bersih Sungai, Ekoriparian, Ekowisata, etc.)	Develop and publish guidance resources (online) based on successful river care and education programs Promote knowledge-sharing via online platform (e.g., BrantaSae) and organized networking events (e.g., roadshows and workshops) Promote / facilitate educational and faith-based programs for water stewardship; develop Green Pesantren and Adiwiyata school programs	Number of active river care community groups Number of Green Pesantren / Ekopesantren Number of Adiwiyata schools	BBWS Brantas, PJT I, DLH Jatim, LSMs, Academia
	Develop compatible citizen science data set (in partnership with host university and existing programs (e.g, JKPKA) and accompanying guidance for data collection Promote online public dissemination of collected data via BrantaSae platform	Number of active citizen science campaigns Number of publicly-available water quality data sets	Universities, LSMs, PJT I
	Develop several (2-3) "flagship" programs that bundle behavior change measures and service provision, focused on key household pollution issues (e.g., diaper waste and food waste)	% reduction / improved management of targeted wastes (diaper waste, food waste)	DLH Jatim, Kab/Kota, LSMs
	Develop Ekoriparian parks on the main river and tributaries Recognize clean river segments via a Clean Brantas certification and recognition scheme	Number of ekoriparian developments Number (or km) of Clean Brantas segments	KLHK, DLH Jatim, Kab/Kota
	Provide technical resources and support for the development of ecotourism (ekowisata) programs on the main river and tributaries Promote knowledge-sharing related to ecotourism via BrantaSae and live networking events and workshops	Number of financially sustainable river ecotourism (ekowisata) operations	KLHK, DLH Jatim, Kab/Kota
Public information	Design and implement public campaign for behavior change based on a clear and unified message that: Targets local beliefs related to cleanliness, environmental stewardship, and waste management, Links with standing concerns, Introduces social friction in the case of non-conformity, and Socially rewards environmental stewardship.	Media	BBWS Brantas, PJT I, DLH Jatim, Gubernor Jatim
	Increase the role of social media in a unified campaign focused on waste management and river care, informed by political communication specialists (private sector or academic) Utilize social media as a platform for citizen monitoring of river water pollution	Social media analytics (TBD)	
	Make water quality data and water management regulations publicly available online (DLH Jatim, Kab/Kota websites) and in desa offices	Demonstrated availability of public information	BBWS Brantas, DLH Jatim, Kab/Kota DLH
	Publish responses to public reports	Public availability of response documentation	BBWS Brantas, DLH Jatim, Kab/Kota DLH

Participatory planning	Publish information on public rights and opportunities to participate in planning Make planning meeting information publicly available online or in desa offices	Public posting of rights and responsibilities Public posting of consultation meeting information	BBWS Brantas, DLH Jatim, Kab/Kota DLH
	Increase the number of women participating in Musrenbang and public consultations on water and the environment	% of women in public meetings on water % of women participating in Musrenbang	Bappeda, BBWS Brantas, DLH Jatim, Kab/Kota
	Promote educational programs that combine river education with advocacy training	Number of river education and advocacy community trainings	BBWS Brantas, DLH Jatim
Empowering women and marginalized communities to participate in water quality management	Jointly develop training materials and programs related to advocacy and environmental management, best practices for household management of pollution sources, and rights to information and reporting, specifically targeted towards women's groups	Demonstrated availability of training programs and materials Number of training events / number of women trained	BBWS Brantas, DLH Jatim, Kab/Kota, DP3AK
	Engage women in village planning and agency consultations through Sekolah Perempuan, PKK, and informal and formal women's groups (e.g., prayer groups)	Number of women consulted in development planning / environmental planning	BBWS Brantas, DLH Jatim, Kab/Kota, DP3AK

CHAPTER V. BRANTAS HARMONI: LOOKING FORWARD

The conclusion of the Brantas Water Quality project and this attendant *Brantas Harmoni* report is not an endpoint; rather, it is a juncture that invites reflection, discussion, and a forward-looking perspective to continue progress towards a cleaner Brantas. More specifically, the chapter focuses on general recommendations to support formulation of an effective Brantas RPPMA; coordinated implementation based on joint planning; and effective plan management to foster ongoing adjustment and learning.

Integrated Water Quality Management is a process and ongoing service that involves a large set of activities performed by multiple organizations and actors in government, the private sector, and in communities. Some of these activities are performed singularly (by one organization or actor), whereas others require high levels of coordination for implementation. As such, the overall process of water quality management involves more "steering" than "rowing", whereby many actors are guided by a common vision and consensus on the problems and goals at hand.

V.1. RECOMMENDATIONS FOR RPPMA FORMULATION, IMPLEMENTATION, AND PLAN MANAGEMENT

V.1.1. PARTICIPATION

Because of the complexity of these interactions and the many subfunctions that must be performed, the formulation of an effective, actionable, and realistic RPPMA will hinge on a participatory and collaborative approach that actively engages government actors across line ministries and levels of government, as well as industry and community stakeholders. So, too, should the processes of ongoing monitoring, evaluation, learning, and adjustment be participatory and inclusive of multiple perspectives to ensure that diverse water uses are considered alongside the ecological integrity of the Brantas basin; to build trust amongst stakeholders and a common vision for river health; to build capacity for problem analysis and solution-finding; and to reduce risks associated with poor understanding of local conditions or community requirements (Winfield et al., 2020). Some key stakeholders that should be actively engaged in RPPMA formulation by way of consultations include:

Table 55. Recommended consultations for RPPMA formulation

National level	Bappenas Kementerian Lingkungan Hidup dan Kehutanan, Ministry of Environment and Forestry Kementerian Pekerjaan Umum dan Perumahan Rakyat (PUPR), Ministry for Public Works and Public Housing BPPW Clpta Karya
Basin level	BBWS Brantas PJT I Tim Koordinasi Pengelolaan SDA WS Brantas (TKPSDA Brantas),
Provincial level	Bappeda Jawa Timur Dinas Lingkungan Hidup Provinsi Jawa Timur Dinas PU SDA Dinas Pertanian dan Ketahanan Dinas Peternakan Dinas Perindustrian Dinas Cipta Karya Dewan Sumber Daya Air Dinas DP3AK
Kota / Kabupaten level	Dinas Lingkungan Hidup Bappeda
Non-governmental	Desa / village focus group Environmental LSMs Manufacturing industry representatives UMKM focus group Faculties of regional universities, including water resources and water engineering, public administration, and gender and social inclusion

During the process of RPPMA formulation, Brantas Harmoni recommends that consultations focus on some of the following key issues:

- Agreement on information used to inform problem / situation analysis,
- Added local information related to pollution sources,
- Challenges of common concern, and
- Agreement on responsibilities and roles in implementation.

V.1.2. ACTIONABILITY AND REALISM

As discussed in Chapter IV, Challenge 6, a realistic and actionable Water Quality Protection and Management plan requires:

- Careful consideration of **resource limitations** as well as social, cultural, and political factors,
- **Specific actions** assigned to specific implementing organizations or actors with the mandates to perform such actions,
- **Measurable and achievable targets and indicators**,
- A clear **prioritization approach** to guide decide-making and investments, and
- **Adequate funding**.

First, actionable and realistic interventions must deal with the real constraints at hand related to human resources, capacities, physical and infrastructural requirements, law, and the availability of finance. Once these are identified, formulators can (a) rule out infeasible options and / or (b) consult stakeholders on potential opportunities to relieve known constraints.

Second, the **activities, targets, and indicators should be specific, measurable, actionable, realistic, and time bound. Many standing plans fall short of providing clear and measurable objectives and targets towards which agencies can work and against which their performance can be effectively measured**. Additionally, available and **alternative intervention options should be considered according to clear criteria that are agreed by key stakeholders**. In this way, decision-making to prioritize water quality interventions can be made more systematic and, at the very least, must be weighed against key considerations such as effectiveness and efficiency.

Last, stipulated actions must be accompanied by adequate funding. This means considering what budgets may be applied for particular measures and creating clear links between plans and budget allocations. A project water managers survey indicated that funding decisions are sometimes guided by strategic plans, but that the links between activities stipulated in plans like the Pola and Rencana and allocated budgets are not always clear. As such, **enabling legislation may be needed to establish the relationship between stipulated activities in the RPPMA and budgeting**. Key but underutilized special funds may be an important source of transfers from the APBN to regional governments tasked with implementation, particularly for pollution control. **Additional guidance on used and development of economic instruments set out in Government Regulation No. 46/2017 regarding Economic Instrument for the Environment could help extend current funding limitations to allow for additional interventions**. Moreover, government may consider whether an additional tariff component could be added to the Biyaya Jasa Pengelolaan Sumber Daya Air (BJPSDA) or other available government tariffs to secure a source of funding for removal of river solid waste, development of riparian green spaces, development of wastewater treatment facilities, or other water quality intervention.

V.1.3. ACCOUNTABILITY

It is also important that specific actions and responsibilities stipulated in the RPPMA are allowable within the legal remits of nominated agencies; aligned with standing policies and plans; and "owned" by agency leaders in formulation deliberations. While recommendatory plans such as the Pola are helpful to identify potential actions and actors, **the likelihood that an agency will, indeed, adopt stipulated interventions in their annual work and activity plans is increased with their participation in formulation**. Moreover, the plan should assign specific activities (when, what, where, etc.) to agencies, particularly for measures that involve multiple organizations in implementation. This will also facilitate more meaningful and effective performance evaluation.

V.1.4. LINKS TO OTHER PLANNING MECHANISMS

The RPPMA should be aligned with the other major plans that govern water resources and pollution sources, including from agriculture, industry, and households. These plans include:

- Pola Wilayah Sungai Brantas[94]
- Rencana Pengeloloaan Sumber Daya Air Wilayah Sungai Brantas[95]
- RPJMD Jawa Timur (Medium-term development plan)
- RTRW Jawa Timur / Kota / Kabupaten (Regional spatial plans)
- Strategic and work plans of DLH Brantas, PJT I, Dinas Pertanian dan Ketahanan Pangan, Dinas Perindustrian, Dinas Peternakan, Dinas Perikanan, Cipta Karya, BPPWS, etc.

Reconciliation of plans will require careful timing to ensure consideration during the formulation processes of each. Moreover, it is important that the RPPMA consider the standing goals of other agencies as important inputs to avoid policy conflict and increase the likelihood that agencies will, indeed, assume responsibility for and commitment to the specific goals and targets included in the RPPMA that require their active participation to attain.

The process of reconciling plans will likely require the active coordination and support of either an enabled and empowered independent coordination body or a standing coordination agency such as Bappenas or Bappeda Jawa Timur. Bappeda's support is particularly important because of the need to align the spatial plan (RTRW) with the RPPMA. While the Pola, Rencana, and RTRW are, by law, to be integrated, the actual alignment of plans is a developing process. A 2016 ADB report noted that a focus on water resources management is notably missing from development plans like the RPJMD. Moreover, because the Pola is limitedly embedded in the RPJMD, it often lacks the budgetary support and support from nominated implementing agencies to be effective (ADB, 2016). A similar fate for the RPPMA should be intentionally avoided – a condition that will require clear coordination processes and enabling legislation.

V.2. PLAN MANAGEMENT

The **RPPMA should also stipulate clear processes and timing for formal reviews (evaluations), responsibilities for evaluation, and processes for plan reformulation and adjustment**. A robust monitoring and evaluation system should be established to track progress and identify areas for adjustment. The water quality monitoring system,

[94] Most recently published in 2020 for the period 2015-2035

[95] Most recently published in 2021

specifically, should be tied to triggers for action when pollution levels increase or where progress in particular areas is stalled.

Key decisions include:

- What are the indicators by which progress will be measured?
- Who is responsible for providing what performance data, how often, and to whom?
- Which agency or organization is responsible for evaluating progress on water quality?
- How often will the plan be evaluated? Who will participate?
- How will results be disseminated?

V.3. ROLE OF COORDINATION BODIES

One of the most significant unresolved issues for supporting water quality management is the set of mechanisms and processes in place to support coordination in planning, implementation, monitoring, and evaluation. As discussed in Chapter IV, Challenge 7, the Brantas Water Quality Project facilitated the formation and activities of a water quality working group (Pokja Kualitas Air) within TKPSDA Brantas under Komisi III (Daya Rusak Air). The purpose of this working group is to institutionalize a multi-stakeholder and cross-sectoral team to coordinate responses to water quality-related problems and provide feedback on planning and evaluation of water quality interventions. There is general consensus that such a coordination function is necessary to attain water quality in the Brantas, but the institutional home and funding mechanisms for ongoing operations are issues that must be decided.

Moreover, different types of coordination may be required for different subfunctions of water quality management. Some options are proposed for coordinating such subfunctions in Table 56.

Table 56. Potential coordination forms for subfunctions of water quality management

Subfunction	Coordination Needs	Potential Forms / Participation
Planning Evaluation Overall coordination and policy guidance	Provision of data to inform problem / situation analysis Consultation during formulation process to agree on actions, targets, and progress indicators Provision of data to track progress Coordinate / perform / hire consultancy for evaluation	TKPSDA Pokja Kualitas Air, led and funded by DLH Jatim, KLHK, or Bappeda Clean Brantas Commission, led and funded by DLH Jatim, KLHK, or Bappeda Dewan SDA Water Quality Working Group, led and funded by Governor / PU SDA
Pollution response	Coordinated response to specific pollution issues (e.g., diaper waste, livestock runoff, etc.)	TKPSDA Pokja Kualitas Air Ad hoc working groups convened by the Governor, DLH Jatim, or KLHK (participation based on specific issue)
Public information	Unified public campaign	Multistakeholder campaign team led by Governor
Industrial effluent monitoring and enforcement	Coordinate response to reported violation; coordinate spot-checks	16 DLH Kota / Kabupaten, DLH Jatim, SatPol, enforcement agencies
Community participation	Support information-sharing and learning across community groups	Academic-LSM coordination body

V.4. CLOSING

In conclusion, *Brantas Harmoni* stands as first step and joint commitment to address the physical, institutional, and managerial challenges in the Brantas and to promote a healthier river ecosystem. The combination of efforts needed to strengthen water quality management includes actions to reduce pollution from domestic wastewater, solid waste, industrial pollution, and agriculture and livestock, as well as efforts to strengthen the processes and activities related to planning, coordination, enforcement, and community engagement.

Through the concerted efforts of various stakeholders and sectors, *Brantas Harmoni* aims to not only mitigate pollution but also to enhance the overall water quality and ecological integrity of the Brantas River, strengthen integrated water resources management, and stand as an example for other river basins in Indonesia that face similar challenges. The success of the *Brantas Harmoni* initiative and the efforts of the Brantas Water Quality Project and its government partners, BBWS Brantas, DLH Jatim, and PJT I, hinges on the ability to harmonize activities and promote ongoing collaboration and shared responsibility. During this time of political change, progress towards a healthy Brantas also depends heavily on strong leadership at the national and regional levels to promote river stewardship, assume joint responsibility for river health, and extend a hand across sectoral divisions to enable collective and coordinated action. By fostering a unified approach and addressing challenges collectively, citizens and agencies in the Brantas River basin can ensure the sustainable management of this vital resource for current and future generations.

REFERENCES

Abedalrazq, K., Jennifer, M.-G., Christopher, W., Mohamad Mova, A., Perwitasari, Xiawei, Tarasinta, and A. M. K., Kamelia, O., Etty, R., & Liao. (2021). *Indonesia Vision 2045: Toward Water Security*. World Bank.

Adi, S., Jänen, I., & Jennerjahn, T. C. (2013). History of development and attendant environmental changes in the Brantas River Basin, Java, Indonesia, since 1970. *Asian Journal of Water, Environment and Pollution*, *10*(1), 5–15.

BBWS Brantas. (2020a). *Pola Tahun 2020 Pengelolaan Sumber Daya Air Wilayah Sungai Brantas*. https://sda.pu.go.id/balai/bbwsbrantas/dokumen/view/pola-pengelolaan-sumber-daya-air-wilayah-sungai-brantas-tahun-2020#book/

BBWS Brantas. (2020b). *Rencana Strategis BBWS Brantas 2020-2024*. https://sda.pu.go.id/balai/bbwsbrantas/assets/uploads/files/rencana_strategis_sda_2020-2024_1675849249_e8f0a64e0046bc4fecaf.pdf

BBWS Brantas. (2021). *Rencana Pengelolaan Sumber Daya Air Wilayah Sungai Brantas*.

Binnie & Partners (Overseas) Ltd. (1999). *Surabaya River Pollution Control Action Plan Study Final Report: Executive Summary*.

Buwono, N. R., Risjani, Y., & Soegianto, A. (2021). Distribution of microplastic in relation to water quality parameters in the Brantas River, East Java, Indonesia. *Environmental Technology & Innovation*, *24*, 101915.

Chand, A. (2021). SMART targets for meaningful action. *Nature Food*, *2*(4), 224.

DLH Jatim. (2019). *Rencana Strategis 2019-2024, Dinas Lingkungan Hidup Provinsi Jawa Timur*. https://dlh.jatimprov.go.id/public/uploads/e678a74b128ed7ea3e5692b78e8522b9.pdf

Fujimoto, K. (2013). Brantas river basin development plan of Indonesia. In *Aid as Handmaiden for the Development of Institutions* (pp. 161–194). Springer.

Fulazzaky, M. A. (2009). Water quality evaluation system to assess the Brantas River water. *Water Resources Management*, *23*(14), 3019.

Harnanto, A., & Hidayat, F. (2004). *Dilution as one measure to increase river water quality*. Kyoto University: Water Resources Research Center.

Indarto, I., Hidayah, E., & Hakim, F. L. (2022). Assessment of Land Use and Land Cover Change from 2000 to 2019 in East Java Indonesia. *Anuário Do Instituto de Geociências*, *45*, 1–15.

Ismanto, A., Hadibarata, T., Kristanti, R. A., Maslukah, L., Safinatunnajah, N., & Sathishkumar, P. (2022). The abundance of endocrine-disrupting chemicals (EDCs) in downstream of the Bengawan Solo and Brantas rivers located in Indonesia. *Chemosphere*, *297*, 134151.

Japan International Cooperation Agency. (2019). *The Project for Assessing and Integrating Climate Change Impacts into the Water Resources Management Plans for Brantas and Musi River Basins Final Report (Water Resources Management Plan)*. https://openjicareport.jica.go.jp/pdf/12353090_02.pdf

Jennerjahn, T. C., Ittekkot, V., Klöpper, S., Adi, S., Nugroho, S. P., Sudiana, N., Yusmal, A., & Gaye-Haake, B. (2004). Biogeochemistry of a tropical river affected by human activities in its catchment: Brantas River estuary and coastal waters of Madura Strait, Java, Indonesia. *Estuarine, Coastal and Shelf Science*, *60*(3), 503–514.

KLHK. (2018). *Indeks Kualitas Lingkungan Hidup Indonesia 2017*. https://dlh.mukomukokab.go.id/site1/wp-content/uploads/2019/10/Indeks-Kualitas-Lingkungan-Hidup-Tahun-2017.pdf

KLHK. (2020). *Statistik 2020: Statistik Kualitas Air, Udara, dan Tutupan Lahan*. https://ppkl.menlhk.go.id/website/filebox/1033/210930123917BUKU STATISTIK PPKL 2020 (versi CETAK).pdf

KLHK. (2021). *2021 Laporan Kinerja, Direktorat Jenderal Pengendalian Pencemaran dan Kerusakan Lingkungan*. https://ppkl.menlhk.go.id/website/filebox/1069/220221103249LKj Ditjen PPKL 2021 (FINAL).pdf

KLHK. (2022a). *IKLH 2022*. https://ppkl.link/Buku-IKLH-2022%0A

KLHK. (2022b). *Rencana Strategis 2020-2024 (Revisi 1)*.

https://www.menlhk.go.id/cadmin/uploads/12_P3_E_Jawa_a5893f660d.pdf

Nurfaizah, D., Pravitasari, A. E., Lubis, I., & Saizen, I. (2023). Land cover changes and spatial planning alignment in East Java Province. *IOP Conference Series: Earth and Environmental Science*, *1133*(1), 12049.

Nuruzzaman, M., Al-Mamun, A., & Salleh, M. N. Bin. (2018). Experimenting biochemical oxygen demand decay rates of Malaysian river water in a laboratory flume. *Environmental Engineering Research*, *23*(1), 99–106.

Pemerintah Daerah Provinsi Jawa Barat. (2019). *Rencana Aksi Pengendalian Pencemaran dan Kerusakan DAS Citarum 2019-2025*. https://drive.google.com/file/d/1VtGjzfKSi3uMEOtFjg6q3auQltH-0GZW/view?usp=sharing

Pemerintah Daerah Provinsi Jawa Timur. (2012). *Peraturan Daerah Provinsi Jawa Timur Nomor 5 Tahun 2012 tentang Rencana Tata Ruang Wilayah Provinsi, Tahun 2011-2031*. https://peraturanpedia.com/download/?id=aHR0cHM6Ly9kb2NzLmdvb2dsZS5jb20vdWM/ZXhwb3J0PWRvd25sb2FkJmlkPTFjRFk1NWVPTDR1WVNvTGstTFdCaGMwMmdrRmZUdWw5Qw==

Pemerintah Daerah Provinsi Jawa Timur. (2019). *Rencana Pembangunan Jangka Menengah Daerah (RPJMD) Provinsi Jawa Timur Tahun 2019-2024*. https://bappeda.jatimprov.go.id/bappeda/wp-content/uploads/dokren/rpjmd_jatim_2019_2024_official.pdf

Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor P.68/Menlhk/Setjen/Kum.1/8/2016 tentang Baku Mutu Air Limbah Domestik, https://ppkl.menlhk.go.id/website/filebox/5/170314114854P.68%20BAKU%20MUTU%20LIMBAH%20DOMESTIK.pdf

Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia Nomor 04/PRT/M2015 tentang Kriteria dan Penatapan Wilayah Sungai, (2015). https://sda.pu.go.id/assets/files/PermenPUPR04-2015.pdf

Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 16 Tahun 2020 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis di Kementerian Pekerjaan Umum dan Perumahan Rakyat, (2020).

Peraturan Pemerintah Republik Indonesia Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup, https://peraturan.bpk.go.id/Details/161852/pp-no-22-tahun-2021

Perrings, C., Naeem, S., Ahrestani, F. S., Bunker, D. E., Burkill, P., Canziani, G., Elmqvist, T., Fuhrman, J. A., Jaksic, F. M., & Kawabata, Z. (2011). Ecosystem services, targets, and indicators for the conservation and sustainable use of biodiversity. *Frontiers in Ecology and the Environment*, *9*(9), 512–520.

PJT I. (2018). *Penyusunan Studi Rencana Induk Pengelolaan Kualitas Air Sistem Sungai Surabaya*.

PUPR. (2010). *Pola 2010 Pengelolaan Sumber Daya Air Wilayah Sungai Brantas*. https://sda.pu.go.id/balai/bbwsbrantas/assets/uploads/files/pola_pengelolaan_sumber_daya_air_wilayah_sungai_brantas_tahun_2010_1671548464_7be4ca35de30bfce04e1.pdf

PUPR. (2020). *Rencana Strategis Tahun 2020-2024 Kementerian Pekerjaan Umum dan Perumahan Rakyat*. https://pu.go.id/assets/media/1927846278Buku Renstra Kementerian PUPR 2020-2024.pdf

PUPR Ditjen Sumber Daya Air. (2020). *Rencana Strategis 2020-2024 Direktorat Jenderal Sumber Daya Air Kementerian PUPR*. https://sda.pu.go.id/assets/files/RENSTRA_SDA_2020-2024.pdf

Rashid, M. I., & Shahzad, K. (2021). Food waste recycling for compost production and its economic and environmental assessment as circular economy indicators of solid waste management. *Journal of Cleaner Production*, *317*, 128467.

Ratnaningsih, I. D., Lestari, R. P., & Nazir, E. (2021). Penanganan Parameter yang Hilang dalam Aplikasi Penilaian Kualitas Air IKA-INA. *Ecolab*, *15*(2), 101–109.

Schroeder, F., Boer, M., & Wijanarko, D. A. (2013). Development and application of the MERMAID water quality monitoring station in the Brantas River, Java, Indonesia. *Asian Journal of Water, Environment and Pollution*, *10*(1), 25–39.

Sholichin, M., & Othman, F. (2006). Application of Surface-water Modeling System (SMS) on River Stream: A Case Study in Brantas River. *4th National Technical Postgraduate Symposium*.

Sudaryanti, S., Trihadiningrum, Y., Hart, B. T., Davies, P. E., Humphrey, C., Norris, R., Simpson, J., & Thurtell, L. (2001). Assessment of the biological health of the Brantas River, East Java, Indonesia using the Australian River

Assessment System (AUSRIVAS) methodology. *Aquatic Ecology*, *35*(2), 135–146.

van Bijsterveldt, C. E. J., van Wesenbeeck, B. K., Ramadhani, S., Raven, O. V, van Gool, F. E., Pribadi, R., & Bouma, T. J. (2021). Does plastic waste kill mangroves? A field experiment to assess the impact of macro plastics on mangrove growth, stress response and survival. *Science of the Total Environment*, *756*, 143826.

Willard, T. (2022). *Water Quality Measurements in the Brantas, Indonesia: Constructing Different Perspectives with Principal Component Analysis*.

Winfield, D., Tilleard, S., Weber, T., Harriss, D., & Grant, M. (2020). *BasinGuide: A Guide to River Basin Planning*.

World Bank. (2021). *Plastic Waste Discharges from Rivers and Coastlines in Indonesia*. World Bank.

Yetti, E., Soedharma, D., & Hariyadi, S. (2011). Evaluasi kualitas air sungai-sungai di kawasan DAS brantas hulu malang dalam kaitannya dengan tata guna lahan dan aktivitas masyarakat di sekitarnya. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)*, *1*(1), 10.

APPENDIX A. KEY LAWS AND REGULATIONS ON WATER QUALITY MANAGEMENT

Key relevant legislation that was reviewed in relation to Brantas Harmoni includes the following. Not all remain in effect.

- Peraturan Pemerintah 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup
- Peraturan Presiden 92 Tahun 2020 tentang Kementerian Lingkungan Hidup dan Kehutanan
- Undang-Undang Nomor 17 Tahun 2019 tentang Sumber Daya Air
- Peraturan Presiden Nomor 10 Tahun 2017 tentang Dewan Sumber Daya Air Nasional
- Peraturan Pemerintah Nomor 69 Tahun 2014 tentang Hak Guna Air
- Undang-undang 37 Tahun 2014 tentang Konservasi Tanah dan Air
- Undang-undang Nomor 23 Tahun 2014 tentang Pemerintahan Daerah
- Peraturan Pemerintah Nomor 37 Tahun 2012 tentang Pengelolaan Daerah Aliran Sungai
- Peraturan Pemerintah 81 Tahun 2012 tentang Pengelolaan Sampah Rumah Tangga Dan Sampah Sejenis Sampah Rumah Tangga
- Peraturan Pemerintah 37 Tahun 2012 tentang Pengelolaan Daerah Aliran Sungai
- Peraturan Pemerintah Nomor 27 Tahun 2012 tentang Izin Lingkungan
- Peraturan Pemerintah 38 Tahun 2011 tentang Sungai
- Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup
- Undang-undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup
- Peraturan Pemerintah Nomor 42 Tahun 2008 tentang Pengelolaan Sumber Daya Air
- Peraturan Pemerintah Nomor 18 Tahun 2008 tentang Pengelolaan Sampah
- Putusan Mahkamah Konstitusi Nomor 85/PUU-XI/2013 (membatalkan Undang-undang Nomor 7 Tahun 2004 tentang Sumber Daya Air)
- Undang-Undang Nomor 32 Tahun 2004 tentang Pemerintahan Daerah
- Undang-Undang Nomor 7 Tahun 2004 tentang Sumber Daya Air
- Keputusan Presiden Nomor 83 Tahun 2002 tentang Perubahan atas Keputusan Presiden Nomor 123 Tahun 2001 tentang Tim Koordinasi Pengelolaan Sumber Daya Air
- Keputusan Presiden Nomor 123 Tahun 2001 tentang Tim Koordinasi Pengelolaan Sumber Daya Air
- Peraturan Pemerintah Nomor 82 Tahun 2001 tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air
- Peraturan Pemerintah Nomor 93 Tahun 1999 tentang Perusahaan Umum Jasa Tirta I
- Undang-Undang Nomor 23 Tahun 1997 tentang Pengelolaan Lingkungan Hidup
- Peraturan Pemerintah Nomor 35 Tahun 1991 tentang Sungai
- Peraturan Pemerintah Nomor 20 Tahun 1990 tentang Pengendalian Pencemaran
- Peraturan Pemerintah Republik Indonesia Nomor 5 tahun 1990 tentang Perusahaan Umum (Perum) Jasa Tirta
- Peraturan Pemerintah Nomor 20 Tahun 1990 tentang Pengendalian Pencemaran Air
- Undang-Undang Nomor 11 Tahun 1974 tentang Pengairan

PERATURAN MENTERI PUPR

- Peraturan Menteri PUPR Nomor 23 Tahun 2020 tentang Rencana Strategis Kementerian Pekerjaan Umum dan Perumahan Rakyat Tahun 2020-2024
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 16 Tahun 2020 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis di Kementerian Pekerjaan Umum dan Perumahan Rakyat
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 13 Tahun 2020 tentang Organisasi dan Tata Kerja Kementerian Pekerjaan Umum dan Perumahan Rakyat (menggantikan Peraturan Menteri PUPR/PRT/M Tahun 2006)
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 17/PRT/M/2017 Tahun 2017 Tentang Pedoman Pembentukan Tim Koordinasi Pengelolaan Sumber Daya Air Pada Tingkat Wilayah Sungai
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 04/PRT/M/2017 tentang Penyelenggaraan Sistem Air Limbah Domestik
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 12/PRT/M/2016 tentang Kriteria Tipologi Unit Pelaksana Teknis Pengelolaan Sumber Daya Air Wilayah Sungai pada Direktorat Jenderal Sumber Daya Air Kementerian Pekerjaan Umum dan Perumahan Rakyat
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 09/PRT/M/2015 tentang Penggunaan Sumber Daya Air
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 04/PRT/M/2015 tentang Kriteria dan Penetapan Wilayah Sungai
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 02/PRT/M/2013 tentang Pedoman Penyusunan Rencana Pengelolaan Sumber Daya Air
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 06/PRT/M/2011 tentang Pedoman Penggunaan Sumber Daya Air
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 21/PRT/M/2010 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis Kementerian Pekerjaan Umum
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 04/PRT/M/2008 tentang Pedoman Pembentukan Wilayah Koordinasi Pengelolaan Sumber Daya Air Tingkat Provinsi, Kabupaten/Kota, dan Wilayah Sungai
- Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 13/PRT/M/2006 tentang Organisasi dan Tata Kerja Balai Wilayah Sungai di Lingkungan Ditjen Sumber Daya Air
- Peraturan Menteri PUPR Nomor 12/PRT/M/2006 tentang Organisasi dan Tata Kerja Balai Besar Wilayah Sungai

PERATURAN MENTERI LINGKUNGAN HIDUP LINGKUNGAN HIDUP DAN KEHUTANAN

- Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 1 Tahun 2021 Tentang Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan Hidup
- Peraturan Menteri Lingkungan Hidup 5 Tahun 2015 tentang Baku Mutu Air Limbah
- Peraturan Menteri Lingkungan Hidup 1 Tahun 2010 tentang Tata Laksana Pengendalian Pencemaran Air
- Peraturan Menteri Lingkungan Hidup 115 Tahun 2003 tentang Pedoman Penentuan Status Mutu

PERATURAN DAERAH PROVINSI JAWA TIMUR

- Peraturan Gubernur 49 Tahun 2018 tentang Nomenklatur, Struktur Organisasi, Uraian Tugas dan Fungsi Serta Tata Kerja Unit Pelaksana Teknis Dinas Pekerjaan Umum Sumber Daya Air Provinsi Jawa Timur

- Peraturan Gubernur 107 Tahun 2016 tentang Nomenklatur, Susunan Organisasi, Uraian Tugas dan Fungsi serta Tata Kerja Unit Pelaksana Teknis Dinas Pekerjaan Umum Sumber Daya Air Provinsi Jawa Timur
- Peraturan Gubernur 98 Tahun 2016 tentang Nomenklatur, Susunan Organisasi, Uraian Tugas dan Fungsi serta Tata Kerja Unit Pelaksana Teknis Dinas Provinsi Jawa Timur
- Peraturan Gubernur 96 Tahun 2016 tentang Nomenklatur, Uraian Tugas dan Fungsi Serta Tata Kerja Unit Pelaksana Teknis Dinas Perumahan Rakyat, Kawasan Permukiman dan Cipta Karya Provinsi Jawa Timur
- Peraturan Gubernur 82 Tahun 2016 tentang Kedudukan, Susunan Organisasi, Uraian Tugas Dan Fungsi Serta Tata Kerja Dinas Perumahan Rakyat, Kawasan Permukiman Dan Cipta Karya Provinsi Jawa Timur
- Peraturan Gubernur 76 Tahun 2016 tentang Kedudukan, Susunan Organisasi, Uraian Tugas Dan Fungsi Serta Tata Kerja Dinas Lingkungan Hidup Provinsi Jawa Timur
- Peraturan Gubernur 61 Tahun 2016 tentang Kedudukan, Susunan Organisasi, Uraian Tugas dan Fungsi serta Tata Kerja Dinas Sumber Daya Air Provinsi Jawa Timur
- Peraturan Gubernur 52 Tahun 2014 tentang Perubahan atas Peraturan Gubernur Jawa Timur Nomor 72 Tahun 2013 tentang Baku Mutu Air Limbah Bagi Industri dan/atau Kegiatan Usaha Lainnya
- Peraturan Gubernur 72 Tahun 2013 tentang Baku Mutu Air Limbah Bagi Industri dan/atau Kegiatan Usaha Lainnya
- Peraturan Gubernur Nomor 5 Tahun 2012 tentang RTRW 2011-2031
- Peraturan Daerah Provinsi Jawa Timur Nomor 5 Tahun 2011 tentang Pengelolaan Sumber Daya Air di Propinsi Jawa Timur
- Peraturan Gubernur Nomor 61 Tahun 2010 Penetapan Kelas Air pada Air Sungai
- Peraturan Gubernur 60 Tahun 2010 tentang Pedoman Penetapan Daya Tampung Beban Pencemaran Air pada Air Permukaan
- Peraturan Gubernur 44 Tahun 2010 tentang Organisasi dan Tata Kerja Unit Pelaksana Teknis Badan Lingkungan Hidup Provinsi Jawa Timur
- Peraturan Gubernur 24 Tahun 2010 tentang Petunjuk Pelaksanaan Peraturan Daerah Provinsi Jawa Timur Nomor 2 Tahun 2008 Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air di Provinsi Jawa Timur
- Peraturan Gubernur Nomor 1 Tahun 2009 tentang Rencana Pembangunan Jangka Panjang Daerah Provinsi Jawa Timur Tahun 2005-2025
- Peraturan Daerah Provinsi Jawa Timur Nomor 2 Tahun 2008 tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air

PERATURAN PERENCANAAN DAN PENGELOLAAN DAS

- Undang-undang 23 Tahun 2014 tentang Pemerintahan Daerah
- Peraturan Pemerintah 37 Tahun 2012 tentang Pengelolaan Daerah Aliran Sungai
- Undang-undang 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup
- Peraturan Menteri Pekerjaan Umum Nomor 05/PRT/M/2008 tentang Pedoman Penyediaan Dan Pemanfaatan Ruang Terbuka Hijau Di Kawasan Perkotaan
- Undang-undang 26 Tahun 2007 tentang Penataan Ruang
- Undang-undang Nomor 26 Tahun 2007 tentang Penataan Ruang

APPENDIX B. TASKS AND FUNCTIONS IN WATER QUALITY MANAGEMENT

This appendix includes (a) a summary of programs and activities for water quality management developed by KLHK in preparation of the RPPLH Rencana Perlindungan dan Pengelolaan Lingkungan Hidup Nasional (RPPLH) 2025-2055 (National Environmental Protection and Management Plan), and (b) the methods and results of a TU Delft review of tasks and functions (tupoksis) related to water quality management in the Brantas River basin. Water quality management in Indonesia spans sectors and levels of government in arrangements that may be characterized as multi-level, polycentric, or fragmented, depending on the operating characteristics and outcomes. Numerous agencies at national, regional, and local levels of government perform tasks and functions similar to or the same as those of other agencies who operate at different levels of government or within different line ministries. As such, the TU Delft review focused particularly on identifying areas of overlapping mandates and responsibilities. This enquiry is relevant because non-singular, non-centralized management systems can give rise simultaneously to distinct opportunities and challenges. Such systems can support local empowerment, generate flexible and tailored management approaches, promote healthy inter-agency competition, and create system redundances for more resilient functioning. Alternatively, such systems can also create challenges related to coordination, fiscal efficiency, accountability, equity, and sustainability.

B.1 PROGRAMS AND ACTIVITIES IN WATER QUALITY MANAGEMENT

First, the following table describes functions of Water Quality Management identified by KLHK in preparation for the RPPLH.

Table 57. KLHK Description of Programs and Activities for Water Quality Management

Program	Activities	Implementing Units	
		Government	Nongovernment
Water Quality Management	Water Quality Monitoring	KLHK, PUPR (BBWS), DLH Prov, DLH Kab/Kota	SOEs, Academics, Business/Activities
	Target water quality evaluation, BMA, APBA	KLHK, DLH Prov, DLH Kab/Kota	
	Preparation of BMA, ABPA, target water quality, RPPMA	KLHK, DLH Prov, DLH Kab/Kota	
	Local Government Development for the preparation of BMA, ABPA, water quality targets, RPPMA	KLHK, DLH Prov	
	Public counseling on water quality management	KLHK, DLH Prov, DLH Kab/Kota	
	PPMA Information System Development	KLHK, DLH Prov, DLH Kab/Kota	Academics, NGOs, Media
Water Pollution Control	Inventory and Identification of Polluting Sources	KLHK, DLH Prov, DLH Kab/Kota	Academics
	Approval of technology based on the allocation of water polluting loads (disposal), wastewater utilization (5R)	KLHK, DLH Prov, DLH Kab/Kota, ESDM, Ministry of Health, Bappenas	Academics, Business, Technical Approval Compilers
	IPALD Communal/Integrated/ Individual (household) Development	KLHK, KemenPUPR, DLH Prov/Kab/Kota, PUPR Office, Bappenas, Ministry of Health	Business Actors
	Construction of WWTP; mix for all types of wastewater	KLHK, KemenPUPR, DLH Prov/Kab/Kota, PUPR Office, Bappenas, Ministry of Health	Business Actors

	OM and evaluation of Communal/Integrated/Individual WWTP	KLHK, KemenPUPR, DLH Prov/Kab/Kota, PUPR Office, Bappenas, Ministry of Health	NGOs, communities
	Procurement of Wastewater Carriers	KLHK, Ministry & PUPR Office, DLH ProvKab/Kota	Business Actors
	Construction of Livestock WWTP (biodigester, etc.)	KLHK, DLH Prov/Kab/Kota, Prov/Kab/City Agriculture Office, ESDM, Ministry of Agriculture	Academics, NGOs, Society
	OM &; Biodigester evaluation or other utilization	KLHK, DLH Prov/Kab/Kota, Prov/Kab/City Agriculture Office, ESDM, Ministry of Agriculture	Academics, NGOs, Society
	Education or counseling to farmers	KLHK, DLH Prov/Kab/Kota, Provincial Agriculture Office/Kab/Kota ESDM, Ministry of Agriculture	Academics, NGOs, Society
	Agricultural wastewater management	KLHK, DLH Prov/Kab/Kota, Prov/Kab/Kota Agriculture Office, Ministry of Agriculture	Academics, NGOs, Society
	OM &; Evaluation of agricultural wastewater management	KLHK, DLH Prov/Kab/Kota, Prov/Kab/Kota Agriculture Office, Ministry of Agriculture	Academics, NGOs, Society
	Education or counseling to farmers	KLHK, DLH Prov/Kab/Kota, Prov/Kab/Kota Agriculture Office, Ministry of Agriculture	Academics, NGOs, Society
	Construction of facilities/household waste management (3R)	KLHK, DLH Prov/Kab/Kota, Kementerian & Dinas PUPR	Private sector
	OM & evaluation of facilities/management of 3R household waste	KLHK, DLH Prov/Kab/Kota, Kementerian & Dinas PUPR	Private sector
	Development of waste banks & 3R waste management	KLHK, DLH Prov/Kab/Kota, Kementerian & Dinas PUPR	Academics, NGOs, Society
	Community education & counseling regarding 3R waste management (garbage bank, fertilizer, etc.)	KLHK, DLH Prov/Kab/Kota, Kementerian & Dinas PUPR	Academics, NGOs, Society
	Procurement of waste transporters	KLHK, DLH Prov/Kab/Kota, Kementerian & Dinas PUPR	Private sector
Spatial planning based on environmental carrying capacity (referenced from Citarum Watershed)	BMA & ABPA based RTRW review	KLHK, Ministry of ATR, Provincial / District / City Bapedda, Provincial / District / City DLH	Academics
	Preparation of KLHS based on BMA &; ABPA	KLHK, Ministry of ATR, Provincial / District / City Bapedda, Provincial / District / City DLH	Academics
	Preparation of RTRW based on KLHS results	KLHK, Ministry of ATR, Provincial / District / City Bapedda, Provincial / District / City DLH	Academics
	Implementation & Supervision of RTRW	KLHK, Ministry of ATR, PUPR, Provincial / District / City Bapedda, Provincial / District / City DLH	Business Actors Academics, NGOs, Society
	Coaching and Counseling	Ministry of ATR, Provincial / District / City Bapedda,	Business Actors Academics, NGOs, Society
Strengthening the culture of the community around the watershed	Public space arrangement	Ministry of PUPR, PUPR Office Prov/Kab/City	Academics, NGOs, Society
	Community education and counseling related to river borders	KLHK, KemenPUPR, DLH &; PUPR Office Prov/Kab/Kota	Academics, NGOs, Society, Media
	Watershed greening movement	KLHK, Provincial/District/City Local Government	Business Actors, Academics, NGOs, Communities

	Development of eco-friendly economic clusters	KLHK, Provincial/District/City Local Government	Business Actors, Academics, NGOs, Communities
	Clean movement of the river	KLHK, Provincial/District/City Local Government	Business Actors, Academics, NGOs, Communities
	Coaching and Counseling	Ministry of ATR, Provincial / District / City Bapedda,	Business Actors, Academics, NGOs, Society
Law Enforcement	Compliance of each person/legal entity to environmental approvals and SPPL, Spatial Planning	KLHK, DLH Prov/Kab/Kota, Kemen ATR, PUPR, Bappeda Province/Kab/Kota	Business Actors
	Supervision of compliance of each person/legal entity to environmental and spatial planning approvals	PPLH Center, Prov, District / City, Ministry of ATR, PUPR, Bappeda Province / District / City	Business Actors
	Guidance of each person/legal entity towards SPPL	KLHK, DLH Prov/Kab/Kota, Kemen ATR, PUPR, Bappeda Province/Kab/Kota	Business Actors
	Environmental approval reporting and SPPL, spatial implementation	KLHK, DLH Prov/Kab/Kota, Kemen ATR, PUPR, Bappeda Province/Kab/Kota	Business Actors
	Law Enforcement for every person/legal entity that commits violations in accordance with the PUU	PPNS, Police, Prosecutor's Office, Ministry of ATR, PUPR, Provincial / District / City Bappeda	Business Actors

Source: KLHK RPPMA PowerPoint, 2023

B.2 TASKS AND FUNCTIONS (TUPOKSIS) IN WATER QUALITY MANAGEMENT

The remainder of this appendix describes the method and results of a doctrinal legal review of tasks and functions (tupoksis) of water quality management and an analysis of areas of functional overlap, both performed by TU Delft in 2021.

METHODOLOGY

The tupoksis under review were extracted from the following laws:

Table 58. Laws defining tasks and functions in water quality management

Year	Statute
2021	Government Regulation (Perpem) 22 of 2021 concerning Protection and Management of the Environment
2021	Perpem 22 of 2021 concerning Protection and Management of the Environment
2021	Permen LHK 1 of 2021 concerning Performance Rating Assessment Program in Company Performance for Environmental Management (PROPER)
2020	Brantas River Basin Pola 2020, unpublished
2020	Permen PUPR 16 of 2020 concerning Organization and Work Procedures Of Technical Implementing Units in the Ministry Of Public Works and Public Housing
2020	Permen PUPR 16 of 2020 concerning Organization and Work Procedures for Technical Implementing Units in Ministry of Public Works and Public Housing
2020	Perpres 92 of 2020 concerning the Ministry of Environment and Forestry
2019	Law (UU) 17 of 2019 concerning Water Resources
2018	Pergub 49 of 2018 concerning Nomenclature, Organizational Structure, Description of Duties and Functions and Working Systems of Technical Implementing Units Department of Public Works of Water Resources, East Java Province
2017	Permen PUPR 17 of 2017 concerning Guidelines for Establishing a Resource Management Coordination Team Water at the Level of the River Area
2017	Presidential Regulation (Perpres) 10 of 2017 concerning National Water Resources Council

2016	Governor's Regulation (Pergub) 76 of 2016 concerning Position, Organizational Structure, Description of Duties and Functions and Working Procedures of DLH Jatim
2016	Governor's Regulation (Pergub) 98 of 2016 concerning Technical Implementation Unit (UPT) of DLH Jatim
2016	Pergub 107 of 2016 on Nomenclature, Organizational Structure, Description of Duties and Functions and Working Systems of Technical Implementing Units, Department of Public Works of Water Resources, Jatim
2016	Pergub 61 or 2016 concerning Position, Organizational Structure, Description of Tasks and Functions and Work Procedures for Public Works Water Resources of East Java Province
2016	Pergub 82 of 2016 concerning Position, Organizational Structure, Description Of Duties And Functions And Working Procedures For Public Housing, Residential Areas And Creation Works Of East Java Province
2016	Pergub 96 of 2016 concerning Nomenclature, Organization Description, Description Of Duties And Functions And Working Systems Of Technical Implementing Units, Public Housing Services, Residential Areas And Creation Works Of East Java Province
2016	Regulation of the Minister of Public Works and Public Housing Number 12 of 2016 concerning Typology Criteria for Technical Implementation Units for River Basin Water Resources Management at the Directorate General of Water Resources of the Ministry of Public Works and Public Housing
2011	Regulation (PP) 38 of 2011 concerning the River
2010	Government Regulation (Perpem) 46 of 2010 concerning Perusahaan Umum (Perum) (General Company) Jasa Tirta
2010	Permen LH 1 of 2010 concerning Procedures for Water Pollution Control
2009	Law (UU) 32 of 2009 Concerning Protection of the Environment
2009	Presidential Decree Number 6 of 2009 concerning Establishment of the National Water Resources Council
2008	Presidential Regulation Number 12 of 2008 concerning Water Resources Council

The full set of tupoksis drawn from laws above were reduced to those that impact water quality management. Tasks and functions assigned to the agencies under review that related exclusively to other aspects of water resource management – allocation or irrigation management, for example – were not included in the analysis. Each tupoksi associated with water quality management was listed separately and coded with the following information: level of government, agency, and source law. The number of tupoksis identified for each agency is summarized in Table 59. The agencies most actively involved in operational functions of water quality management are DLH Jatim (25) and the Kotas and Kabupaten (8). DLH Jatim and the district governments also provide a large number of enabling functions.

Table 59. Number of tupoksis in analysis, by agency

Agency	Tupoksis (#)
KLHK	11
PUPR Ditjen SDA	3
PUPR Ditjen Cipta Karya	3
Dewan SDA	2
BBWS Brantas	13
TKPSDA	5
PJT I	8
Governor	13
DLH Jatim	66
Dinas PUSDA	12
Dinas CK	9
Dewan SDA Jatim	6
Kota / Kabupaten	27
Total	178

Because of the number of tupoksis included in review was large (178), an approach was needed to organize them into smaller subgroups to allow for manageable comparison. Thus, tupoksis were organized into two group levels – four general types with several subfunctions in each. First, the tupoksis were manually organized into groups based on similar categories of activities. These groupings are labelled as subfunctions of river quality management and are listed in Table 61.

GROUPING TUPOKSIS INTO SUBFUNCTIONS

These functions were further grouped into four primary function types - namely, whether they serve provisioning, regulating, facilitating, or strategic functions (see Table 60). Provisioning functions are operational and involve activities or tasks that directly provide a service related to water quality (e.g., maintaining riverbank areas or providing solid waste services). Regulating functions regulate activities in order to preserve or improve water quality (e.g., issuing wastewater discharge permits or enforcing environmental standards). Facilitating and strategic tupoksis, on the other hand, are enabling functions that underpin water

quality management by organizational, resource-related, or strategic means. Example facilitating tupoksis include the collection and provision of water quality monitoring data, conflict resolution, or implementation of financial instruments to support environmental management. Strategic functions generally related to policy-setting and planning. Some functions may serve two or more purposes. Community engagement, for example, may serve provisioning, regulating, facilitating, or strategic functions, depending on the content of engagement activities. Others, such as standard-setting, for example, exclusively serve a regulatory purpose.

Table 60. Categories of WQM Functions and Tasks

Operational	*Provisioning*	Provides a direct or adjacent service that affects the level of pollutants entering the river system (e.g., solid waste management, sanitation, riverbank maintenance), or provides early warning, recovery, or rehabilitation services in the event of pollution.
	Regulating	Mediates water quality via prevention, pollution control, or enforcement.
Enabling	*Facilitating*	Allocates resources, such as funding, manpower, technical guidance, or physical assets; provides data / information needed to manage water quality (WQM); or involves coordination and/or administration to enable functions of water quality management.
	Strategic	Plans, formulates, or monitors and evaluates policies and activities to support water quality management.

The organizing logic for the review was to examine tupoksis in groupings by function type and subfunction as described below in Table 61.

Table 61 Key sub-functions of water quality management

Strategic	Facilitating	Regulating	Provisioning
Policy formulation	Water quality monitoring	Regulation: Compliance	Riverbank management
Planning	Information systems management	Regulation: Permitting	Sanitation / Wastewater treatment
Program and Policy M&E	Coordination	Regulation: Standard-setting	Solid waste management
	Technical guidance	Enforcement	Urban drainage
	Community engagement		Pollution response / recovery
	Public information	Conservation	
	Environmental management		
	WRM general		
Pollution prevention / control			

CONTINGENCY

An additional tag coded to each tupoksi, "contingent," indicates simply whether the tupoksi is included because it *could* or *may* deal with water quality, depending on the content of performed activities. Contingent functions are those that could or may affect water quality management, but only if the agency chooses to include some aspect of water quality management in a prescribed activity or task. For example, a requirement to perform water resource planning or community outreach may or may not deal with water quality, depending on the content of formulated policy objectives or planned activities. Agencies have the discretion to relate these activities to water quality management, or not. In contrast, regularized functions of water quality management (those without a contingency description) always attend to water quality in some form or fashion. For example, the issuance and enforcement of wastewater discharge permits consistently and directly applies to water quality management and, thus, is not coded as a contingent activity. Of the 178 tupoksis included in the analysis, 124 were coded as regular and 54 as contingent.

It is important to note that these summary data have limitations with respect to interpretation, as they capture only the number of prescribed functions without giving any information about the actual content of activities, the

resources spent to engage in such activities, or the impacts yielded by such activities. It is entirely possible, for example, that the *real* activities captured by one tupoksi far outweigh a basket of alternative tupoksis in terms of resource use or impacts on water pollution. Despite this important limitation, it is apparent that DLH Jatim and the Kota/Kabupaten governments are the primary regulators of water quality, supported by the regulating activities of BBWS Brantas.

FRAGMENTATION, OVERLAP, AND DUPLICATION,

Grouping tupoksis into function groups allowed for more systematic examination of potential overlaps, duplications, or fragmentation. Thus, by function group, the tupoksi were scanned and coded as follows:

Fragmentation / Coordination	More than one agency is involved in the same broad policy space and there may be opportunities to improve service coordination, but there is no direct duplication of services and targets.
Duplication	More than one agency engages in the same activities or provides the same services to the same targets or beneficiaries. Such duplication may occur only between levels within a functional line led by a single Ministry (e.g., water resources in PUPR, environment under KLHK), or it may involve instances where more than one agency across functional lines led by *different* Ministries engages in the same activities.
Overlap	Multiple agencies have similar goals and activities targeting similar beneficiaries, where duplication is possible depending on the content of activities.

B.3 RESULTS: TUPOKSIS BY SUBFUNCTION

The tables below lay out the tupoksis identified by subfunction, with additional notes on contingency as well as areas of overlap, duplication, or potential fragmentation, where coordination would be recommended to reduce inefficiencies or policy conflict (noted below in the first column as "coordinate"). The areas where overlapping responsibilities are designed in law are summarized in Table 62 below.

Table 62. Designed overlap in responsibilities for water quality management

General Function	Description of overlap
Water quality monitoring and information systems management	At least twenty agencies are routinely monitoring water quality in the Brantas River basin (BBWS Brantas, KLHK, DLH Jatim, PJT I, and sixteen DLH kota / kabupaten). Each manages their own data (see the section below on water quality monitoring) in a variety of formats.
Water quality planning and program evaluation	Many plans attend to various components of water quality management and program evaluation. This overlap is not a problem, as long as individual strategies and work plans are aligned with the RPPMA and based on a shared understanding of the problems facing the Brantas watershed.
Enforcement of environmental law related to water pollution	A number of agencies are empowered to enforce environmental law related to water pollution. In practice, there is very little enforcement. In addition to the issues laid out in the section above on industrial pollution control, low enforcement is exacerbated by accountability issues and due to the overlap in duties for enforcement, i.e., it is easier for an enforcing agency to defer responsibility for oversight and the imposition of sanctions.
Community engagement and public information	All agencies are tasked with community engagement and public information. As with planning, this is not a negative overlap, but some efficiencies and effectiveness in public communication and outreach programs could be gained with (a) information and program-sharing across communities and across agencies (related to community engagement), (b) coordinated programs focused on community mapping, data collection, etc. to gather more data across the watershed, and (c) joint commitments to strengthen public communication and participation.

Source: TU Delft doctrinal legal review, 2021-2022

The following sections list each tupoksi in groups by subfunction.

GENERAL WRM / ENVIRONMENTAL MANAGEMENT

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Overlap	Basin	BBWS	Manage water resources, which includes conservation of water resources, utilization of water resources, and controlling the destructive force of water in river areas; "Conservation" as "an effort to maintain the existence and sustainability of the condition, nature and function of Water Resources so that they are always available in sufficient quantity and quality to meet the needs of humans and other living creatures, both now and in the future" involving the following activities: "a. protection and preservation of water sources; b. water preservation; c. water quality management; and d. water pollutant control." (UU 17 of 2019, Article 24)	Yes contingent on BBWS discretion regarding what aspects of conservation are to be included in their work program.
	Dati-II	Kota / Kab.	Carry out water resource management	Yes, contingent on discretion to include WQ management in "water resource management"
	Dati-II	Kota / Kab.	Participate in maintaining the effectiveness, efficiency, quality, and order of the implementation of Water Resources Management	No
Coordinate	SOE	PJT I	Help Government maintain and secure water resources and water resource infrastructure to maintain sustainability, as appropriate with the ability of the Company	Yes, contingent on discretion of Company / Government to manage WQ
	Dati-II	Kota / Kab.	Assist Central Government and / or Regional Government in managing Water Resources in the village area based on the principle of public benefit and taking into account the interests of other villages (village)	Yes, contingent on discretion to include WQ management in "water resource management"
	Dati-II	Kota / Kab.	Facilitate dispute resolution within the city related to Water Resource Management	Yes, contingent on disputes
	Provincial	Dewan SDA Jatim	Make natural resources and the environment as capital and assets for sustainable development	No
	Provincial	DLH Jatim	Implement environmental economic instruments (EM)	No

COMMUNITY ENGAGEMENT AND PUBLIC INFORMATION

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Coordinate / Share Information	Basin	BBWS	Community empowerment in resource management water power	Yes, contingent on WQ content in community programming
	SOE	PJT I	Together with other water resource managers, provide guidance and outreach to the community in order to increase public empowerment	Yes, contingent on WQ content in community programming
	Provincial	Dinas PUSDA Jatim	Plan and implement water resource community development and empowerment activities (BD)	Yes, contingent on WQ content in community programming
	Dati-II	Kota / Kab.	Encourage the initiative and participation of village communities in Water Resources Management in their area	Yes, contingent on WQ content in community programming
Coordinate	Provincial	DLH Jatim	Institutional development of the Community Care for the Environment and Environmental Awards (EC)	Yes, contingent on WQ content in awards program
	Provincial	DLH Jatim	Formulate and implement awards related to a clean and healthy environment (WM)	Yes, contingent on WQ content in awards program
	Provincial	DLH Jatim	Socialize results of environmental "arrangements" to stakeholders (EM)	Yes, contingent on WQ content in community programming
	SOE	PJT I	Disseminate results of evaluation / monitoring to water resources users, communities, and stakeholders	Yes, contingent on inclusion of WQ data in reported results

	Provincial	Dewan SDA Jatim	Realizing stakeholder commitment to natural resource management	Yes, contingent on WQ content in community programming

COORDINATION

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Overlap	Basin	TKPSDA	Integrate and align interests between sectors, regions, and stakeholders in water resource management	Yes, contingent on discretion of BBWS/TKPSDA to engage in WQ issues
Overlap	Provincial	Dewan SDA Jatim	Carry out vertical and horizontal coordination functions for all parties involved in implementation of joint / cross-sector programs and activities	Yes, contingent on inclusion of water quality and water pollution management in national policy and coordination efforts
	National	Dewan SDA	Coordinate national-level IWRM across Ministries	Yes, contingent on inclusion of water quality and pollution management in national policy
	Basin	BBWS	Facilitate activities of the resource management coordination team water in river areas (TKPSDA)	Yes, contingent on discretion of BBWS/TKPSDA to engage in WQ issues
	Basin	BBWS	Prepare and implement line determination studies for river boundaries, lake boundaries, and irrigation network demarcation	No
	Provincial	Dewan SDA Jatim	Realizing stakeholder commitment to natural resource management	Yes, contingent on WQ content in community programming / stakeholder coordination
Overlap	Provincial	Dinas PUSDA	Coordinate technical planning for water resources (WRP)	Yes, contingent on inclusion of water quality in water resource planning
Overlap	Basin	BBWS	Coordinate technical planning for Brantas River Basin	Yes, contingent on inclusion of water quality in water resource planning

POLICY FORMULATION

Level	Agency	WQM Tupoksi (Task/Function)	Contingent
National	PUPR Ditjen SDA	Formulate national policy for water resource management	Yes. contingent on inclusion of water quality and pollution issues in national policy
National	Dewan SDA	Provide advice to the President and national government for national policy formulation in the field of water resources	Yes, contingent on discretion of Dewan SDA to prioritize water quality as a policy issue
National	KLHK	Formulate and implement (or coordinate implementation of) national policies related to environmental management and conservation of natural resources, including policies aimed at: • increasing carrying capacity of watersheds, • controlling pollution and environmental damage, • managing solid and hazardous waste, and • handling complaints and enforcing environmental law.	No
		Stipulate national-level water pollution control policy based on results of inventory and identification of polluting sources, carrying capacity, and water quality targets.	No
Basin	BBWS	Prepare and implement line determination studies for river boundaries, lake boundaries, and irrigation network demarcation.	No
Provincial	Governor	Stipulate a water pollution control policy at the Provincial level based on results of the inventory and identification of pollution sources, carrying capacity of pollution loads, and water quality targets.	No

		Establish policies and strategies in waste management in accordance with Government policy	No
Provincial	DLH Jatim	Plan and set policy on conservation and control of damage to biodiversity (EM)	No
		Formulate provincial environmental management policy (EM)	No
		Formulate and implement technical policies for prevention of environmental pollution (PC)	No
		Formulate policy on environmental impact assessment and determination of carrying capacity (EM)	No
		Formulate technical policies for prevention of environmental pollution and standardization of the environmental sector (PC)	No
		Formulate policies for the development and supervision of businesses and / or activities that have environmental permits and permits for environmental protection and management (EC)	No
		Implementing mapping of needs and suitability of environmental permits (EC)	No
		Prepare materials for policies on environmental permits application and supervision (EC)	No
		Formulate policies for transportation, collection, procession, and storage of regional waste, and formulation of waste management cooperation policies (WM)	No
		Formulate waste management cooperation policies between regions in the province (WM)	No
		Set policy regarding provincial RPPLH, Amdal, and UKL-UPL	Yes, contingent on inclusion of WQ considerations in policy
Provincial	Dinas PUSDA	Formulate technical policies on water resources planning; implementation of water resource planning for surface water (WRP)	Yes, contingent on inclusion of WQ in plans
		Formulate and implement technical policies for river, reservoir, and riverbank operations, maintenance, and rehabilitation (RRR)	Yes, contingent on inclusion of WQ management considerations in technical guidance
		Prepare materials for supervision and control of water resources (BD)	Yes. contingent on inclusion of water pollution as an issue for control
		Prepare materials for river and coastal rehabilitation (RRR)	No
Provincial	Dinas CK	Formulate technical policies on regional spatial planning (RSP)	Yes, contingent on consideration of water quality impacts in RSP
		Formulate technical planning policies for environmental sanitation (WSES)	No
Dati-II	Kota / Kab.	Formulate district / city water resources management policies based on national policies on water resources and provincial water resources management policies by taking into account the interests of the surrounding districts / cities	Yes, contingent on discretion of Kota/Kabupaten to include water quality management in "water resource management"
		Formulate district/city policy on environmental protection	No
		Set policy regarding Amdal and UKL-UPL at the district/city level	No
		Stipulate a water pollution control policy based on results of the inventory and identification of pollution sources, carrying capacity of pollution loads, and water quality targets.	No
		Stipulate requirements and procedures for environmental licensing related to wastewater discharges in regulation, including appointment of responsible agency, licensing requirements and procedures, and terms of validity.	No

		Establish waste management policies and strategies based on national and provincial policies	No

WATER QUALITY MONITORING AND INFORMATION SYSTEM MANAGEMENT

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Overlap	Basin	BBWS	Manage water resources information systems	Yes, contingent on inclusion of WQ data
	Basin	TKPSDA	Discuss information system management plan for hydrology, hydrometeorology, and hydrogeology to reach integrated management of information systems	No
	Provincial	DLH Jatim	Manage environmental information at the provincial level	No
	Provincial	DLH Jatim	Implement (*water quality monitoring and*) data management (UPT)	No
	Provincial	Dinas PUSDA	Prepare materials for water resources information system (WRP)	Yes, contingent on inclusion of WQ data in water resources information system
	Provincial	DLH Jatim	Compile guidelines for environmental quality monitoring and managing environmental quality data (UPT)	No
Overlap	Provincial	Dinas PUSDA	Implement water quality monitoring (*and data management (UPT)*)	No
	SOE	PJT I	Monitor and evaluate water quantity and quality in water resources under the responsibility of the Company	No
	Provincial	DLH Jatim	Develop programs and networks for environmental quality monitoring and coordinate and carry out collaborative monitoring and research on environmental quality monitoring (UPT)	No
			Monitor environmental quality and provide analysis of results (UPT)	No
			Monitor water sources with two or more cities within one province	No
			Prepare infrastructure and implementation of environmental quality monitoring (PC)	No
			Prepare materials for the implementation of environmental monitoring, evaluation and reporting (EC)	No
			Prepare materials for water quality monitoring, coordination of water quality monitoring networks, and evaluation of water quality monitoring (WRP)	No
	Dati-II	Kota / Kab.	Monitor water quality for water resources within the district / city	No

PLANNING

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Coordination	Basin	BBWS	Prepare water resource management "pattern" / strategy (Pola) and plan (Rencana) in the area river (a), along with preparation of water resource management programs and activity plans	Yes, depends on inclusion of WQ in Pola / Rencana
	Provincial	Dinas PUSDA	Coordinate technical planning for water resources (WRP)	Yes, contingent on inclusion of WQ in plans and evaluation
	Provincial	Dinas PUSDA	Formulate technical policies on water resources planning; implement water resource planning for surface water (WRP)	Yes, contingent on inclusion of WQ in plans
	National	KLHK	Formulate water quality management plans for national strategic river basins	No
	Basin	TKPSDA	Discuss design patterns (Pola) and design plans (Rencana) for water resource management in National Strategic River basins during formulation	Yes, contingent on inclusion of WQ issues in plans

	Provincial	Dinas CK	Implement development of regency / municipal spatial planning (RSP)	No
	National	PUPR Ditjen SDA	Approve and evaluate basin-level long-term plans (Pola) and medium-term strategies (Rencana)	Yes, contingent on inclusion of WQ in plans / evaluation
	Provincial	Dinas CK	Formulate technical policies on regional spatial planning (RSP)	No
	Provincial	DLH Jatim	Determine targets for waste management (WM)	No
	Provincial	Dinas CK	Prepare guidance for environmental sanitation planning and development (WSES)	No
	Provincial	Dewan SDA Jatim	Prevent damage to natural resources due to development that is not environmentally friendly or motivated by self-profit/greed	No
	Basin	BBWS	Prepare and implement line determination of river boundaries, lake boundaries, and irrigation network demarcation	No
	Provincial	DLH Jatim	Map potential sources and management facilities for hazardous and toxic materials (WM)	No

POLICY AND PROGRAM MONITORING & EVALUATION

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Overlap	Basin	BBWS	Monitor and evaluate implementation or application of water resources management patterns and plans water resources management	Yes, depends on inclusion of WQ in Pola / Rencana
	Basin	TKPSDA	Monitoring and evaluation of program implementation and water resource management plans	Yes, contingent on inclusion of WQ issues in plans
	Provincial	Dinas PUSDA	Monitor and evaluate water resource planning (WRP)	Yes, contingent on inclusion of WQ in plans and evaluation
	Provincial	DLH Jatim	Compile environmental balance sheets, regional environmental status, and environmental quality index (EM)	No
			Implement evaluation and monitoring in the environmental sector (EM)	No
			Implement monitoring in environmental management (EM)	No
			Implement monitoring, evaluation and reporting of environmental pollution and damage control (PC)	No
			Monitor and evaluate environmental pollution and damage control (PC)	No
			Monitor, evaluate, and report on Environmental Compliance (EC)	No
			Prepare, facilitate, monitor and evaluate provincial strategic environmental studies (EM)	Yes, presuming WQ assessed in studies
			Monitor and evaluate solid and hazardous waste management (WM)	No
	Provincial	Dinas CK	Evaluate planning and development of sanitation facilities (WSES)	No
	Dati-II	Kota / Kab.	Conduct regular monitoring and evaluation of waste processing	No

POLLUTION PREVENTION & CONTROL

Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Basin	BBWS	Manage water resources, which includes *(conservation water resources, utilization of water resources, and)* controlling the destructive force of water in river areas	Contingent on definition of "controlling the destructive force of water": PP 38 of 2011 defines in terms of flood risk management; UU 17 of 2019 defines as "effort to prevent, overcome, and restore environmental damage caused by the Damaging Power of Water."
Provincial	DLH Jatim	Coordinate policies to control pollution and environmental damage (PC)	No
Provincial	DLH Jatim	Coordinate implementation of environmental pollution prevention instruments (EM)	No
Provincial	DLH Jatim	Implement measures to prevent environmental pollution or damage (PC)	No
Provincial	DLH Jatim	Implement pollution prevention and recovery (PC)	No
Provincial	DLH Jatim	Coordinate and implement pollution control across city/district	No
Provincial	DLH Jatim	Formulate technical policies for prevention of environmental pollution and environmental sector standardization (PC)	No
Provincial	DLH Jatim	Set policy regarding provincial RPPLH, Amdal, and UKL-UPL	No, presuming assessment policies include wastewater discharge assessment
Provincial	DLH Jatim	Formulate policy on environmental impact assessment and determination of carrying capacity (EM)	No
Provincial	Governor	Calculate carrying capacity for rivers that cross regencies / cities	No
Provincial	DLH Jatim	Calculate water pollution carrying capacity for rivers that cross regencies / cities	No
Dati-II	Kota / Kabupaten	Calculate carrying capacity for rivers within regencies / cities	No
Dati-II	Kota / Kabupaten	Establish and implement strategic environmental assessments (KLHS) at the district/city level	Yes, contingent on inclusion of water-related impacts in KLHS
Provincial	Governor	Recapitulate analysis of water pollutant sources in the province and submit analysis annually to Minister	No
Dati-II	Kota / Kabupaten	Carry out and maintain inventory of water pollution sources at the district / city level	No

POLLUTION RESPONSE AND RECOVERY

Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Province	DLH Jatim	Implement countermeasures, damage control, and restoration of environmental damage (PC)	-
		Implement environmental damage control by providing information, isolating and terminating sources (PC)	-
		Implement pollution recovery and countermeasures through cleaning, remediation, rehabilitation and restoration (PC)	-
		Implement follow-up guidance on evaluation recommendations for institutional and non-institutional polluting sources (PC)	-
SOE	PJT I	Flush / dilute the river in the framework of river maintenance	-

REGULATION: COMPLIANCE AND ENFORCEMENT

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
Overlap	National	KLHK	Supervise compliance with water quality management laws and regulations and technical requirements for controlling water pollution in EIA documents approved by the Minister.	No
	Provincial	DLH Jatim	Enforce environmental law at the provincial level	No
	Dati-II	Kota / Kabupaten	Enforce environmental law at the district/city level, including compliance with solid waste and wastewater disposal regulations	No
	Provincial	DLH Jatim	Implement law enforcement for violations of environmental protection and management (EC)	No
	Basin	BBWS	Monitor and supervise the use of water resources and investigate criminal acts in the field of water resources	Yes, depends on whether WQ / water pollution is in purview of "monitoring and supervising use of water resources"
Overlap	Provincial	DLH Jatim	Guidance and supervision of regional environmental supervisors (EC)	No
	Provincial	Dinas PUSDA	Prepare materials for supervision and control of water resources (BD)	Yes, contingent on inclusion of water pollution as an issue for control
Overlap	Provincial	Governor	Supervise compliance of businesses (via regional environmental supervisor) with technical requirements of water pollution control listed in Amdal or UKL-UPL document and implementation of the environmental permit system for wastewater disposal.	No
	Dati-II	Kota / Kabupaten	Supervise compliance of businesses (via environmental supervisory officials) with technical requirements of water pollution control listed in environmental permit	No
	Provincial	DLH Jatim	Coordinate environmental compliance policies (EC)	No
Overlap	Provincial	DLH Jatim	Give guidance "within respective authority" to persons in charge of businesses to increase compliance with wastewater laws and regulations, including WWT technology, waste minimization efforts, and use of incentives and disincentives	No
	Dati-II	Kota / Kabupaten	Give guidance "within respective authority" to persons in charge of businesses to increase compliance with wastewater laws and regulations, including WWT technology, waste minimization efforts, and use of incentives and disincentives	No
	National	KLHK	Carry out guidance and supervision of parties in charge of businesses / activities via Proper, which includes planning, implementing, ranking, coaching, and law enforcement	No

	National	KLHK	Conduct Proper rating evaluations and determine Proper rating	No
	Provincial	DLH Jatim	Supervise Provincial implementation team Proper rankings	No
	Provincial	DLH Jatim	Manage Provincial-level Proper implementation to assess businesses with respect to compliance and environmental performance and rank performance achievements.	No
	Provincial	DLH Jatim	Monitoring / follow-up based on evaluation of businesses / activities that do not have environmental permits (EC)	No, presuming environmental permit policies linked to wastewater policies
	Dati-II	Kota / Kabupaten	Issue and revoke wastewater disposal licenses, with consideration of determined pollution load carrying capacity	No

REGULATION: STANDARD-SETTING AND PERMITTING

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
	National	KLHK	Calculate water pollution loads in case Governor cannot do so	No
	Provincial	Governor	*(Prepare water standards /)* Calculate water pollution loads in the event that a regent/mayor is unable to	No
	Provincial	DLH Jatim	Calculate water pollution carrying capacity for rivers that cross regencies / cities	No
	National	KLHK	Compile and stipulate water quality standards in coordination with other Ministers in the fields of water resources, energy and mineral resources, spatial planning, and/or forestry	No
	Provincial	Governor	Prepare and stipulate water quality standards after obtaining technical consideration from the Minister and coordinating with regents/mayors	No
	Provincial	Governor	Prepare water standards *(/ calculate water pollution loads)* in the event that a regent/mayor is unable to	No
	Provincial	Governor	(May) determine wastewater quality standards for businesses / activities with same or more stringent provisions of standards set by Minister	No
Coordination	Provincial	DLH Jatim	Provide guidance to regents / mayors on environmental permits related to wastewater	No
	Dati-II	Kota / Kabupaten	Stipulate requirements and procedures for environmental licensing related to wastewater discharges in regulation, including appointment of responsible agency, licensing requirements and procedures, and terms of validity.	No
	Dati-II	Kota / Kabupaten	Issue and revoke wastewater disposal licenses, with consideration of determined pollution load carrying capacity	No
	Provincial	Governor	Supervise compliance of businesses (via regional environmental supervisor) with technical requirements of water pollution control listed in Amdal or UKL-UPL document; implementation of the environmental permit system for wastewater disposal (wastewater discharge permit)	No
	Provincial	DLH Jatim	Provide guidance on management of EIA and assessment of environmental documents and permit processes (EM)	No
	Provincial	DLH Jatim	Formulate policies for the development and supervision of businesses and / or activities that have environmental permits and permits for environmental protection and management (EC)	No
	Provincial	DLH Jatim	Guidance, supervision, and monitoring of environmental permit applications (EC)	No

	Provincial	DLH Jatim	Implementing mapping of needs and suitability of environmental permits (EC)	No
	Provincial	DLH Jatim	Issue environmental permits at the provincial level	No
	Provincial	DLH Jatim	Prepare materials for policies on environmental permits application and supervision (EC)	No
	Provincial	DLH Jatim	Provide recommendations on environmental permits (EM)	No
	Dati-II	Kota / Kabupaten	Set policy regarding Amdal and UKL-UPL at the district/city level	No

SANITATION AND WASTEWATER MANAGEMENT

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
	National	PUPR Ditjen CK	Formulate national policy and provide project funding for managing domestic wastewater	No
	Provincial	Dinas CK	Implement environmental sanitation and solid waste systems in inter-regional settlements, slum areas, and provincial strategic areas (WSES)	No
	Provincial	Dinas CK	Implement regional solid waste system development and development of regional domestic wastewater systems (WSES)	No
	Provincial	Dinas CK	Evaluate planning and development of sanitation facilities (WSES)	No
	Provincial	Dinas CK	Formulate technical planning policies for environmental sanitation (WSES)	No
	Provincial	Dinas CK	Implement community empowerment programs and stakeholder participation related to environmental sanitation in inter-regional settlements, slum areas, and provincial strategic areas (WSES)	No
	Provincial	Dinas CK	Prepare guidance for environmental sanitation planning and development (WSES)	No
	Provincial	DLH Jatim	Monitor and overcome pollution through provision of information, planning, and building infrastructure for waste treatment (PC)	No
Coordination	Provincial	DLH Jatim	Give guidance "within respective authority" to small-scale businesses by building WWT facilities, providing assistance with facilities and wastewater minimization practices, developing pilot mechanisms, organizing training and technical consultation	No
	Provincial	DLH Jatim	Give guidance "within respective authority" to control pollution from household waste via building WWT facilities, encouraging septic tanks, self-help in household wastewater management, forming NGOs (KSM), or community groups for household WW management, pilots, dissemination re: household WW management, training	No
	Dati-II	Kota / Kabupaten	Give guidance "within respective authority" to control pollution from household waste via building WWT facilities, encouraging septic tanks, self-help in household wastewater management, forming NGOs (KSM), or community groups for household WW management, pilots, dissemination re: household WW management, training	No
	Dati-II	Kota / Kabupaten	Give guidance "within respective authority" to small- and medium-size businesses by building WWT facilities, providing assistance with facilities and wastewater minimization practices, developing pilot mechanisms, organizing training and technical consultation	No

SOLID WASTE MANAGEMENT

Level	Agency	WQM Tupoksi (Task/Function)	Contingent
National	PUPR Ditjen CK	Formulate national policy and provide project funding for solid waste management	No
SOE	PJT I	Operations and maintenance of existing water resources and water resource infrastructure handed over to the Company	Yes, solid waste removal from infrastructure
Provincial	Dinas CK	Implement environmental sanitation and solid waste systems in inter-regional settlements, slum areas, and provincial strategic areas (WSES)	No

Provincial	DLH Jatim	Coordinate waste management in special situations (e.g., disputes between regencies or disasters) (WM)	No
		Determine targets for waste management (WM)	No
		Formulate policies for transportation, collection, procession, and storage of regional waste, and formulation of waste management cooperation policies (WM)	No
		Formulate waste management cooperation policies between regions in the province (WM)	No
		Foster community resources for managing regional waste processing sites (WM)	No
		Map potential sources and management facilities for hazardous and toxic materials (WM)	No
		Monitor and evaluate solid waste and hazardous waste management (WM)	No
Provincial	Governor	Carry out coordination, guidance and supervision of district / city performance in waste management	No
		Establish policies and strategies in waste management in accordance with Government policy	No
		Facilitate cooperation between regions within a province, partnerships and networks in waste management	No
		Facilitate settlement of waste management disputes between districts / cities	No
Dati-II	Kota / Kabupaten	Carry out district / city-level waste management according to norms, standards, procedures, and criteria determined by the Government	No
		Conduct regular monitoring and evaluation of waste processing	No
		Determine the location of temporary waste depots, integrated waste processing facilities, and / or landfills	No
		Establish waste management policies and strategies based on national and provincial policies	No
		Provide guidance and supervision of waste management carried out by other parties	No

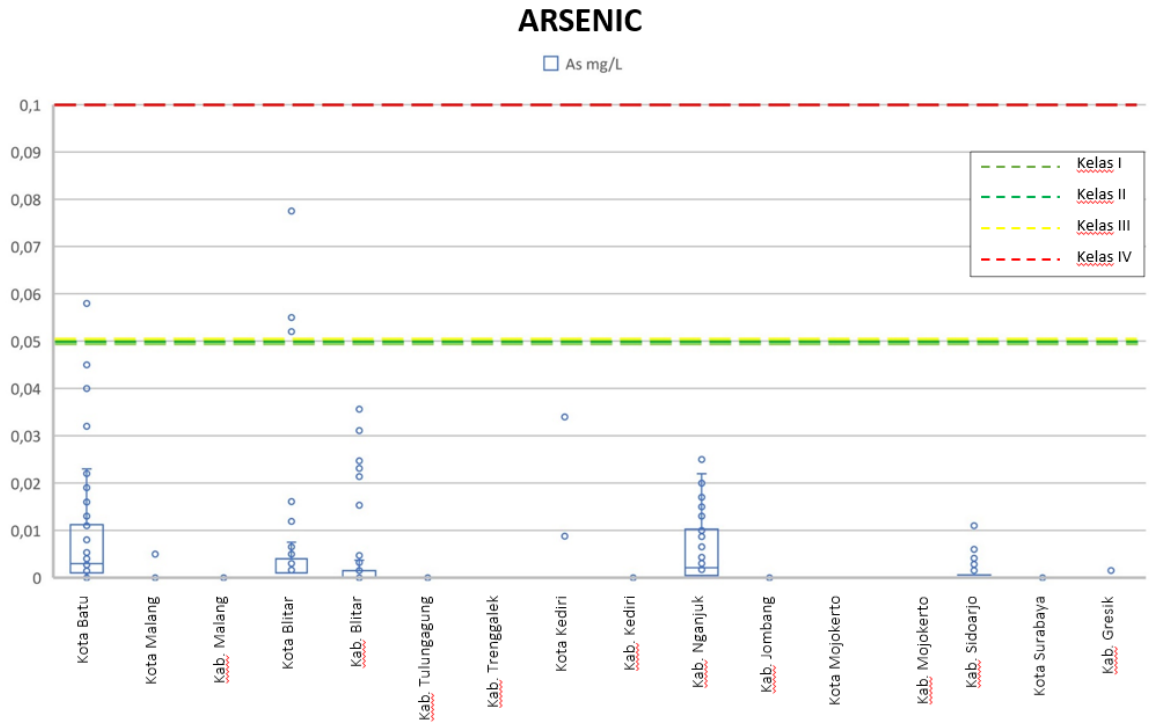
URBAN DRAINAGE & RIVERBANK MANAGEMENT

	Level	Agency	WQM Tupoksi (Task/Function)	Contingent
	National	PUPR Ditjen Cipta Karya	Formulate national policy and provide project funding for urban drainage management	No
Overlap	Basin	BBWS	Manage main urban drainage	No
	Provincial	Dinas CK	Implement drainage systems connected directly to cross-regency and cross-municipality rivers (WSES)	No
	Provincial	Dinas PUSDA	Formulate and implement technical policies for river, reservoir, and riverbank operations, maintenance, and rehabilitation (RRR)	Yes, contingent on inclusion of WQ in technical guidance
			Prepare materials for river and coastal rehabilitation (RRR)	No

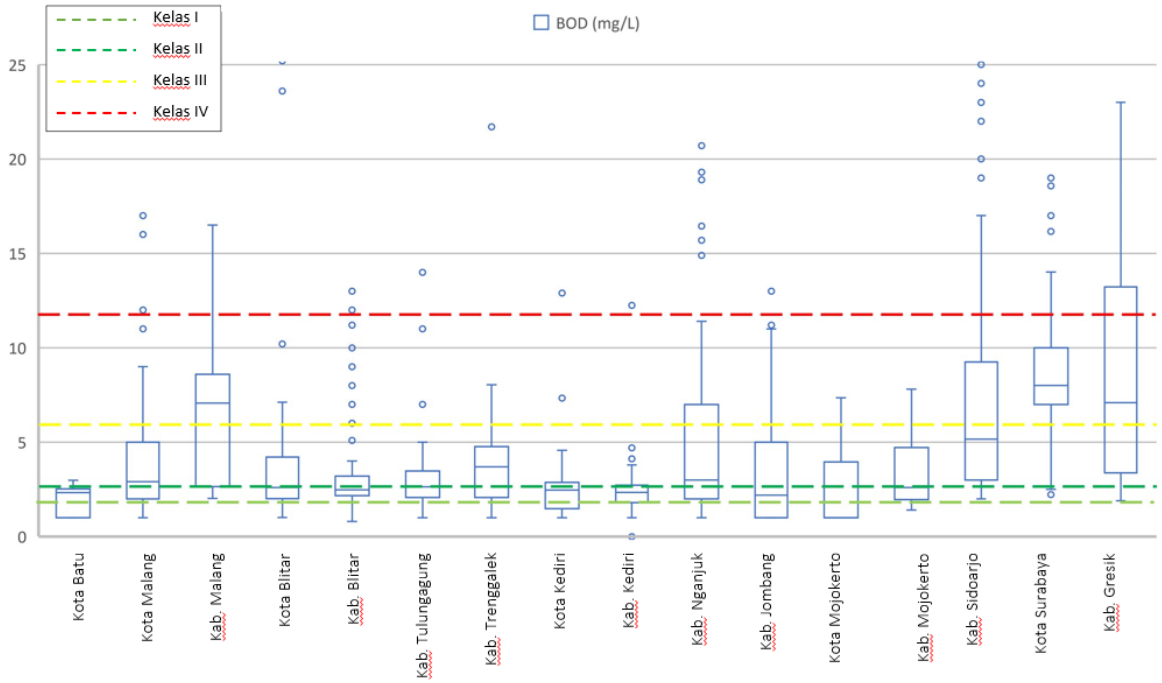
APPENDIX C. WATER QUALITY INDICATORS BY PARAMETER

Most of the following figures provide overviews of average observed measurements for the following parameters: Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), pH, Phosphate, NO3-N (Nitrate), Nitrite, NH3, Fecal Coliform, Total Coliform, Sulfate, Chloride, Fluoride, Cyanide, Sulfur, Mercury, Arsenic, Selenium, Cadmium, Iron, Free Chlorine, color, Manganese, Nickel, Copper, Lead, Chromium, and Zinc. Data reported is the average measured concentration in the river region of each administrative area over the period of 2021-2023. This includes measurements taken by KLHK, DLH Jatim, and DLH units of kota / kabupaten. It does not include data from BBWS Brantas or PJT I.

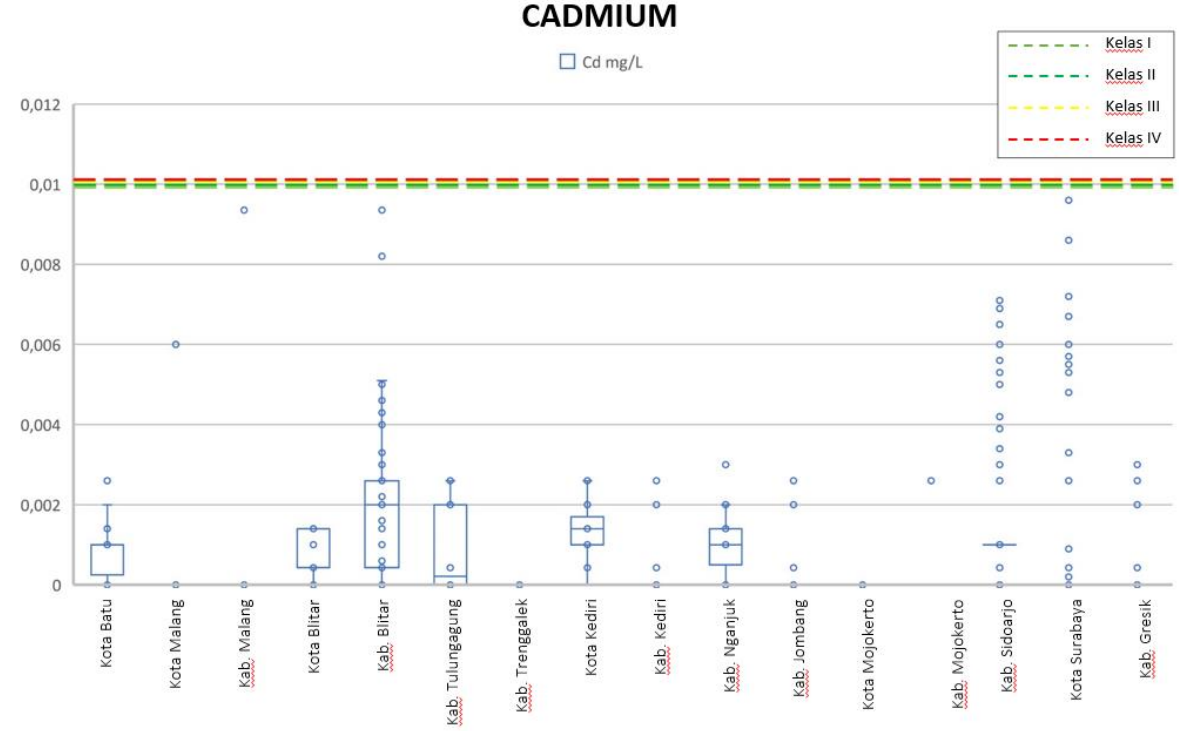
Data is reported from upstream to downstream, labeled by kota / kabupaten. The horizontal colored lines indicated class concentration limits (class I = light green, class II = green, class III = yellow, class IV = red).



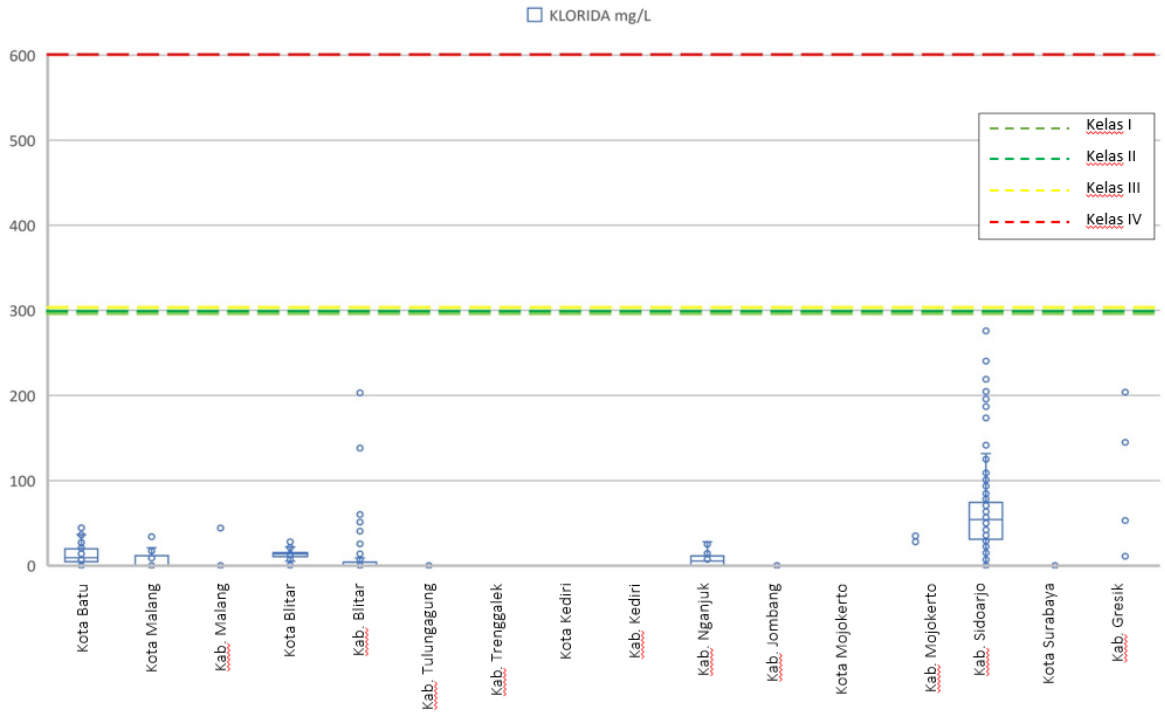
BIOCHEMICAL OXYGEN DEMAND (BOD)



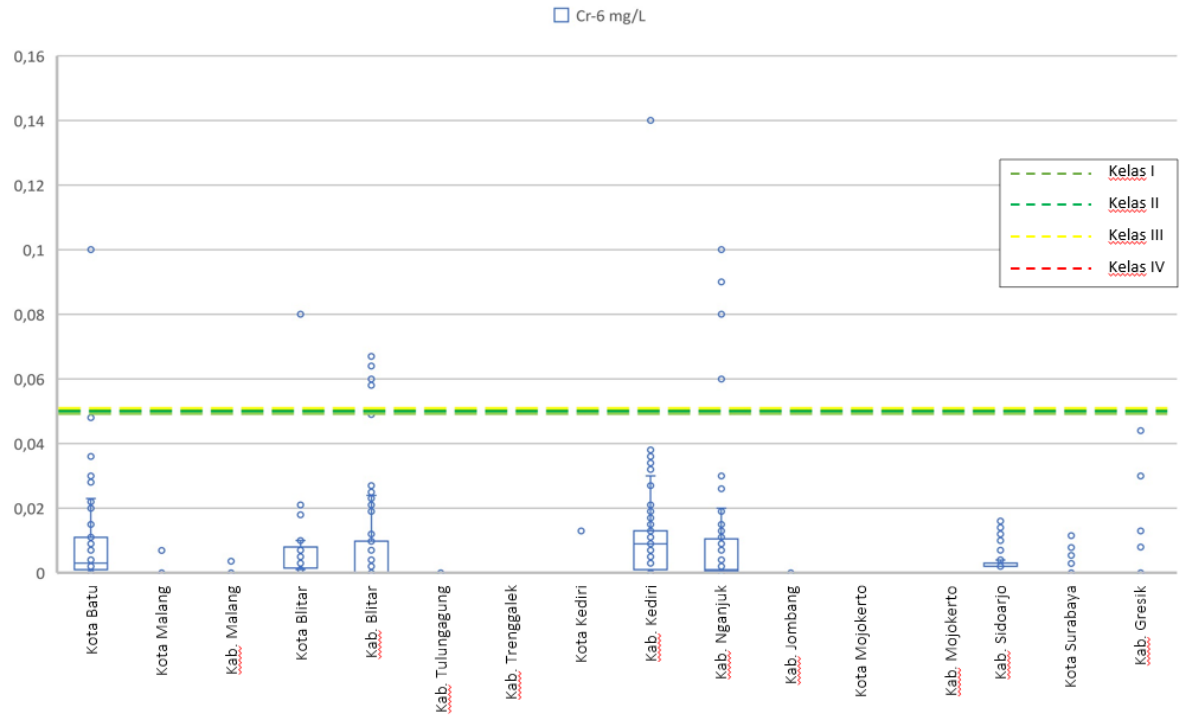
CADMIUM



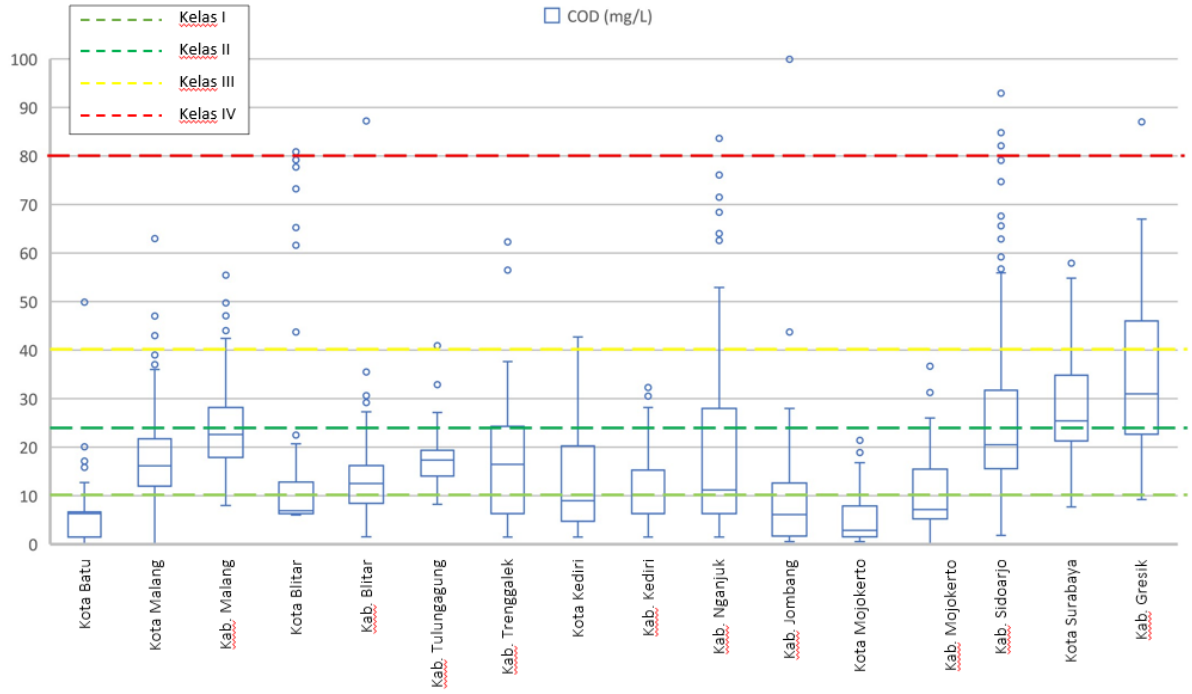
CHLORIDE



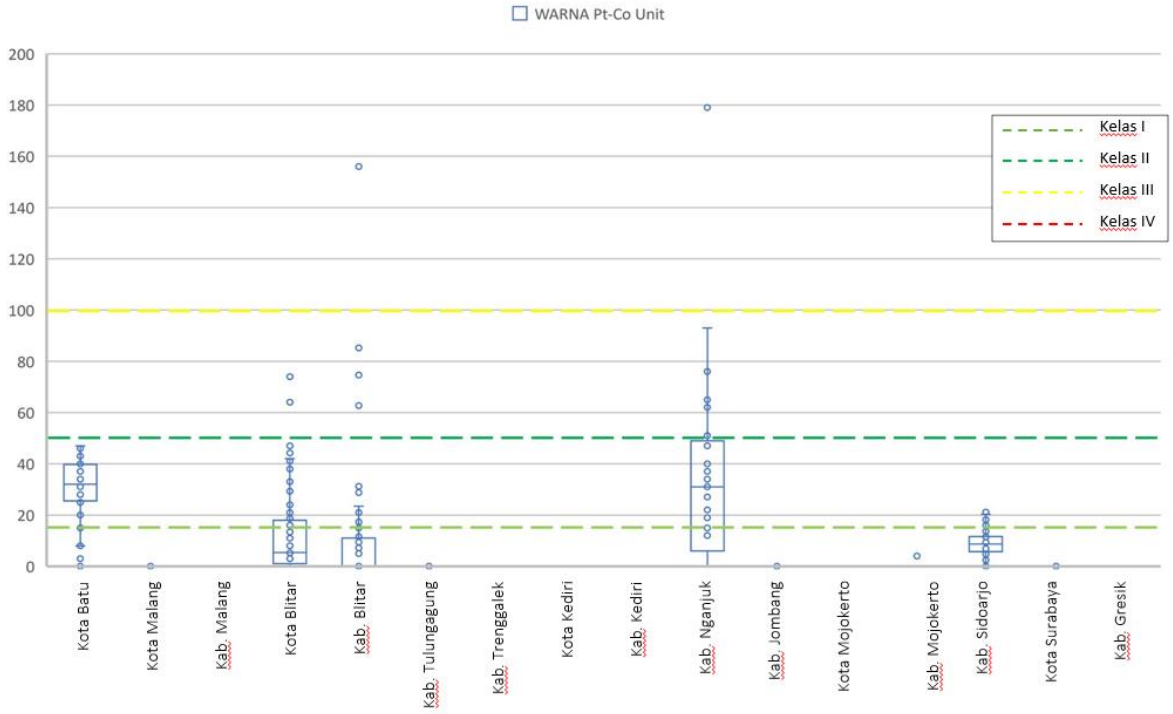
CHROMIUM



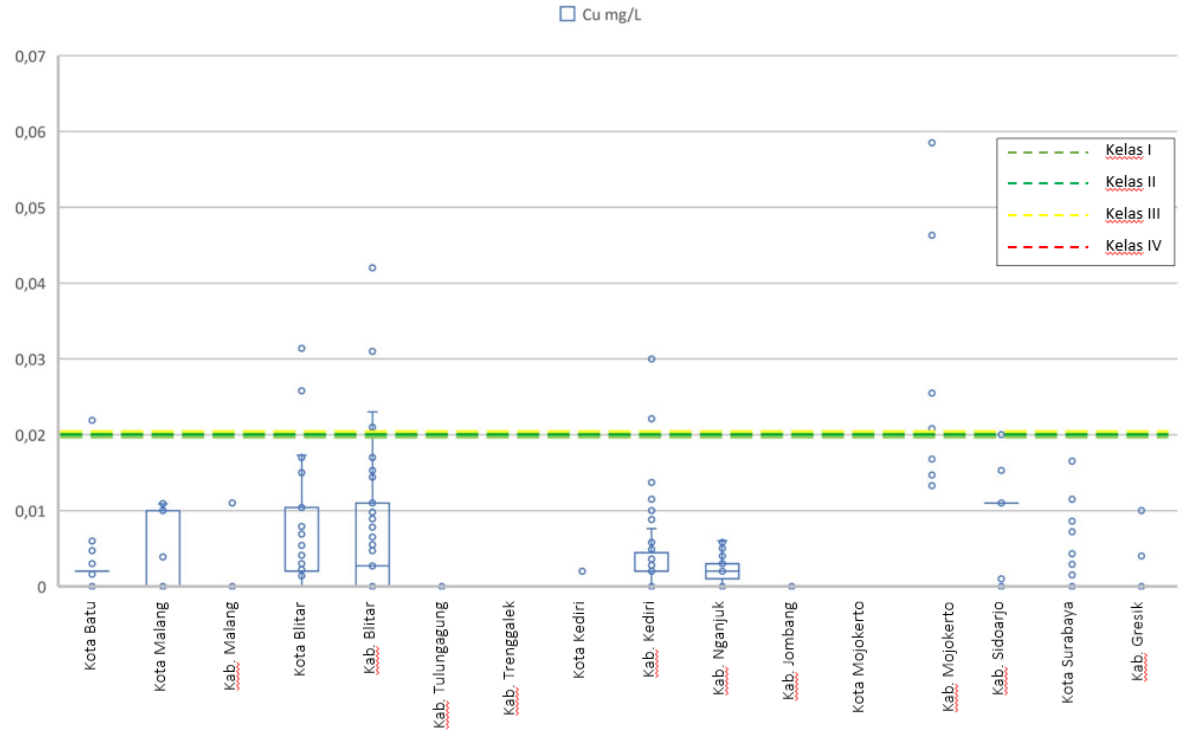
CHEMICAL OXYGEN DEMAND (COD)



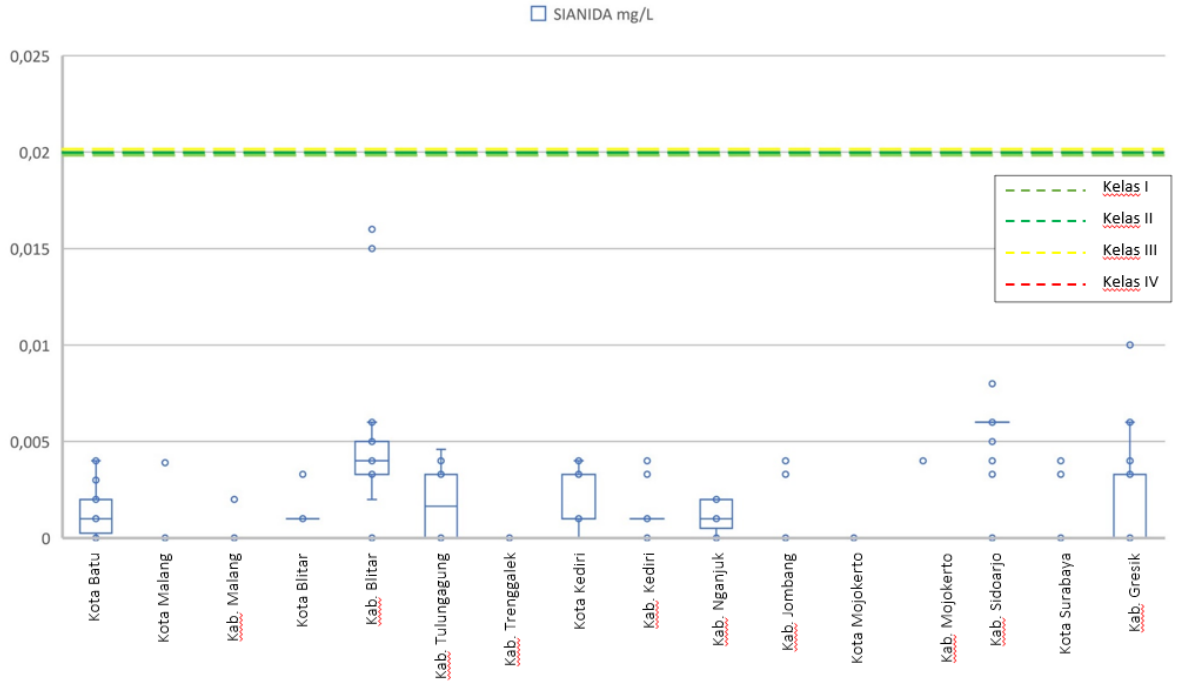
COLOR



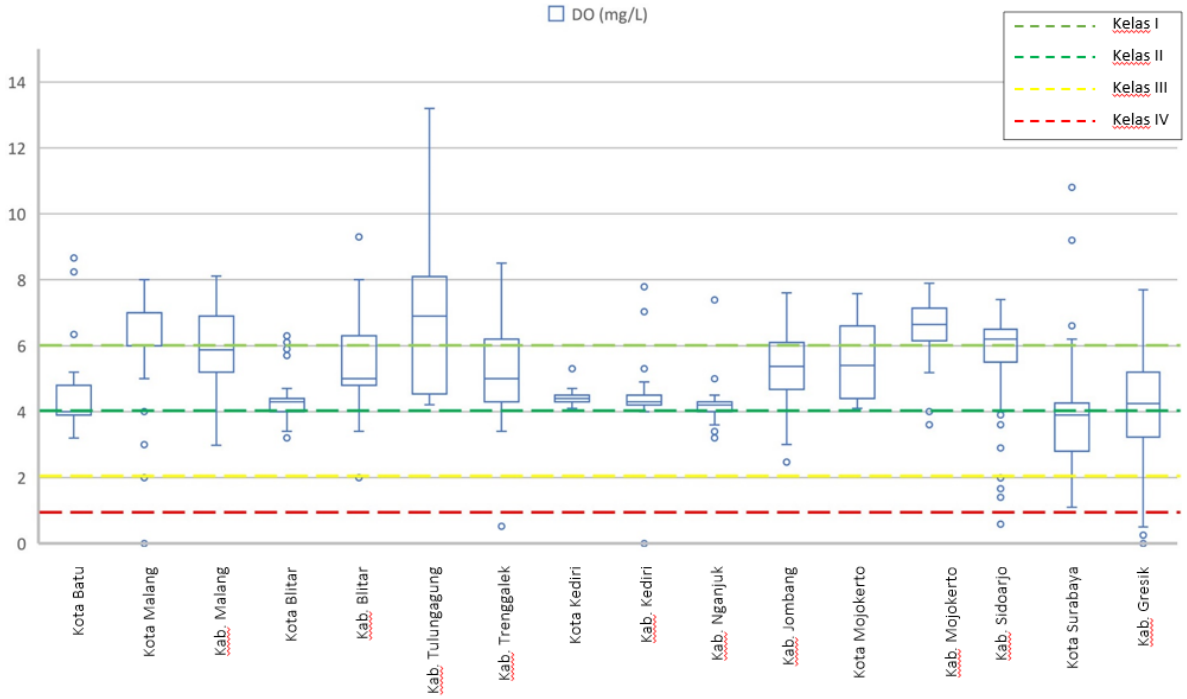
COPPER



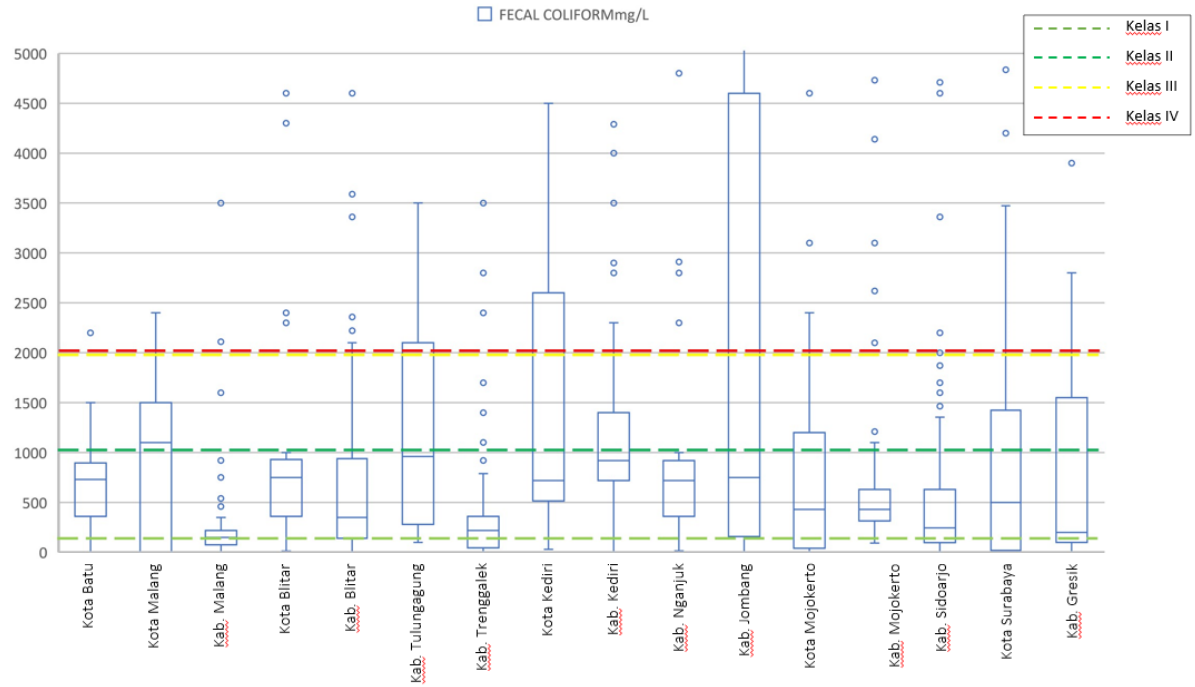
CYANIDE



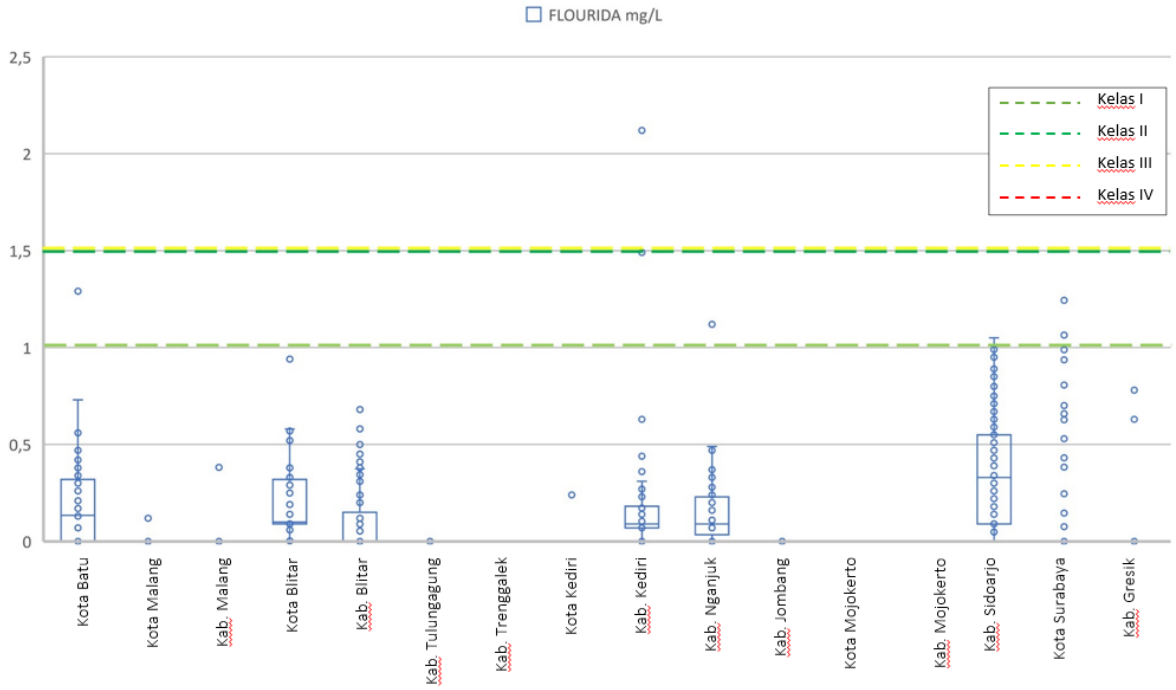
DISSOLVED OXYGEN (DO)



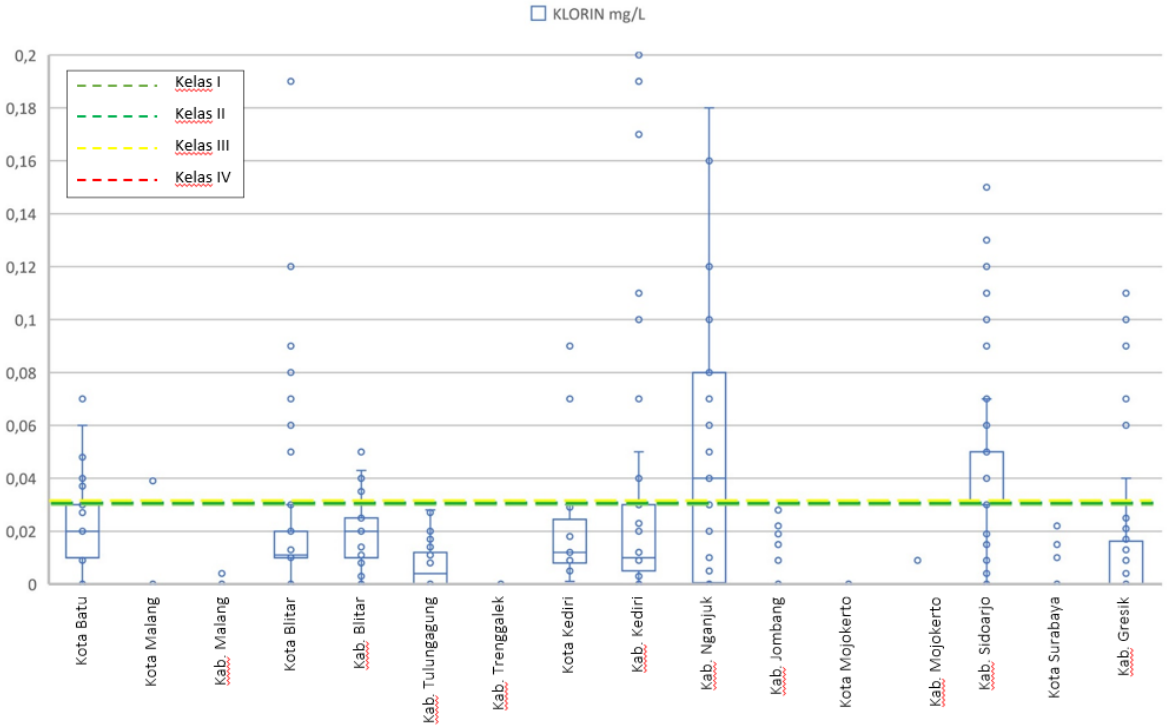
FECAL COLIFORM



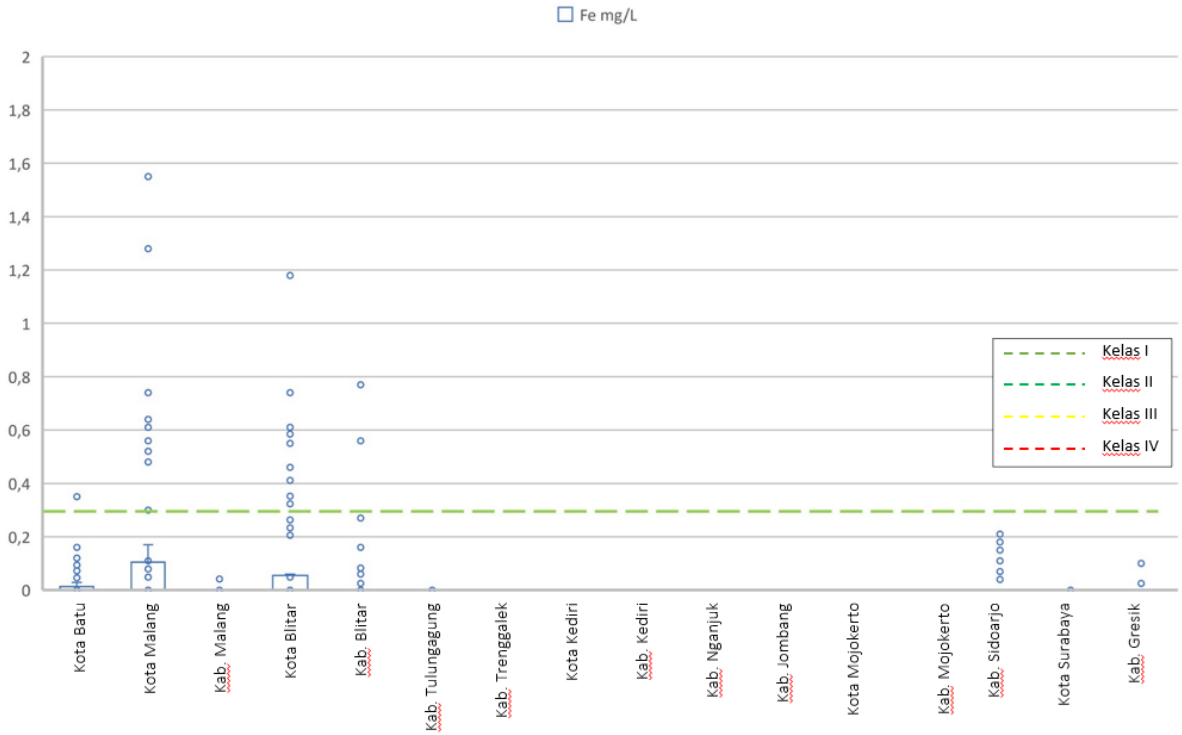
FLOURIDE



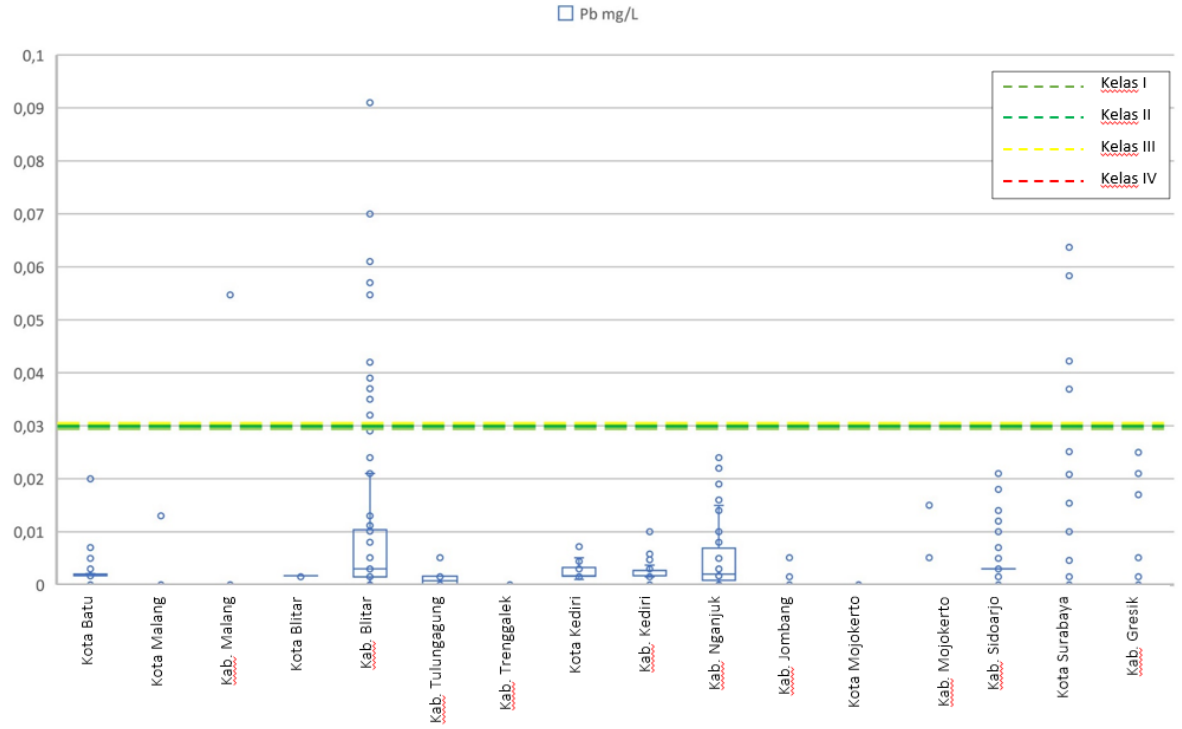
FREE CHLORINE



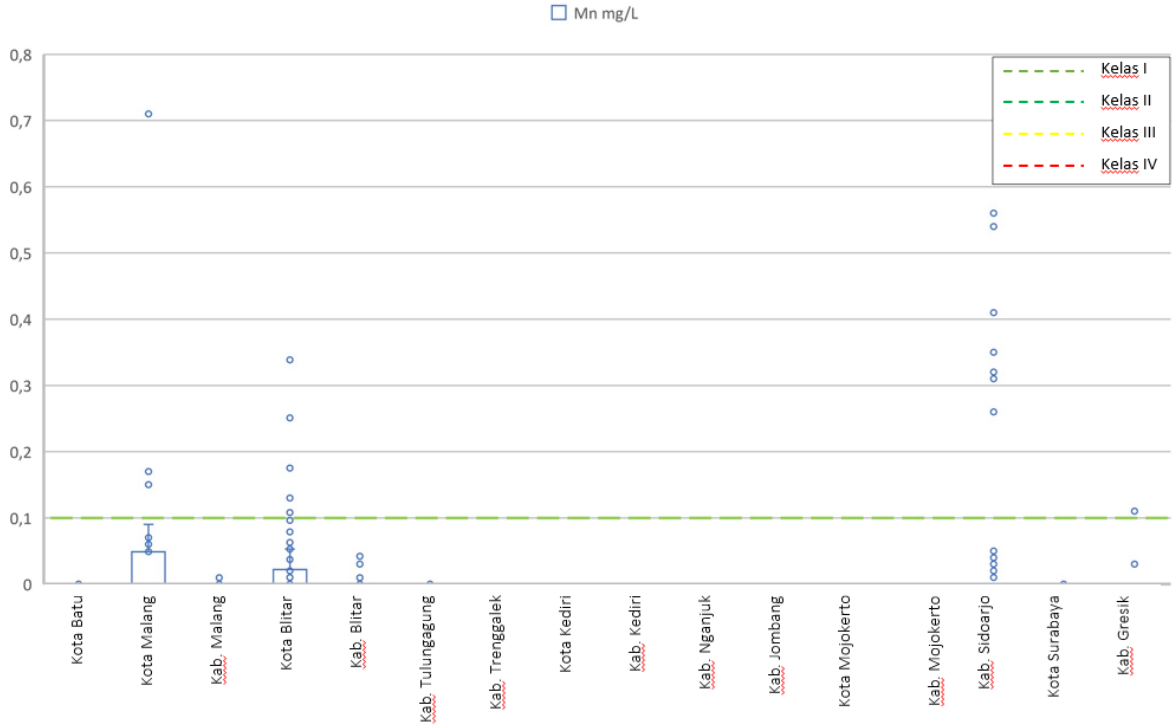
IRON


Fe mg/L
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
Kelas I
Kelas II
Kelas III
Kelas IV
Kota Batu
Kota Malang
Kab. Malang
Kota Blitar
Kab. Blitar
Kab. Tulungagung
Kab. Trenggalek
Kota Kediri
Kab. Kediri
Kab. Nganjuk
Kab. Jombang
Kota Mojokerto
Kab. Mojokerto
Kab. Sidoarjo
Kota Surabaya
Kab. Gresik

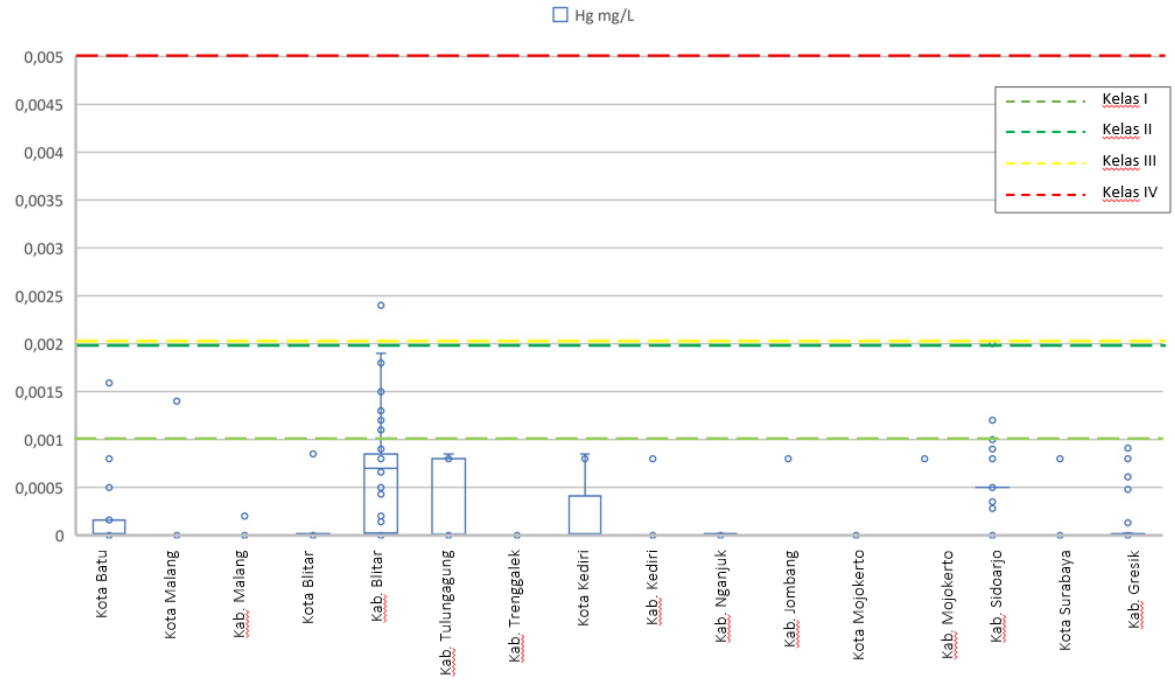
LEAD


Pb mg/L
0,1
0,09
0,08
0,07
0,06
0,05
0,04
0,03
0,02
0,01
0
Kelas I
Kelas II
Kelas III
Kelas IV
Kota Batu
Kota Malang
Kab. Malang
Kota Blitar
Kab. Blitar
Kab. Tulungagung
Kab. Trenggalek
Kota Kediri
Kab. Kediri
Kab. Nganjuk
Kab. Jombang
Kota Mojokerto
Kab. Mojokerto
Kab. Sidoarjo
Kota Surabaya
Kab. Gresik

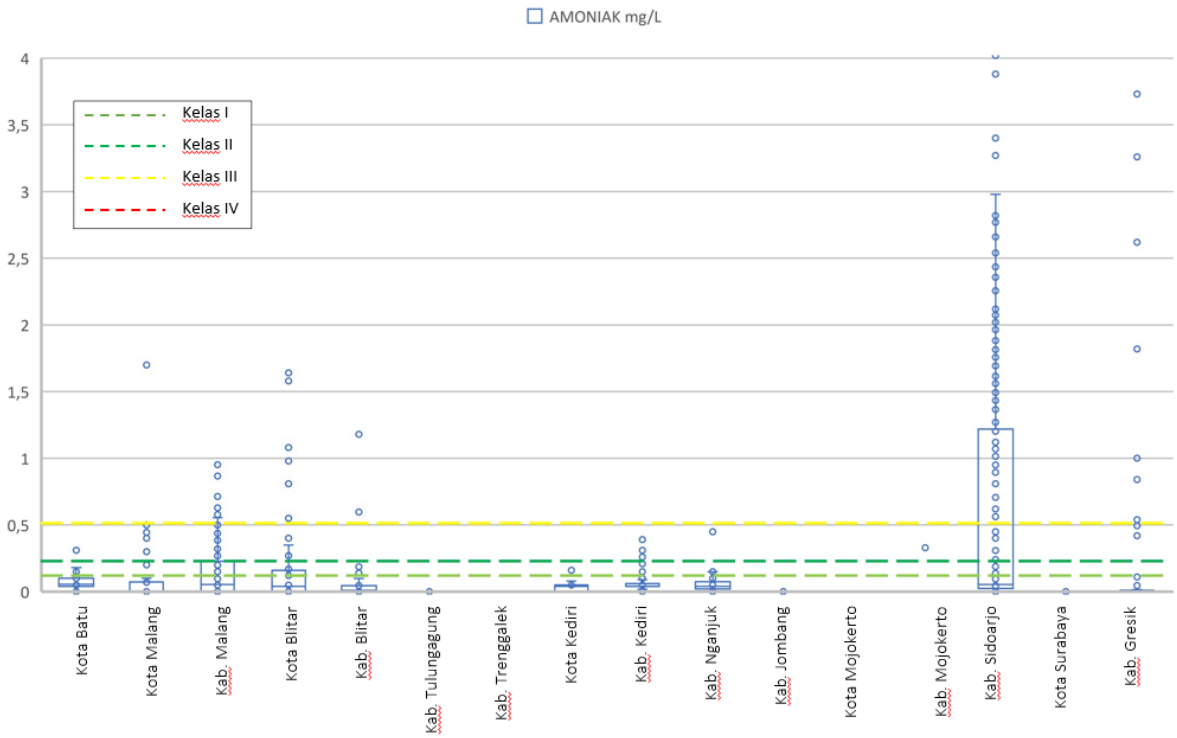
MANGANESE



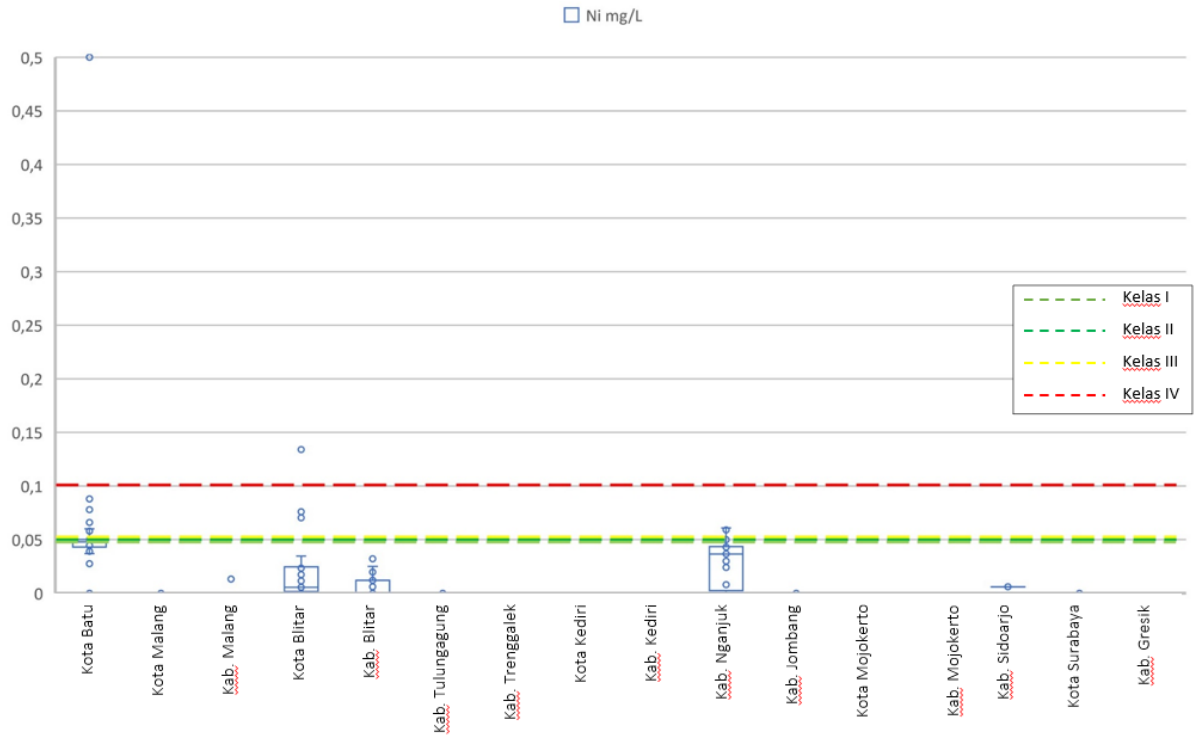
MERCURY



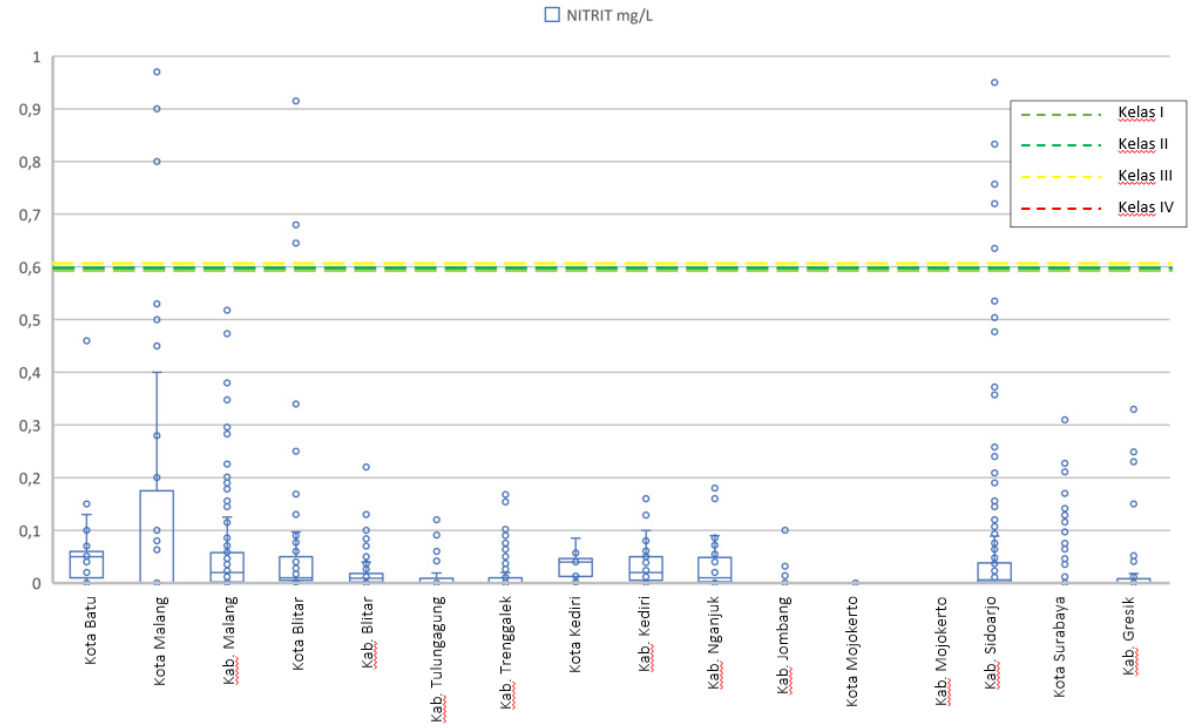
AMMONIA (NH3)



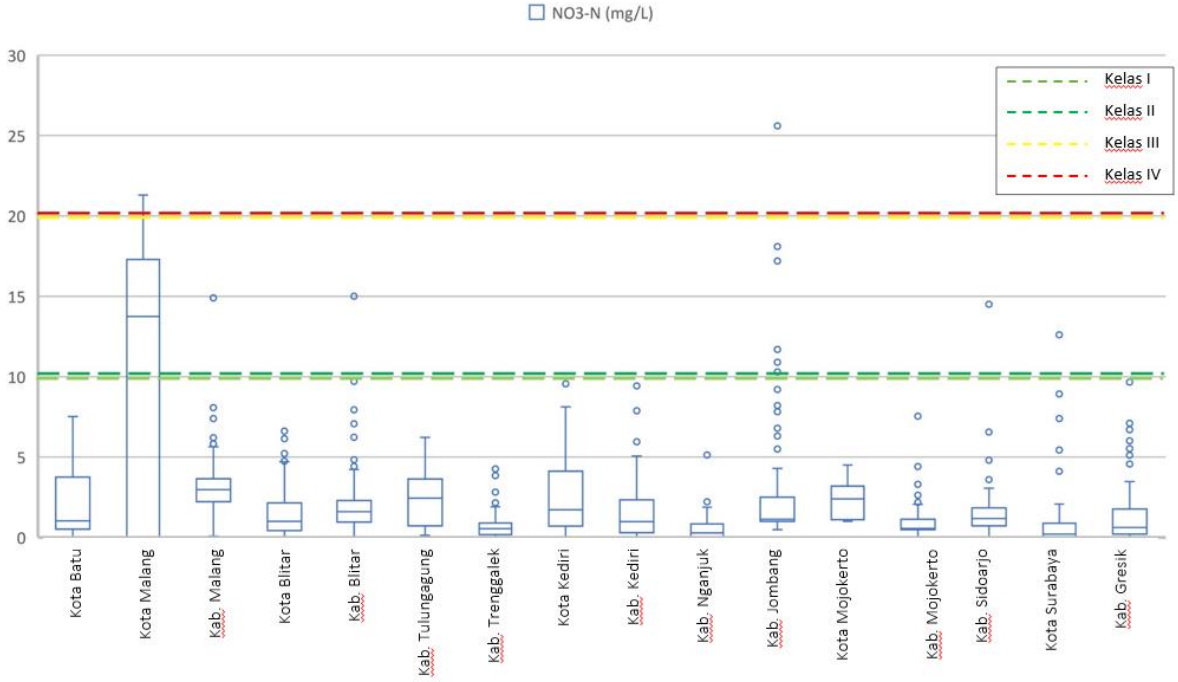
NICKEL



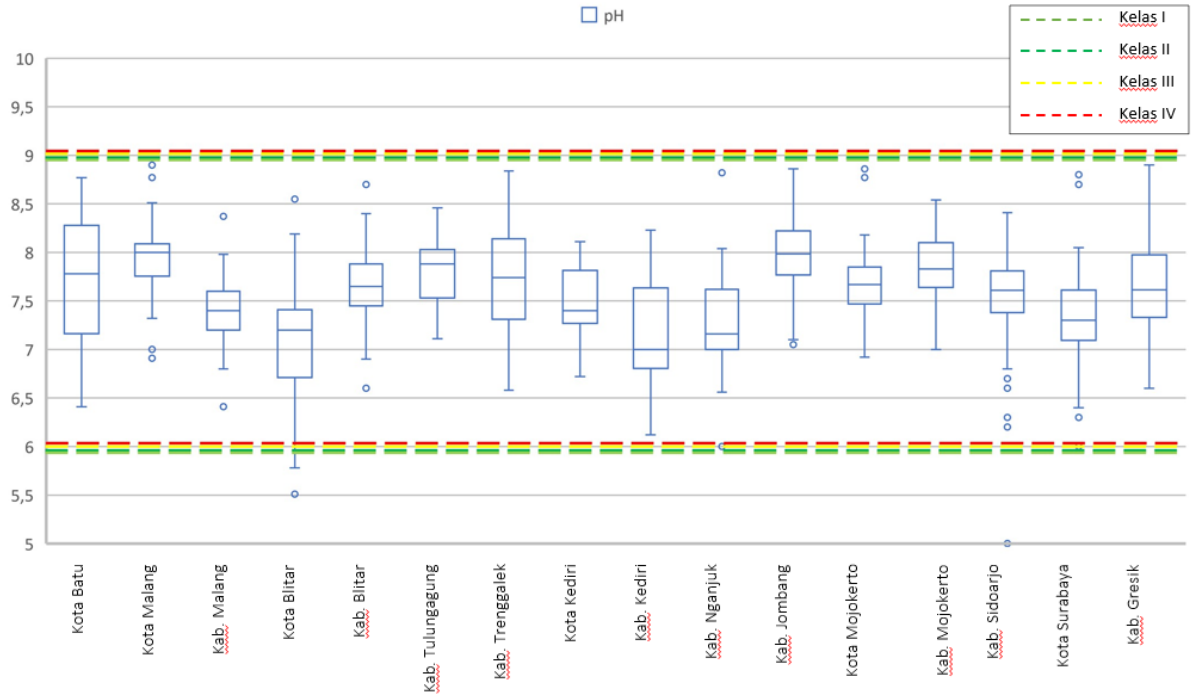
NITRITE



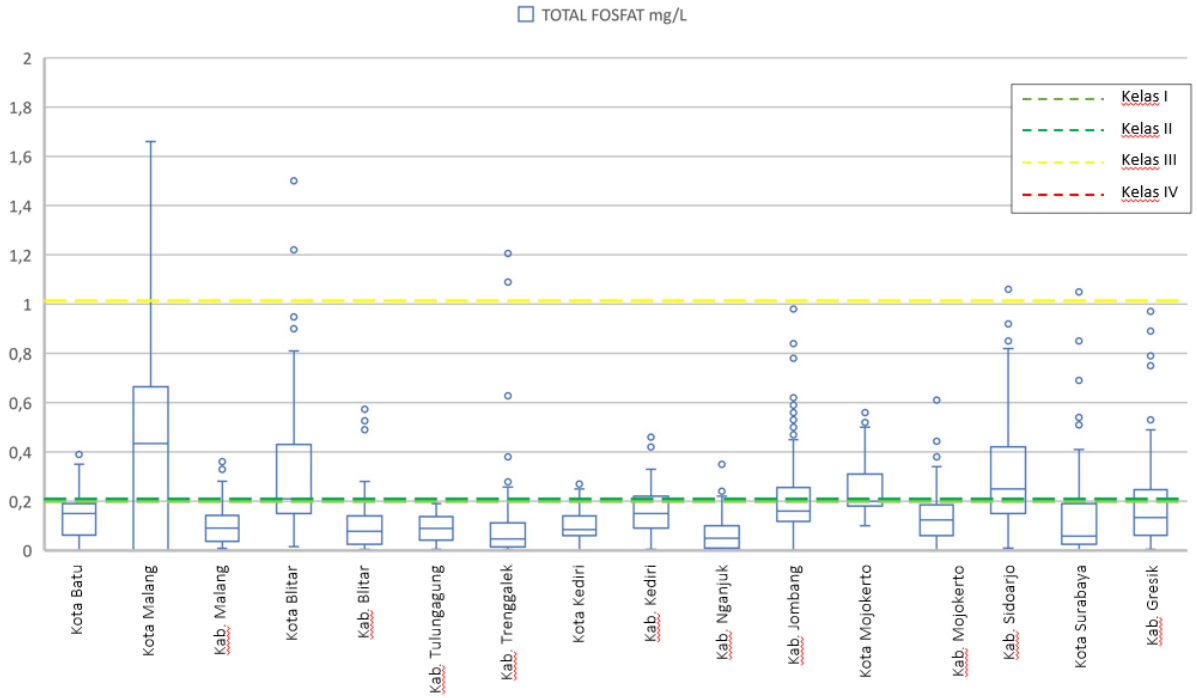
NITRATE NITROGEN (NO3-N)



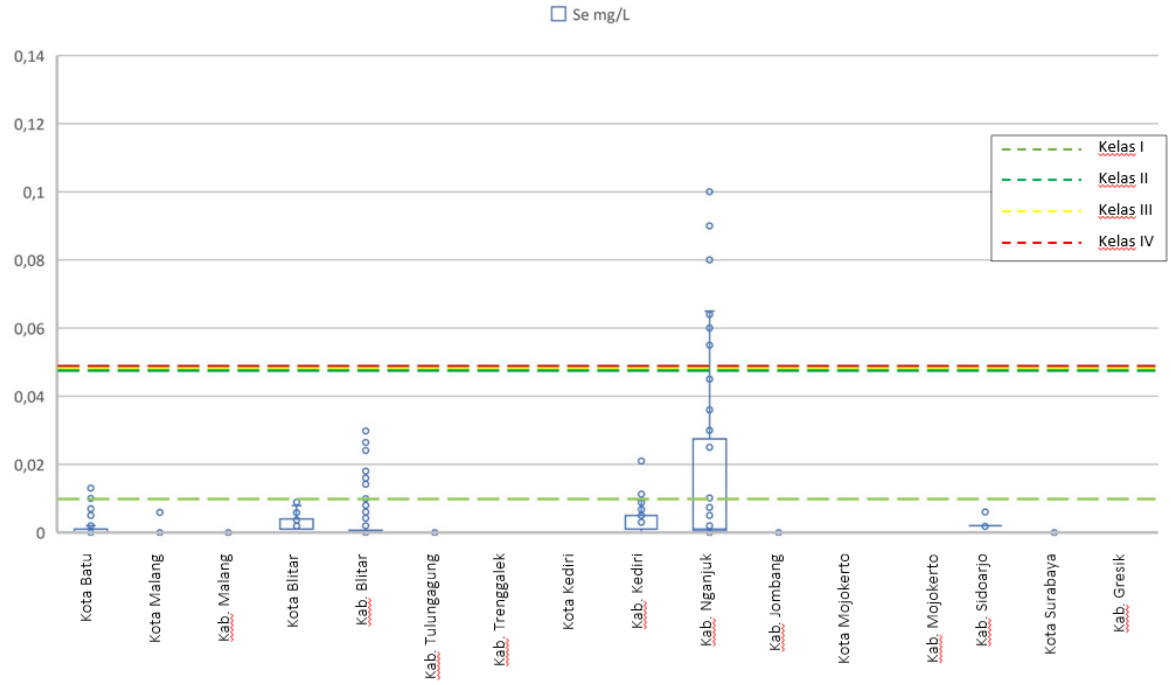
PH



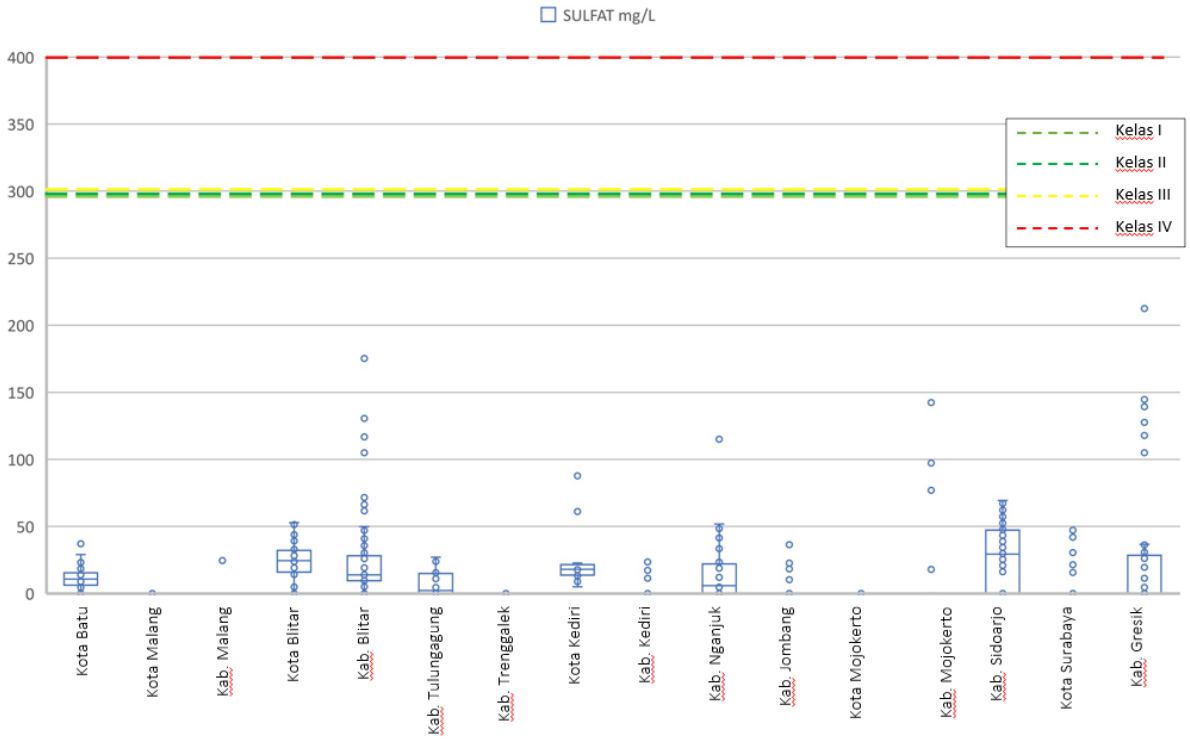
PHOSPHATE



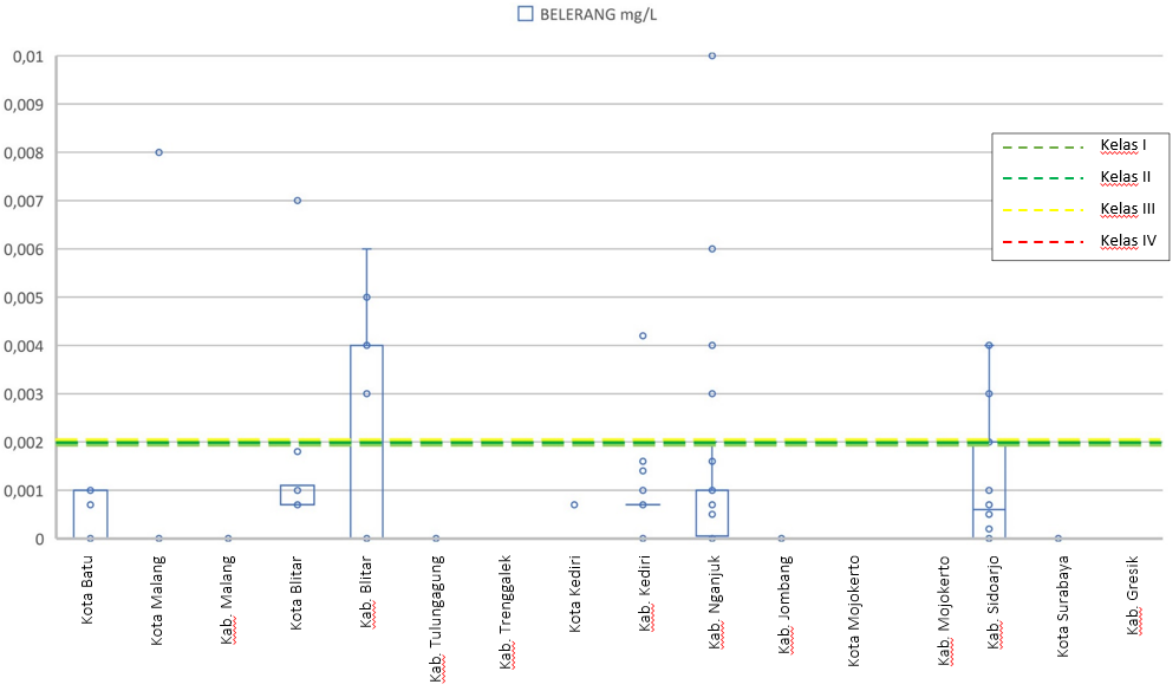
SELENIUM



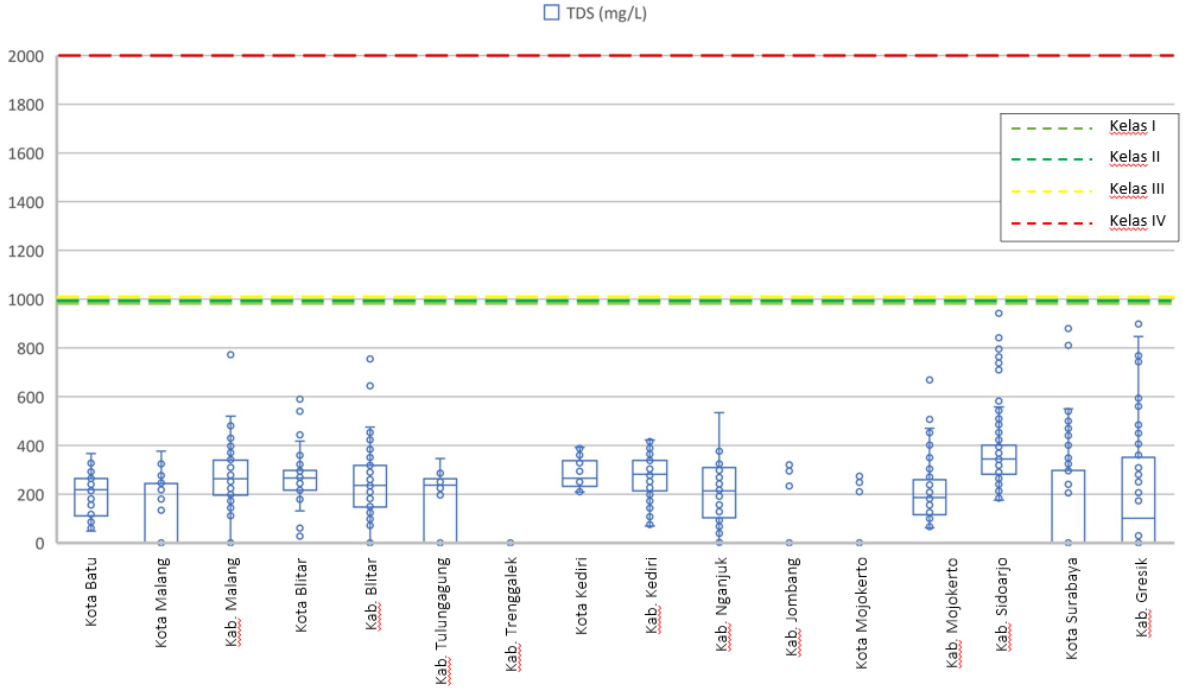
SULFATE



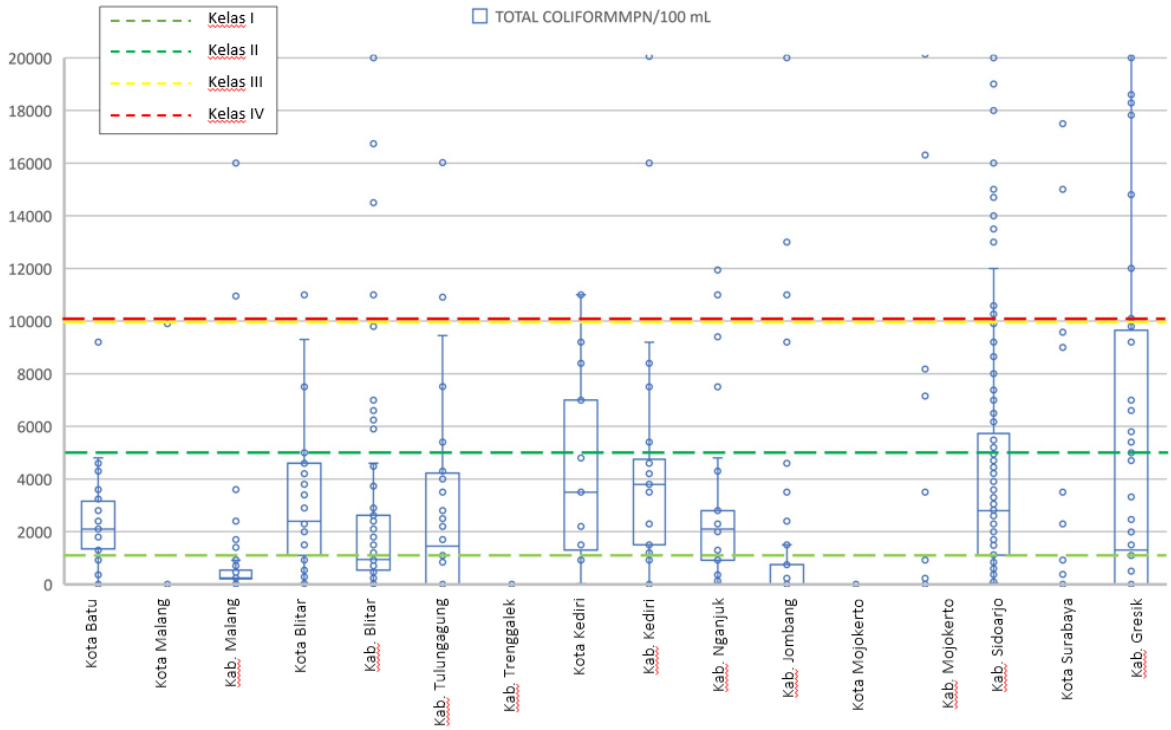
SULFUR



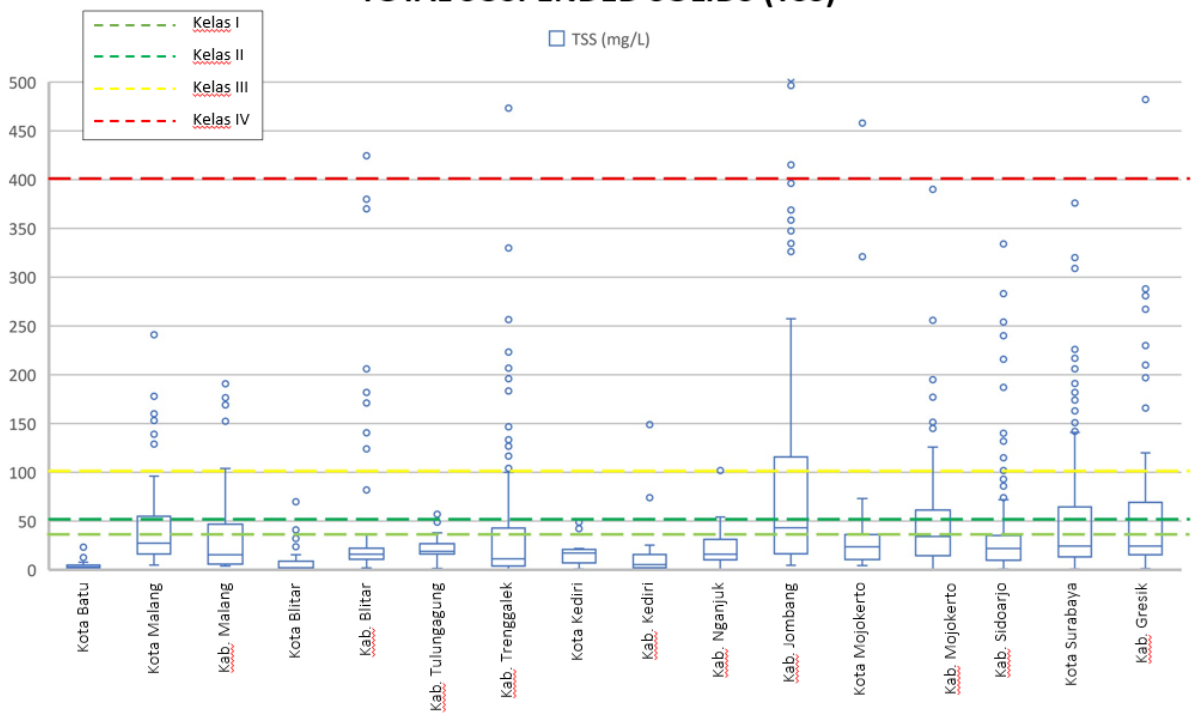
TOTAL DISSOLVED SOLIDS (TDS)

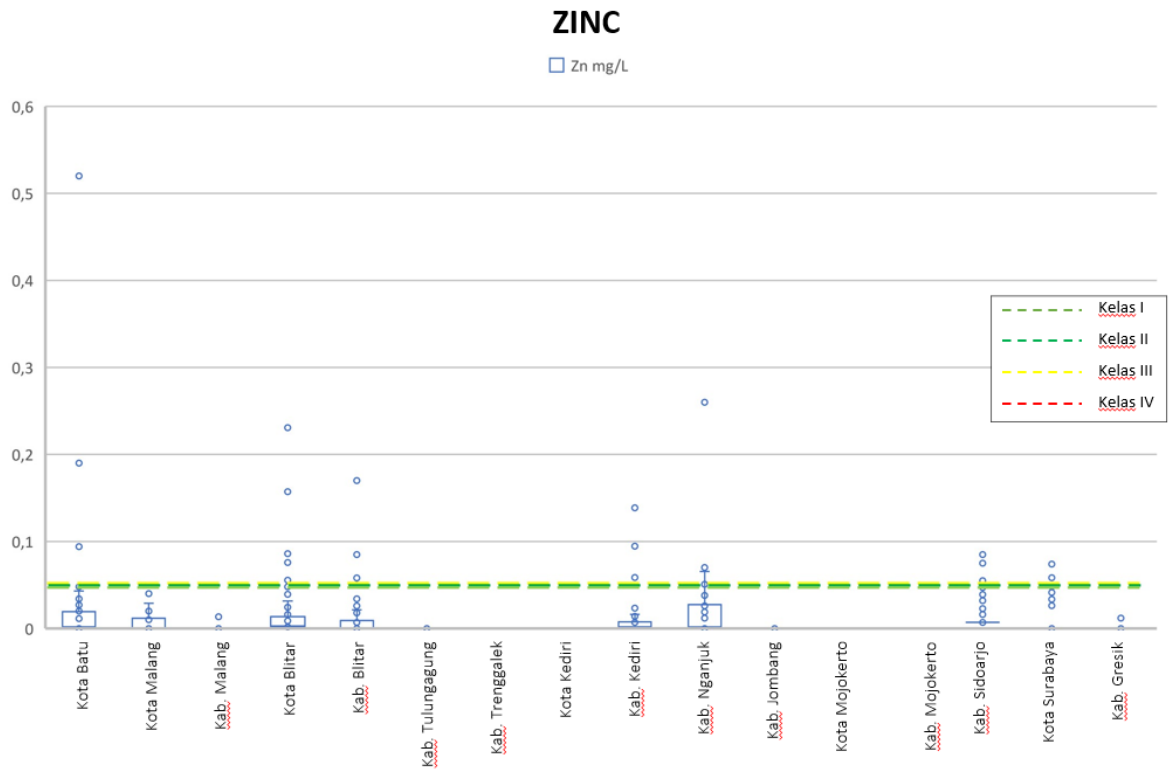


TOTAL COLIFORM



TOTAL SUSPENDED SOLIDS (TSS)





APPENDIX D. WATER QUALITY MODELING RESULTS

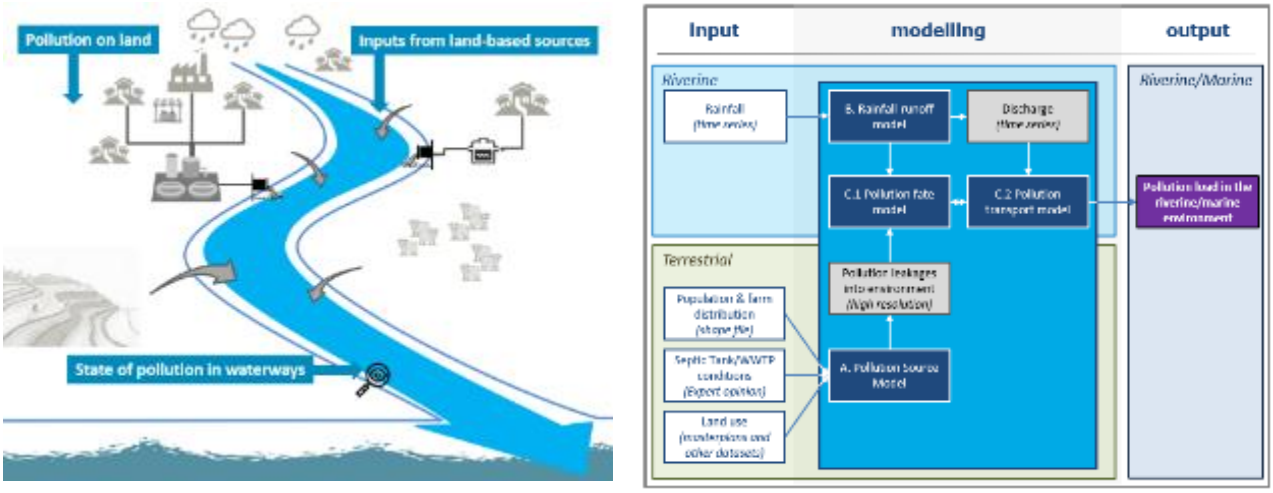
The following section describes the methodology and results of a water quality modeling exercise performed by Deltares in 2023, within the activities of the Brantas Water Quality project. The model is used to estimate pollution loads from domestic wastewater, agriculture, and livestock in the Brantas and the effects of these source contributions on BOD levels in the mainstem of the Brantas River.

D.1 CONCEPTUAL MODEL

The water quality model employed here is based on primary processes and takes into account pollution source estimates, transport via hydrological processes (rainfall runoff) and behavioral processes of pollution (Figure 31). These are summarized as follows:

Pollution sources	- Actual population at desa/kelurahan level - Actual number of e.g., cattle and crops - Local figures of conditions of septic tanks/WWTPs/etc. - Provincial estimates on handling practices for waste water
Hydrological processes	- Rainfall leads to run-off - Run-off leads to river discharge
Behavioural processes of pollution	- Pollution run-off from terrain (direct to water, via paved/unpaved terrain, and via soil) - Pollution degradation processes (disintegration processes and sinking of pollutants in water) - Transportation of pollutions (including retention and trapping of pollutants, e.g. in lakes/reservoirs)

Figure 31. Conceptual model



The modeling exercise combines an Excel-based pollutions source model with the WFLOW Brantas Hydrological Model and DELWAQ pollution fate and transport model developed by Deltares. The model employs a resolution of approximately 1 km^2.

D.2 DATA INPUTS

Static data used to generate the WFLOW model is summarized in Table 63.

Table 63. Data inputs to WFLOW

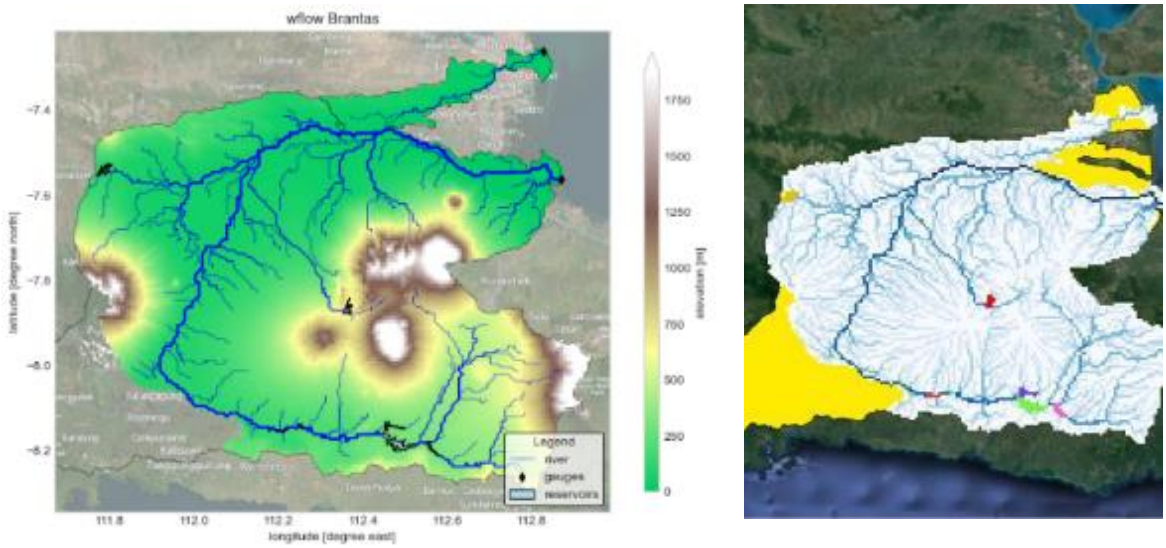
Static data	Elevation = merit_hydro Soil map = Soil grid Reservoir = GRAND (1984-2016) Lakes = hydroLAKES (2016) Landuse map = Vito (2019) Soil map = soilgrids Leaf area index = modis_lai Setup river width = chelsa & koppen_Geiger
Dynamic data	Precipitation

	Potential evapotranspiration Temperature Reservoir information.

Reservoirs in the hydrological model include larger reservoirs, namely, Lodoyo, Karngkates, Sengguruh, Lahor, Selorejo, Bening/Widas, and Wlingi (Figure 32).

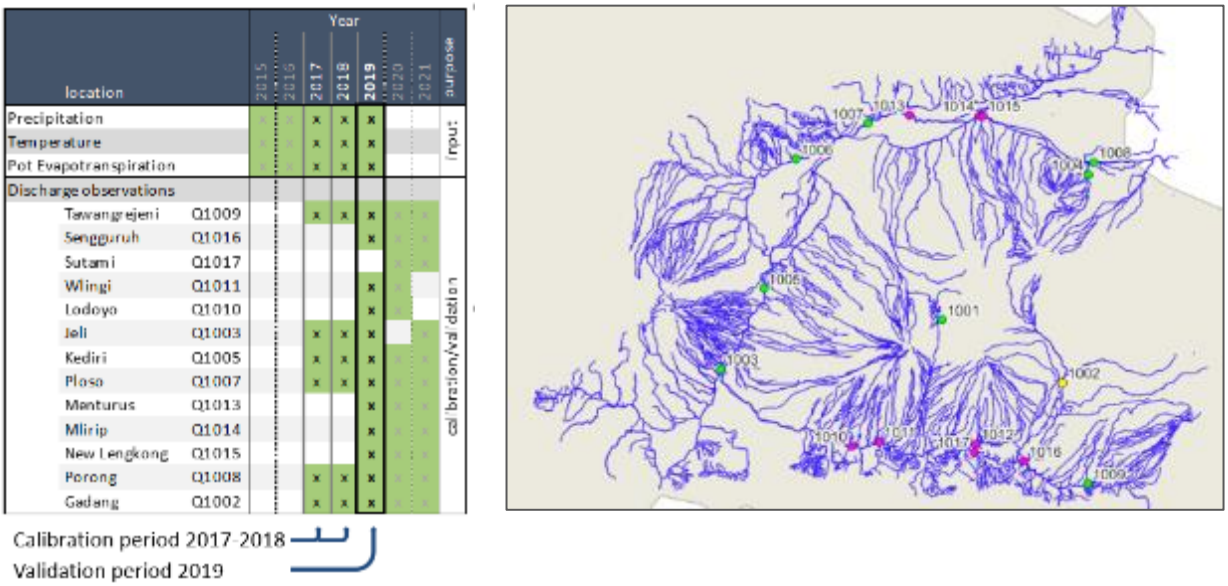
The relevant dynamic outputs are runoff (from terrain), river discharge, and infiltration.

Figure 32. WFLOW model coverage and reservoirs included



Data used for the hydrological model is described in Figure 33.

Figure 33. Hydrological data for WFLOW

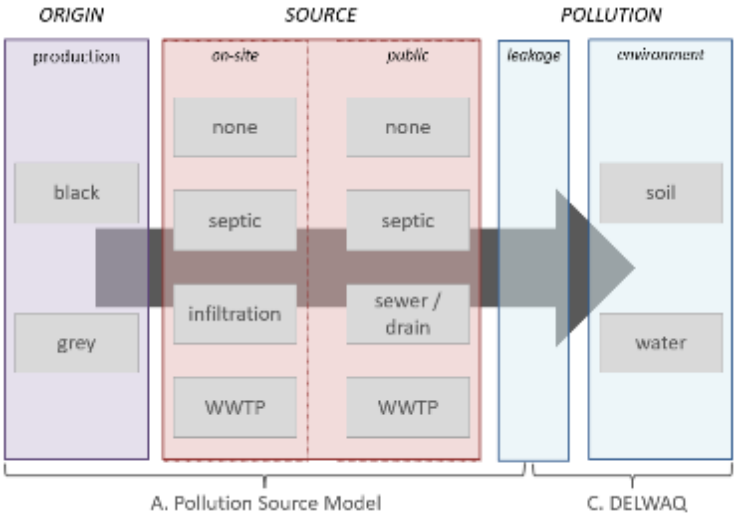


D.3 METHODOLOGY

EMISSIONS MODEL

Pollution sources and leakages were estimated using a simple Excel model. These were applied thereafter in the DELWAQ model to simulate fate and transport of pollution (Figure 34). The Excel model inventories types of pollution and estimates production loads and leakage to the environment (e.g., from septic tanks or direct discharge levels, in the case of domestic wastewater). Estimates for leakage rates are needed (step A below) in order to model the transport of pollution in open water with DELWAQ (step C)

Figure 34. Conceptual combination of pollution source and DELWAQ models



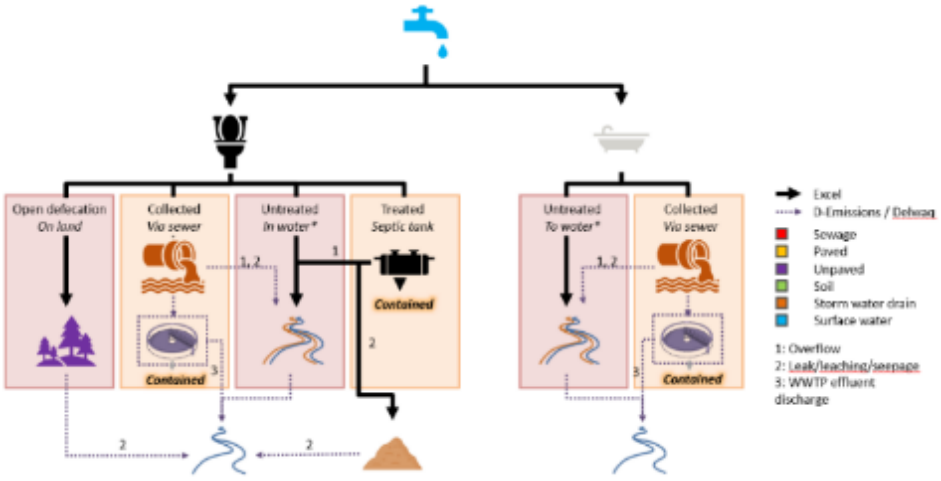
While additional sources are recognized (e.g., industrial wastewater and hospitals), data limitations made it necessary to account only for domestic wastewater and agricultural and livestock runoff (Table 64).

Table 64. List of sources identified for the Brantas Basin

Sources identified	Implemented in modeling exercise
Domestic wastewater	Yes
Agriculture	Yes, for rice and corn
Livestock	Yes, for cows, goat&sheep and chicken
Industrial wastewater	No
Hospitals	No

Domestic wastewater pathways and receptors are conceptualized in Figure 35.

Figure 35. Domestic wastewater pathways and receptors



At the desa / kelurahan level, the total load of a substance, in this case BOD (kg/d), is calculated based on the following approach:

$$\frac{population \times per\ capita\ water\ production\ \times concentration}{1000}$$

where water production is measured in units of (L per person per day) and concentrations are measured in mg/L. Water production rates for gray and black water are differentiated, as are average BOD concentrations. Water production rates are also differentiated by rural and urban areas.

Usually, a source gets distributed to receptors by simply setting fixed distribution factors in the emission model for the entire river basin. In the case of the Brantas, however, information is available per kota and kabupaten to more accurately estimate transmission by each pathway or receptor (Table 65,
Table 66, and
Table 67). Therefore, the distribution of total loads to receptors was determined by creating a source per receptor as follows:

- Domestic waste to unpaved areas (open defecation on land)
- Domestic waste to stormwater (50% of overflow from septic tanks and direct discharge to water)
- Domestic waste to soil (leakage from septic tanks)
- Domestic waste to surface water (50% of overflow from septic tanks and direct discharge to water, plus discharge from WWTPs)

Table 65. Fraction of domestic wastewater per receptor per kabupaten / kota

	Tangki Septik	IPAL	Kolam/Sawah/ Sungai/Laut	Lubang Tanah	Pantai/Lapang-an/Kebun	On Land
	% to Septic	% to WWTP	% Direct Water			% on Land
Kota Batu	89.95	4.5	5.55	0	0	0
Kota Malang	85.47	1.24	10.51	2.78	0	2.78
Malang	61.1	0.57	1.85	36.37	0.11	36.48
Blitar	74.55	0	6.23	19.22	0	19.22
Kota Blitar	94.34	4.45	1.21	0	0	0
Kediri	85.46	0.17	1.47	12.9	0	12.9
Mojokerto	90.78	0	2.28	6.94	0	6.94
Jombang	96.4	0	1.01	2.59	0	2.59
Nganjuk	83.8	0	2.24	13.87	0.09	13.96
Gresik	88.96	0	0.31	10.72	0	10.72
Kota Kediri	98.1	0.34	0.76	0.8	0	0.8
Kota Mojokerto	97.47	0.48	0.77	0	0	0
Kota Surabaya	94.91	1.79	3.17	0.12	0	0.12
Sidoarjo	95.68	0.4	2.79	1.13	0	1.13

Source: NAWASIS, BPW 2023

Table 66. Fractions of overflow and leakage from septic tanks (% of total volume to receptor septic tank)

	Urban	Rural
Septic leak	31.6%	28.1%
Septic overflow	5%	5%

Table 67. Emissions factors, domestic wastewater; Gray- and blackwater production rates and concentrations for urban and rural areas

Source	Urban-water production (L/person/day)	Rural water production (L/person/day)	BOD (mg/l)	Generation load (kg/person/day)	
				Urban	Rural

Grey water	119	50	263	0.03	0.007
Black water	40	18	528	0.02	0.002

Widyarani, et al., (BRIN) 2021

Estimations of BOD from agriculture focus on rice and corn, as these are the two predominant crop types in the Brantas River basin. Other crops may be important at the local scale but are not considered in this study. It is assumed that the entire load is distributed across "unpaved" receptor areas.

There are some important data issues to note related to agriculture BOD estimates. First, not all administrative regions in the analysis report the areas of rice and corn fields. This is the case for Tulungagung (Kabupaten), Malang (Kabupaten), Madiun (Kabupaten), and Surabaya (Kota). For Kota Surabaya, it may be realistic that there is no coverage reported, as the area is urbanized and there, is in fact, little agriculture in the city. In regions that report the rice paddy area but not corn, the production values are used to generate the area taken by corn fields. It is assumed that the yield on 1 hectare of paddy field and corn fields is identical. For Kabupaten Kediri, only production ("yields") are reported. For now, this has not been converted to an estimated area.

There are a total of 38 kecamatan for which the reported paddy and corn field area is larger than the surface area of the kecamatan itself. This should be further investigated to determine if the reported areas too large, or if it is because multiple harvests are recorded from the same areas.

Table 68. Emissions factors, agriculture

Source	BOD (kg/ha/harvest season	TN (kg/ha/harvest season)	BOD (kg/ha/d)	TN (kg/ha/d)
Rice field	225	20	1.23	0.11
Corn field	125	10	0.68	0.05

Source: KLHK, 2018

With respect to livestock estimations, different "types" of cow (e.g. dairy cow, meat cow) are combined into a single cow emission; goats and sheep are combined, using the emission factor for goats; different types of chicken are combined (kampong and broiler) into one chicken emission; and different types of duck (bebek, titik entok) are grouped as one. The emissions factors used for each combined model are based on the highest percentage representative group in the combined type set.[96] For chickens, information for "Ayam Ras" was not used, because it is reported only in Kabupaten Blitar was the number of chicken reported as such. Therefore, the current approach may give an underestimation of the number of chicken in this region. Based on the assessment, cows, chickens and goats (and sheep) are the major sources within the category "livestock". Populations for these livestock and are used for estimations in the Emission Model. As with agriculture, it is assumed that all livestock loads to go to receptor "unpaved".

Table 69. List of emission factors, livestock

Parameter	Unit	Cattle	Dairy cow	Goat	Buffalo	Horse
Weight	Kg	210	190	50	275	125
BOD	mg/cap/d	100380	87400	2100	110000	58125
TN	mg/cap/d	27720	28120	26200	60225	14500

Source: Iskandar (BLK, PusAir), 2018

[96] The emissions factor for cows is based on meat, since 85% of the cow population in the Brantas is meat cow. The number of goat in the Brantas catchment is approximately 9 times larger than the population of sheep. Therefore, the emissions factors for goats are used for the combined quantity.

Table 70. Calculation of emission variables

			Emission Variable		Emission Factor		
Source	Sub-source	Spatial scale*	Calculation/quantity	Units	Calculation/quantity	Unit	Data sources
Domestic wastewater	Unpaved	4	Fraction On Land (-) * (Population * Black Water Production (L/pp/d) * Substance Concentration Black Water (g/m^3) / (Surface Area (km^2) * 1,000,000))	kg/d/km^2	Surface area computational grid EM-WQ	km^2	Population (Kecamatan reports) Grey and black wastewater production urban and rural areas and concentration BOD and TN in grey and black wastewater (Firdayati et al. 2015) Fraction WWTP, Septic tank, water, in and at land (NAWASIS, BPS)
	Storm water	4	0.5 * (1 - Fraction to WWTP) * (Population (pp) * Grey Water Production (L/pp/d) * Substance Concentration Grey Water (g/m^3) / (Surface Area (km^2) * 1,000,000)) + 0.5 * (Fraction to Septic (-) * Fraction Septic to Overflow (-) + Fraction Direct Water) * Population (pp) * Black Water Production (L/pp/d) * Substance Concentration Black Water (g/m^3) / (Surface Area (km^2) * 1,000,000))	kg/d/km^2		km^2	
	Soil	4	Fraction to Septic * Fraction Septic Leak * (Population * Black Water Production * Substance Concentration Black Water / Surface Area) [kg/d/km^2]	kg/d/km^2		km^2	
	Surface water	4	0.5 * (1 - Fraction to WWTP) * (Population (pp) * Grey Water Production (L/pp/d) * Substance Concentration Grey Water (g/m^3) / (Surface Area (km^2) * 1,000,000)) + 0.5 * (Fraction to Septic (-) * Fraction Septic to Overflow (-) + Fraction Direct Water) * Population (pp) * Black Water Production (L/pp/d) * Substance Concentration Black Water (g/m^3) / (Surface Area (km^2) * 1,000,000)) + Fraction to WWTP (-) * (Population (pp) * Graywater Production (L/pp/d) * Substance Concentration Grey Water (g/m^3) / (Surface Area (km^2) * 1,000,000)) + Fraction to WWTP (-) * (Population (pp) * Black Water Production (l/pp/d) * Substance Concentration Black Water (g/m^3) / (Surface Area (km^2) * 1,000,000))	kg/d/km^2		km^2	
Agriculture	Rice paddy	3	Rice paddy area (ha) * Load (kg/ha/harvest season) * 2 / Surface area (km^2)	kg/d/km^2		km^2	Kabupaten, Kecamatan resorts
	Jagung	3	Jagung area (ha) * Load (kg/ha/harvest season) * 2 / Surface area (km^2)	kg/d/km^2		km^2	
Livestock	Cows	3	(Population (pp) * Load (mg/pp/day) / (Surface area (km^2) * 1,000,000)	kg/d/km^2		km^2	
	Goat/sheep	3	(Population (pp) * Load (mg/pp/day) / (Surface area (km^2) * 1,000,000)	kg/d/km^2		km^2	
	Chicken	3	(Population (pp) * Load (mg/pp/day) / (Surface area (km^2) * 1,000,000)	kg/d/km^2		km^2	

Source: Deltares, 2023; * 1 = Provinsi/Daerah Istimewa (province), 2 = Kabupatan (regency) / Kota (city), 3 = Kecematan (district), 4 = Kelurahan/Desa (village)

MODEL VERIFICATION

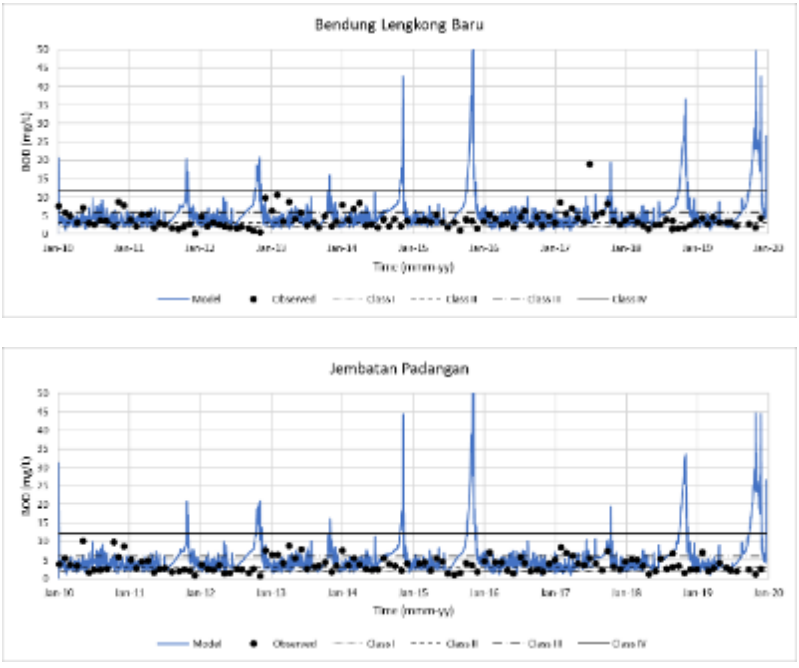
Time-series of modelled BOD concentrations and observed BOD concentrations are compared at selected locations (Jembatan Ploso, Bendung Lengkong Baru, and Jembatan Padangan). Spatial comparisons of modelled and observed concentrations were made, referring to river class designations.[97] At the bifurcation of the Sungai Brantas to Sugai Surabaya and Sungai Porong, water gets first directed to Sungai Surabaya. However, during the dry season this may lead to dry fall in Sungai Porong. This, in return, yields unrealistic modelled BOD concentrations. Therefore, the discharge from Sungai Brantas to Sungai Surabaya was limited to 2 m3/s to prevent dry fall in Sungai Porong.

Modelled BOD concentrations in the river are sensitive to the decay rate, which was estimated based on first order kinetics decay rates of 0.191 d-1 to 0.92 d-1 (Nuruzzaman et al., 2018). Additional sensitivity testing was conducted with decay rates of 0.2, 0.4 and 0.9 d-1. These tests resulted in the following findings:

- 0.9 d-1 too high: results in average concentrations with bias below measured concentrations
- 0.2 d-1 too low: results in concentrations that are too high compared to measured
- 0.4 d-1 chosen as the most appropriate rate for the BOD modelling for the Brantas River.

Figure 36 shows modelled BOD results versus observations over a ten-year period. Most notable are the peaks in modelled BOD during dry periods. This may be an artefact of the modelled discharge volumes, which are close to zero during the dry season. During years that the river does not fall dry, the model 's dry-period results are closer to observation data.

Figure 36. Model verification, BOD results (10-year period) versus observations for June 2010 – Jun 2011 and Nov 2015 – Aug 2018

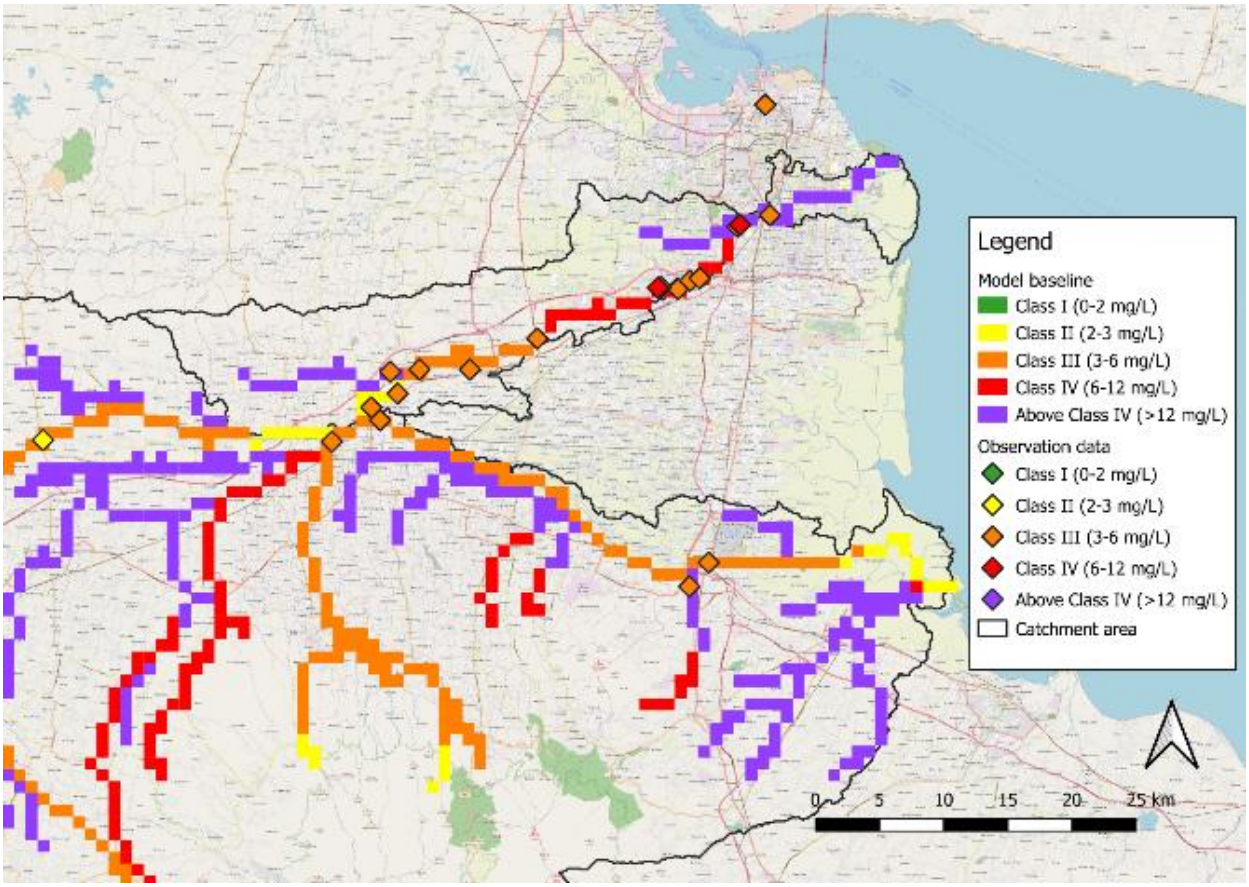


[97] According to Government Regulation 22 of 2021 on Environmental Protection and Management

Source: Deltares, 2023

Water quality measurements available at the time of modeling were limited to the downstream region of the Brantas River, the Porong River, and the Surabaya River. Figure 37 shows a comparison of modeled water class by segment and observed BOD class standards (diamond-shaped points). Notably, in terms of BOD (based on median concentrations), Sungai Brantas was modeled with Class III quality but observed to be of Class II at Jembatan Ploso. Similarly, Sungai Surabaya is noted as largely Class II in observation data, whereas the model indicates Class III. These results may indicate measurement issues; however, they are subject to some uncertainties. For one, source data from local administrative regions may be inconsistent. Second, in the quantification of agricultural loads, only rice (jagung) areas were included, and some areas had not data on agricultural land use. Second, the BOD contributions from industrial wastewater were not taken into account altogether (though these would be expected to further increase estimated BOD loads).

Figure 37. Model verification, spatial interpretation using river water class



D.4 RESULTS: BASELINE ANALYSIS

Figure 38, Figure 39, and Figure 40 show the baseline estimations of BOD (kg/day/km^2) from each source. Naturally, domestic wastewater emissions are concentrated in populated areas, many of which are near the main Brantas (e.g., Kota Malang, Kota Blitar, Kota Kediri, and downstream areas).

Figure 38. Baseline BOD load for domestic wastewater (kg/d/km^2)

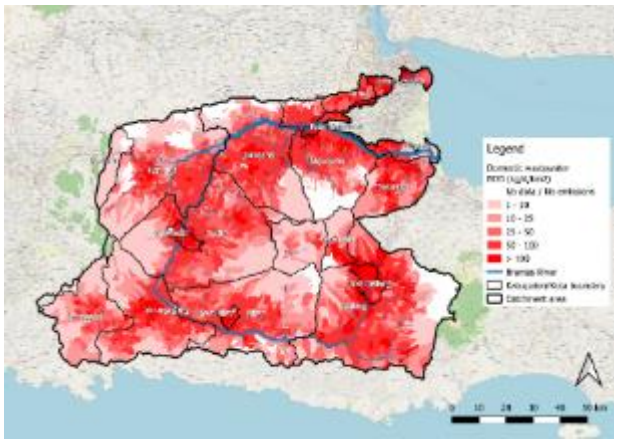


Figure 39. Baseline BOD load for agriculture (kg/d/km^2)

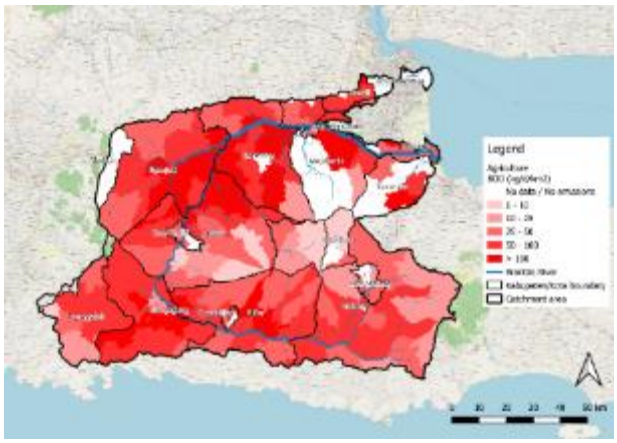
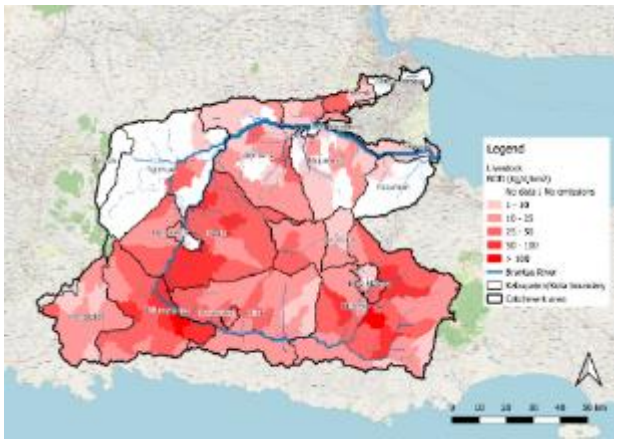


Figure 40. Baseline BOD load for livestock (kg/d/km^2)



Scenarios	Measure / Intervention	Purpose
1a-c	Basin-wide emission reduction by 30% per source: Domestic wastewater Agriculture Livestock	Identify effects on water of basin-wide efforts to reduce emissions by 30% per source (domestic wastewater, agriculture, livestock)
2a-b	Basin-wide emission reduction by 30% for: All sources (domestic wastewater, agriculture, livestock) Domestic wastewater and agriculture only	Identify effects on water quality of basin-wide effort to reduce emissions by 30% for all sources (domestic wastewater, agriculture, livestock) / combination of the two largest sources (domestic wastewater and agriculture)
3a-d	Basin-wide emission reduction for domestic wastewater and agriculture: 40% reduction on both 50% reduction on both 60% reduction on domestics wastewater, 30% reduction on agriculture 30% reduction on domestic wastewater, 80% reduction on agriculture	Identify effects on water quality of basin-wide effort to reduce emissions for domestic wastewater and agriculture symmetrically and asymmetrically

D.5 RESULTS: INTERVENTION SCENARIOS

The table below summarizes key findings from each intervention scenario:

Scenario	Key Findings
1a. 30% reduction in loads from domestic waste water	30% reduction in domestic wastewater emissions, leads to 20-30% reduction in modelled median BOD concentrations in the river system in areas where this is the dominant source of pollution (e.g. cities such as Surabaya, Malang). However, this does not directly result in a change in river water class locally. Changes to a better river water class may occur in downstream reaches of the river
1b. 30% reduction in loads from agriculture	30% reduction in agriculture emissions leads to 10-20% reduction in modelled, median BOD concentrations in the river in areas where agriculture is prevalent (e.g. Jombang, Nganjuk); however, this does not directly result in a change in river water class locally. Some changes to a better river water class may occur in downstream reaches of the river.
1c. 30% reduction in loads from livestock	30% reduction in livestock emissions does not effect change larger than 10% in the modelled, median BOD concentrations, except in some upstream reaches. There are hardly any changes in the river water class compared to baseline.
2a: 30% reduction domestic wastewater, agriculture and livestock combined	The combined 30% reduction scenario (all sources) leads to a 20-30% reduction in the modelled, median BOD concentrations in large parts of the Brantas River. There are possible changes from river water Class III to Class II for BOD for the downstream part of Sungai Brantas and Sungai Porong. There is a 20-30% reduction in the modelled, median BOD concentrations in large parts of the Brantas River.
2b: 30% reduction domestic wastewater and agriculture	30% reduction of emissions from domestic wastewater and agriculture combined lead to a 20-30% reduction in the modelled, median BOD concentrations in large parts of the Brantas River. There is a possible change from river water Class III to Class II for BOD for the downstream part of Sungai Brantas and Sungai Porong.
NOTE: Scenarios 2a and 2b indicate a similar possible change from river water Class III to Class II for BOD for the downstream part of Sungai Brantas and Sungai Porong compared to the baseline. This suggests that reduction of livestock emissions is a less effective measure for reducing overall BOD loads in the river. As such, the following scenarios focus only on combined reductions of domestic wastewater and agriculture.	
3a: 40% reduction domestic wastewater and agriculture	Relative reduction in BOD concentrations in the Brantas River increase from between 20-30% for scenario 2b, to 30-40% for scenario 3a and >40% for scenario 3b. As such, 40-50% reductions in domestic wastewater and agricultural emissions may lead to conversion from Class III to Class II for a large part of the Brantas River.
3b: 50% reduction domestic wastewater and agriculture	

3c: 60% reduction domestic wastewater and 30% agriculture	Scenario 3c represents an intervention scenario focused on domestic wastewater reduction. A reduction of 60% in domestic wastewater and 30% in agricultural emissions (scenario 3c) has a similar effect as a reduction of 50% for each (scenario 3b) – i.e., conversion from Class III to Class II for a large part of the Brantas River.
3d: 30% reduction domestic wastewater and 80% agriculture	Scenario 3d represents an intervention scenario focused on an extreme (80%) reduction of agricultural emissions, combined with a lesser reduction of domestic wastewater (30%). When agricultural emission are almost eliminated, large parts of the Brantas River may exhibit Class II BOD levels, except for around cities (e.g. Kediri, Blitar), where the river remains Class III for BOD due to the relatively large input of BOD from domestic wastewater.

Table 71. Scenarios 1a, 1b, 1c (expressed as river class per segment)

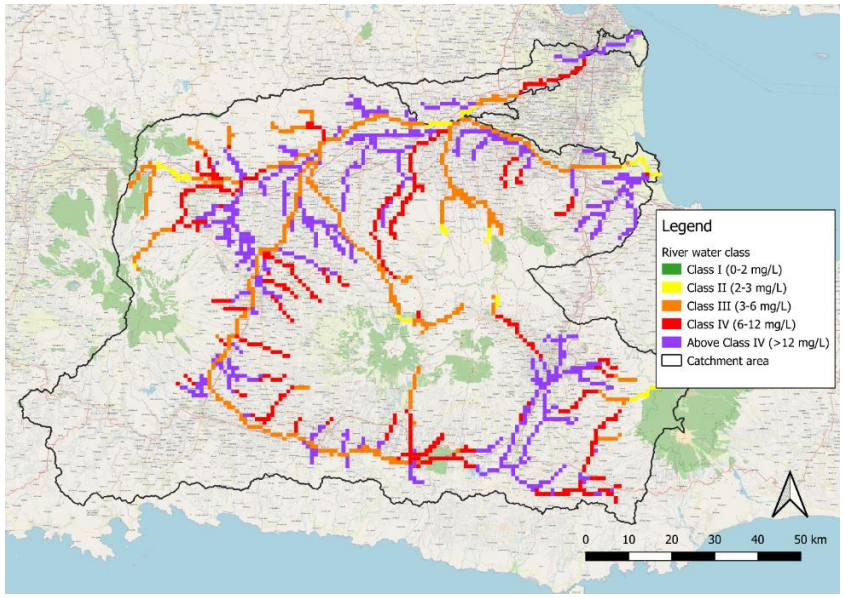
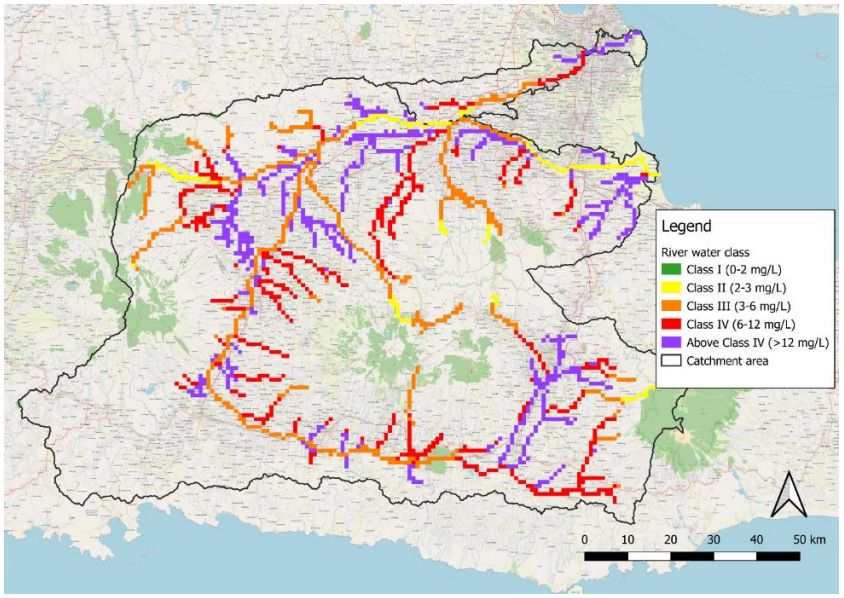
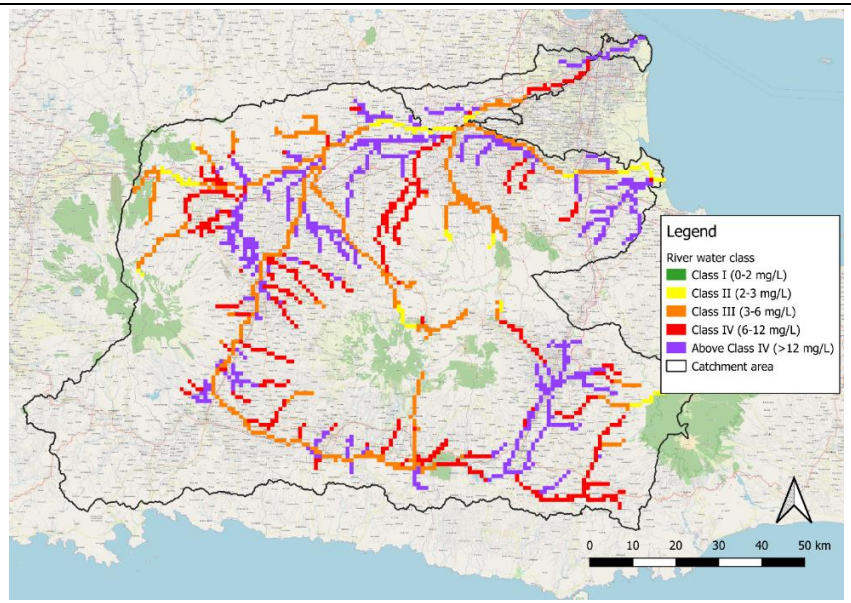
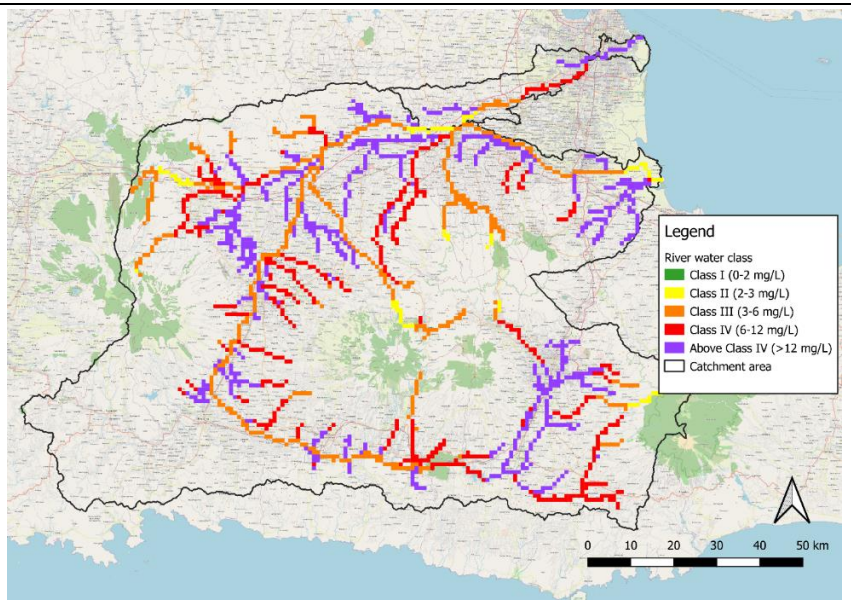
Baseline	1a. 30% reduction of loads from domestic wastewater
	
1b. 30% reduction of loads from agriculture	1c. 30% reduction of loads from livestock
	

Table 72. Scenarios 2a, 2b: Symmetric reductions, expressed as river class per segment

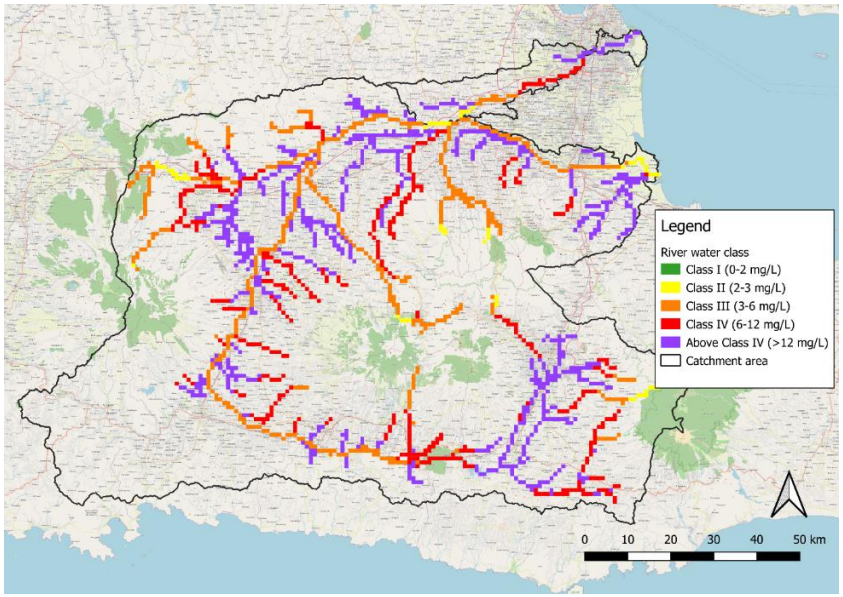
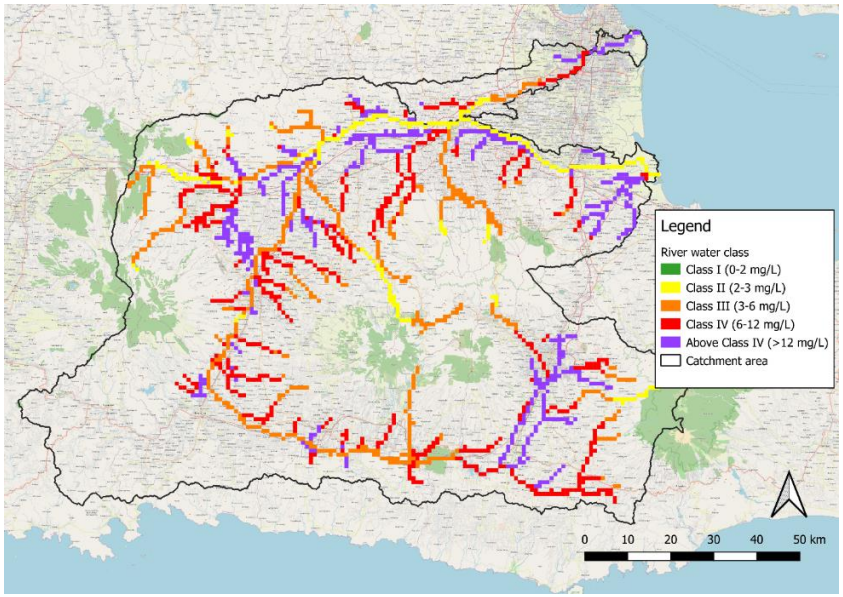
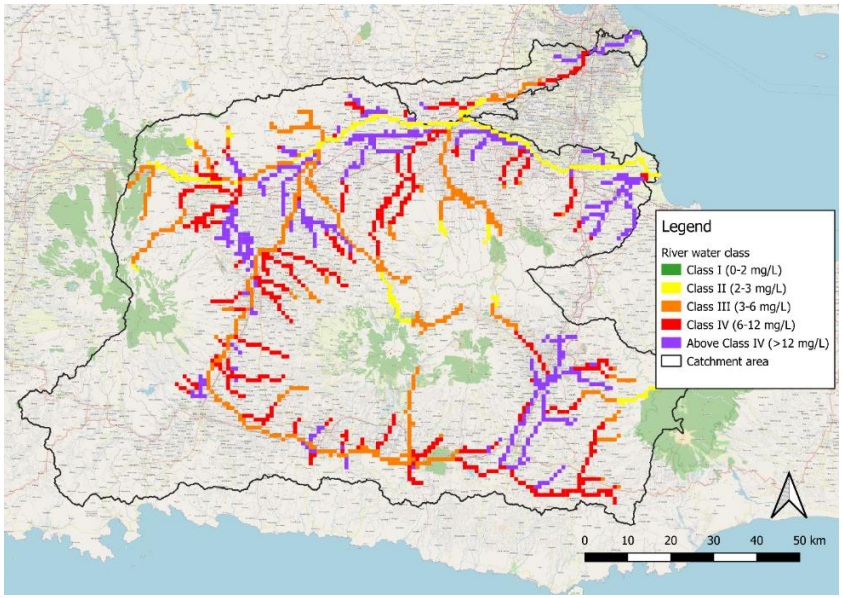
Baseline	2a. 30% reduction of domestic wastewater, agriculture, livestock combined
	
2b. 30% reduction of loads from domestic and agriculture only	
	

Table 73. Scenarios 3a, 3b: Symmetric reduction of domestic wastewater and agriculture only, expressed as river class per segment

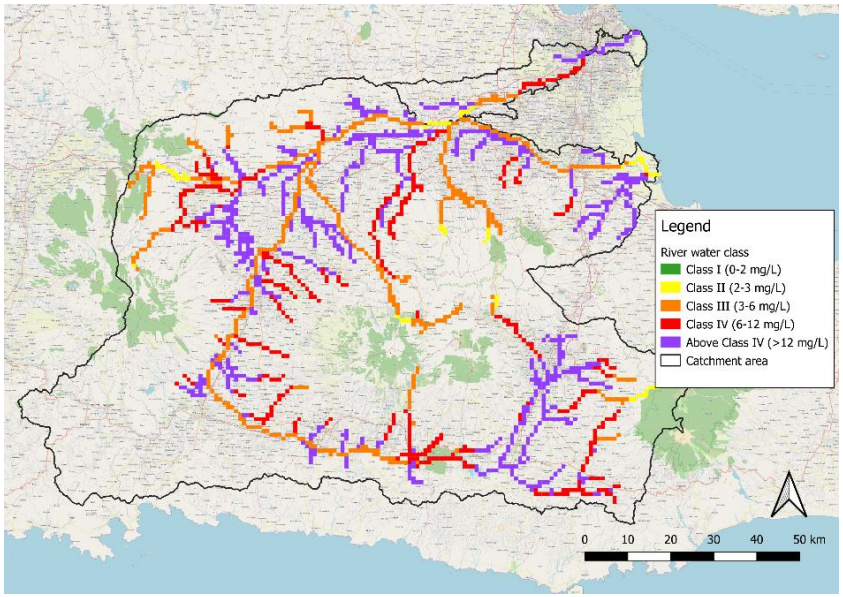
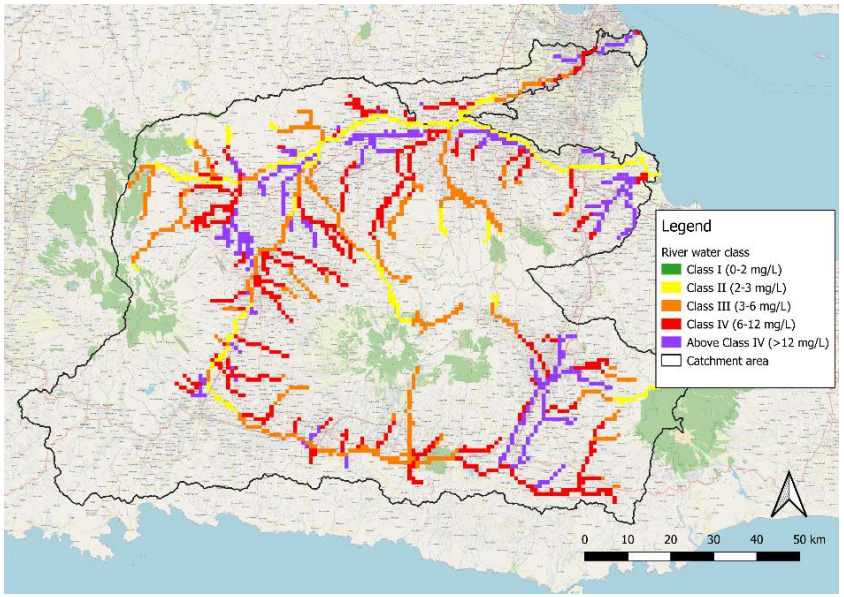
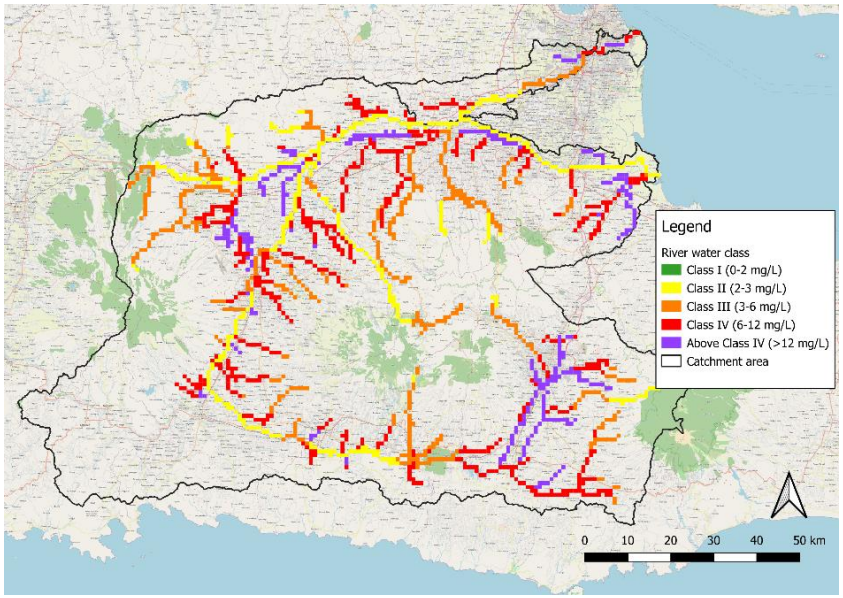
Baseline	3a. 40% reduction of loads from domestic and agriculture combined
	
3b. 50% reduction of loads from domestic and agriculture combined	
	

Table 74. Scenarios 3c, 3d: Asymmetric reductions in domestic wastewater and agriculture combined (expressed as river class per segment)

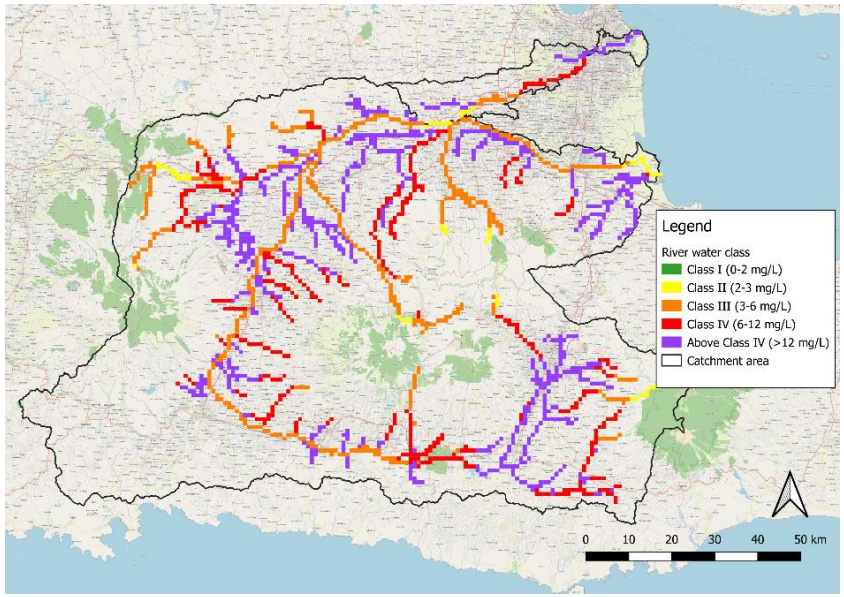
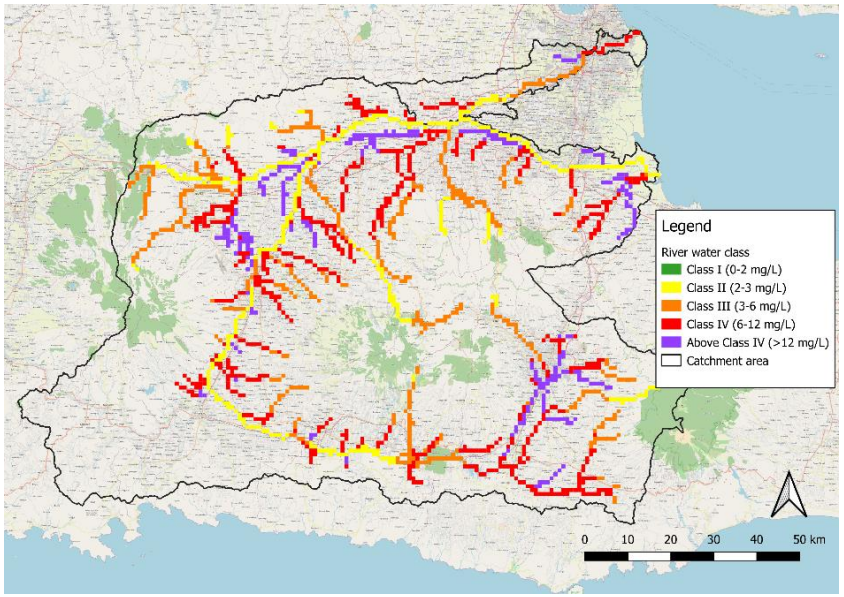
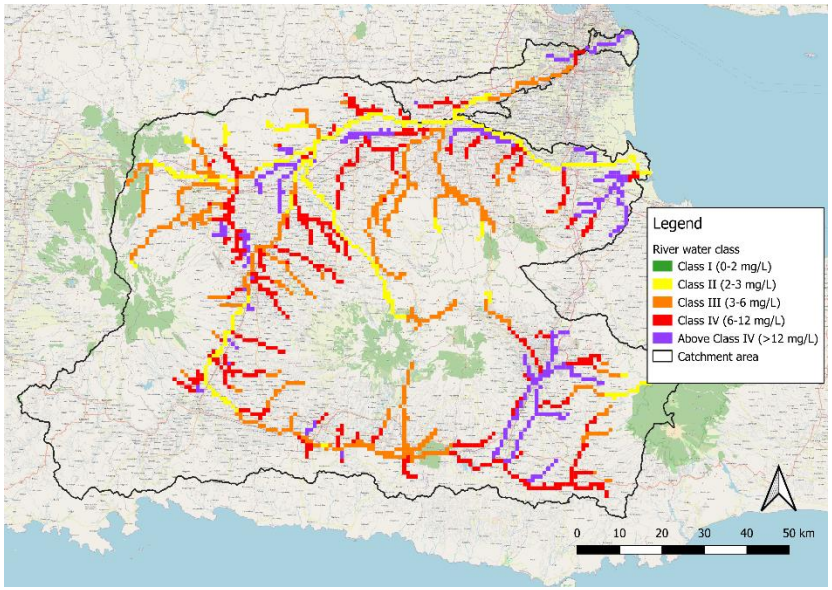
Baseline	3c. 60% reduction domestic wastewater and 30% agriculture
	
3d. 30% reduction domestic wastewater and 80% agriculture	
	

Table 75. Relative change (% reduction) in BOD per segment by intervention scenario

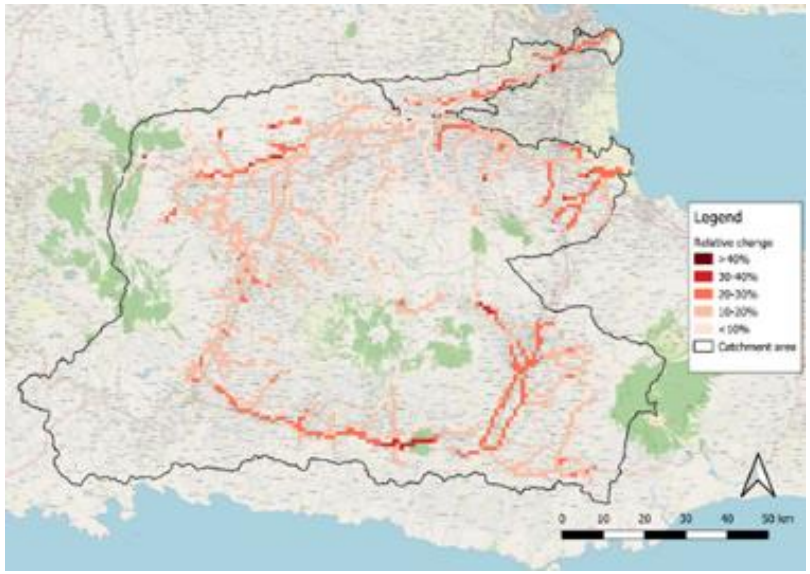
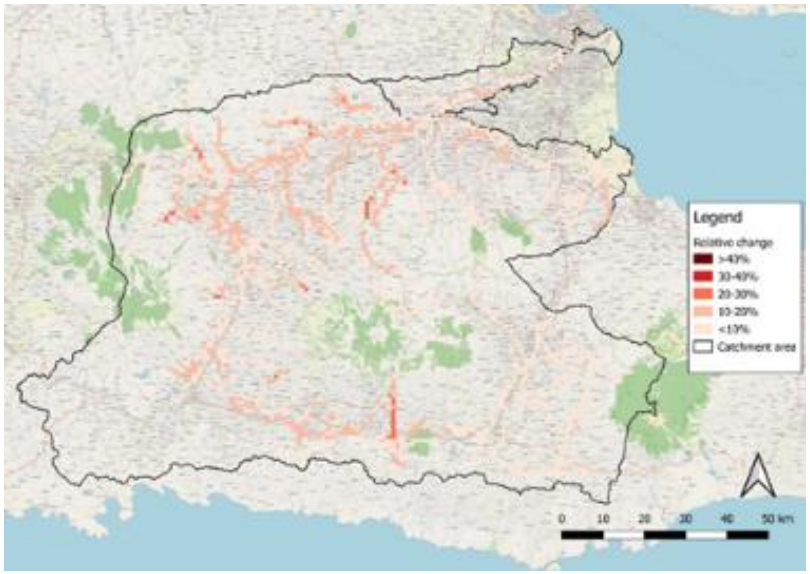
1a. 30% reduction of domestic wastewater	1b. 30% reduction of agriculture
	
1c. 30% reduction of livestock	
	

Table continued

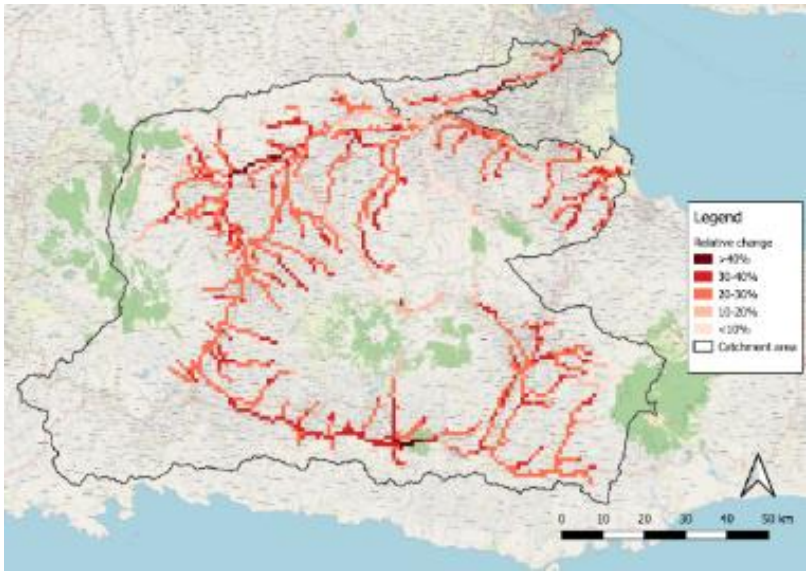
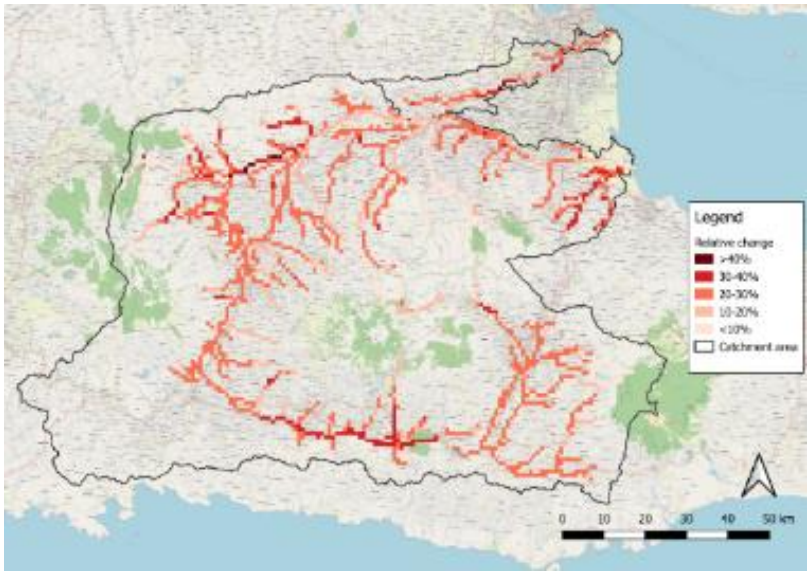
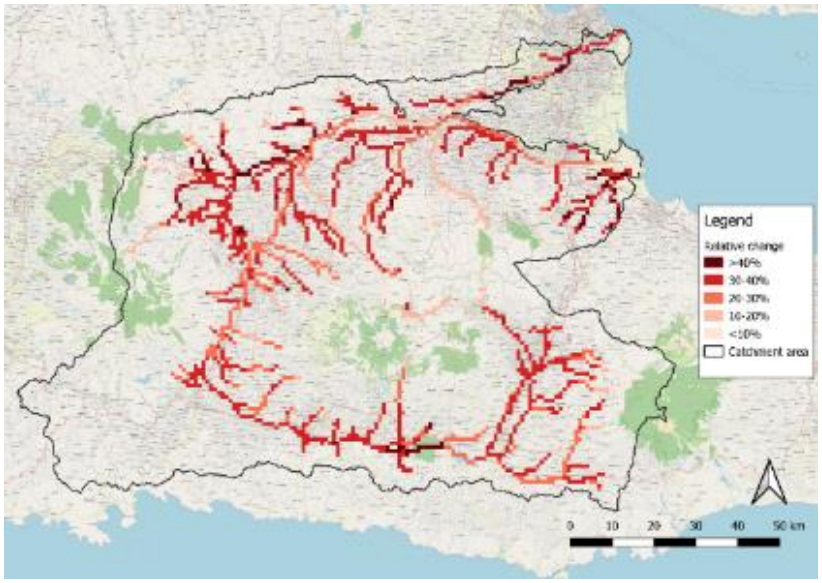
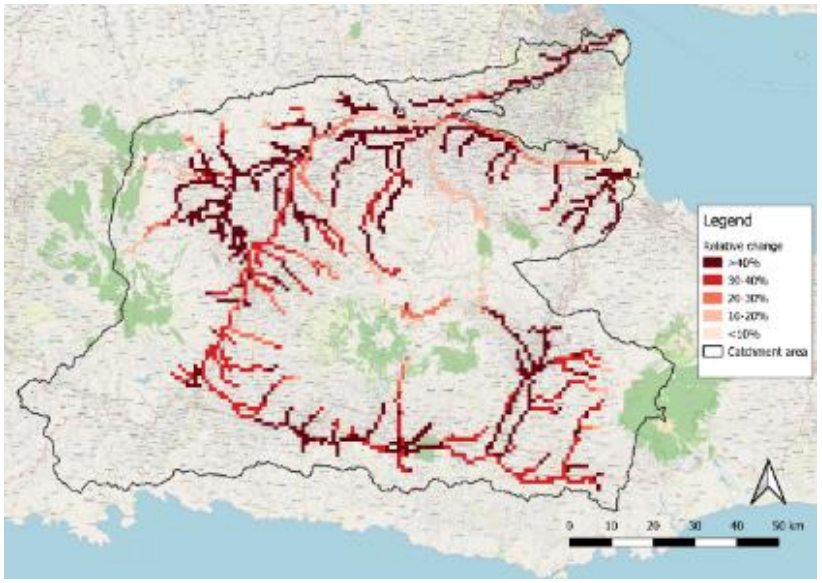
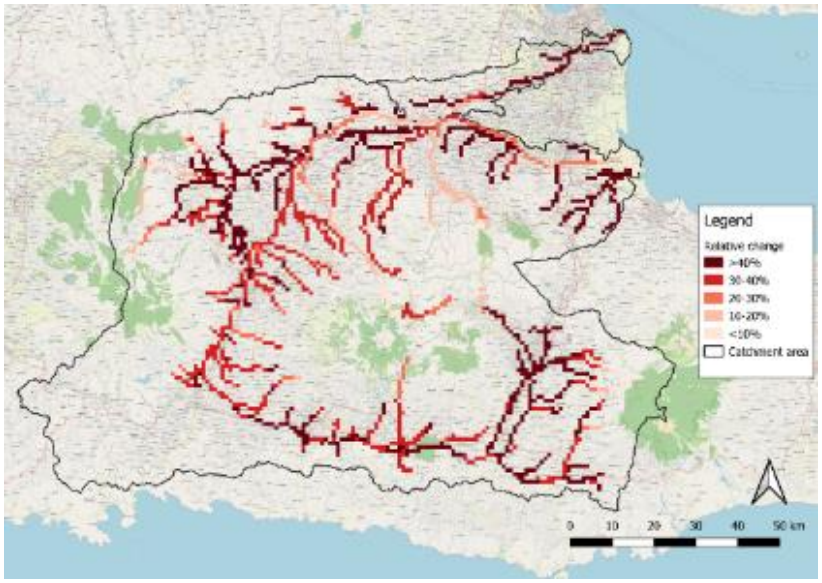
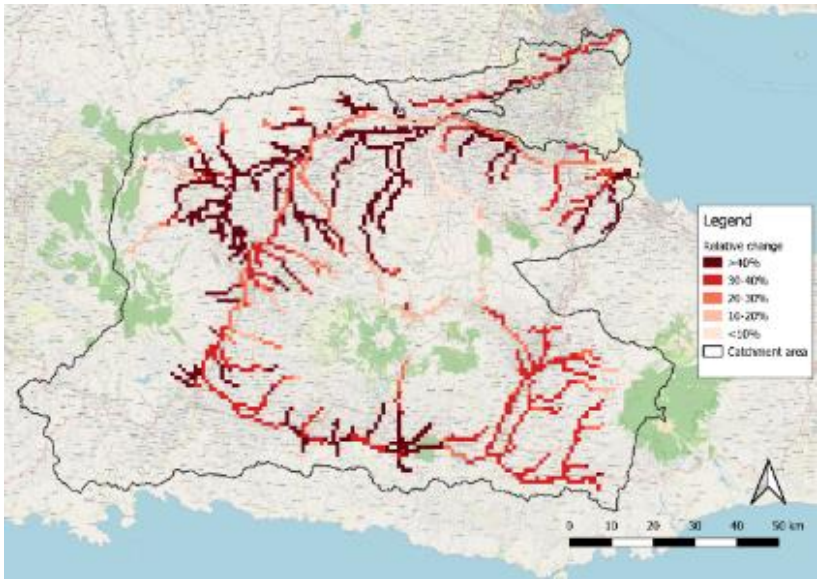
2a. 30% reduction of all sources combined	2b. 30% reduction of domestic wastewater and agriculture
	

Table continued

3a. 40% reduction domestic wastewater and agriculture	3b. 50% reduction domestic wastewater and agriculture
	
3c. 60% reduction domestic wastewater and 30% agriculture	**3d. 30% reduction domestic wastewater and 80% agriculture**
	

In summary, significant reductions in emissions from domestic wastewater and agriculture are required to reduce BOD levels in large parts of the mainstem of the Brantas River to a Class II river levels. Out of the three sources (domestic wastewater, agriculture, livestock) that were considered, emissions from domestic wastewater and agriculture are the largest. Reductions in the loads from these two sources are therefore most effective to reduce BOD concentrations in the Brantas River towards Class II. That said, in some local areas with high livestock concentrations, even significant reductions in domestic wastewater and agriculture will be insufficient to bring local concentrations below Class II levels.

Moreover, reducing agricultural emissions alone is insufficient to achieve Class II for BOD. Reductions in domestic wastewater emissions are relatively effective because it is a large source of BOD and affects large parts of the Brantas River and its tributaries. This analysis suggests that reductions in domestic wastewater emissions are the most important interventions required to achieve Class II levels for BOD, particularly around cities where loads from domestic wastewater emissions are relatively high and concentrated.

In deciding amongst alternative policies to reduce agricultural, domestic wastewater, and livestock BOD loads, cost-effectiveness is an important additional consideration. While domestic wastewater is undoubtedly a major contributor to BOD (as well as fecal coliforms and Total Coli), the costs of reducing each kg/day of domestic wastewater should be estimated and compared to the estimated costs of reducing BOD loads from other sources. This information will allow for more informed decision-making that takes cost-effectiveness into consideration.

APPENDIX E. KEY QUESTIONS AND POTENTIAL GENDER INDICATORS FOR PLANNING AND EVALUATION

This appendix includes key gender-responsive questions to be considered in planning for water quality management and evaluation, along with potential indicators related to assessing each.

	Measurable / Observable Indicator
Key Question 1: Who does what in the context of water quality management?	
Who undertakes household tasks related WQ, including wastewater disposal, solid waste management, and care of sick?	Percentage of (F/M) with primary responsibility for household solid waste disposal
	Percentage of (F/M) responsibility as primary carer for sick family members in the household
	Percentage of (F/M) responsibility as primary purchaser of cleaning goods and care items (e.g., shampoo, detergents)
What are gendered concerns related to water quality?	(F/M) satisfaction with river water quality
	(F/M) satisfaction with the quality of waste disposal arrangement
	Perception of household members (disaggregated by sex, age and job type) on impact of water quality on sustainability of / risks to livelihoods.
	Perception of householder members (gender-disaggregated) of water quality adaptation burdens (lost time, sickness)
Who undertakes water quality management?	Number of F/M staff in different job (levels) and fields in water resource and environmental agencies
	Percentage (F/M) involved in NGOs active in environmental protection of water
Who undertakes livelihoods that affect or are affected by water quality?	Percentage of (F/M) entrepreneurs operating small-scale laundries
	Percentage of (F/M) entrepreneurs operating small-scale food and beverage enterprises with wastewater discharge
Key Question 2a: Who has access to and who owns what assets? Who has access to financial resources, information, education, and other services?	
Who has access to assets, jobs, and financial resources?	Number of F/M small-scale entrepreneurs with sustainable income from provision of wastewater management services
	Number and percentage of women contractors or women's groups awarded contracts for waste disposal or sanitation
	Number of F/M small-scale entrepreneurs with sustainable income from waste management
	Number of F/M small-scale entrepreneurs with sustainable income from circular economy enterprises / waste reuse
	F/M access to available funding for community solid waste and wastewater organization
Who has access to information regarding participation and accountability mechanisms?	(F/M) knowledge regarding options to participate in public planning meetings (e.g., Musrenbang, public meetings on water resource management)
	Evidence that procedures for responding to water-related complaints (e.g., pollution incidents) are publicly available and accessible to women and that responses are implemented and monitored
	Evidence that information on water forums, community planning meetings, and other participation opportunities are publicly available and accessible to women
Who has access to information? What knowledge gaps exist?	F/M knowledge of water quality-related environmental issues
	F/M knowledge of environmental rights and access to complaint mechanisms
	Number of water-related publications with gender-specific content produced by regional organizations, NGOs, and academia available in the public domain
	Number and type of gender sensitization / awareness-raising events / public communication by agencies
	Number and percentage (F/M) participating in community education programs / awareness-raising events related to water quality management

Who gets the opportunity to engage in professional development, capacity building, training, and education on water and waste management?	Number and percentage of women and men who receive water quality management training, by type of training (e.g., community-based early warning systems and procedures) in agencies, commissions (TKPSDA, etc.), industry; and feedback on the usefulness of the training from F/M staff/employees.
	Number of F/M staff in different job positions participating in gender training events in (a) agencies that deal with water resources, (b) commissions for water management (c) water-related industry and enterprise; feedback from F/M staff
	Number of F/M community members who have received technical training related to water management from government/non-government organizations; constraints to participation; reasons and solutions for constraints
	Number of F/M members in the community who have received technical training related to water quality monitoring (wells, springs, rivers, etc.) and are using it in their job or daily activities
Key Question 3: Who has the power and capabilities to act? Who decides what?	
Who takes decisions related to water resource management?	(F/M) membership with position in TKPSDA
	(F/M) membership with position in local institutions for managing solid waste
	(F/M) membership with position in local institutions for public budgeting
	(F/M) membership with position institutions for spatial planning
	Participation by F/M committee members in decision-making meetings for spatial planning; reasons for participation; proportion F/M participation
	F/M participation in decision-making processes in community-based management systems; changes over time with reasons; and discriminatory practices, if any.
	Evidence and examples of improved service delivery in waste management or water resource management due to advocacy and action taken by women
Who has the organizational and financial resources to act, participate, engage?	Number and percentage of women and men attending consultation meetings about planning, design, pricing of services, differentiated by meeting type (Musrenbang, public meetings on water resource management)
	Number and percentage of women and men in community associations on water management / waste management (e.g., user groups, self-help groups)
	Number of women's organizations involved in the assessment and management of environmental hazards
	Number of women's groups engaging in national debate and analysis of environmental impacts, and climate change policy, regulatory frameworks, and programs
	Number of women's organizations and coalitions supported by project
	Description of work undertaken through civil society to establish an enabling environment for women to participate in decision making
	Presence and role of local women's groups/ organizations receiving technical and/or financial support from government/non-government organizations for managing solid waste or domestic wastewater
	Number and percentage of male and female-led organizations receiving environmental funding for community organization
Capabilities, including leadership	Number and percentage of women in leadership positions in community associations related to waste management or water, by type of association
	Evidence and examples of awareness-raising and community mobilization with women on water management and participation
Beliefs and Ideas	Views of women and men regarding changes in women's household or community decision making due to their involvement in water activities
	Evidence of changes in attitudes of women and men (including youth) on appropriate roles for women and their right to participate in governance and public administration
	Views of female public sector and local government employees regarding respect from male colleagues and community
Self-confidence / confidence	Beliefs regarding the roles of women in WRM and community participation
	Beliefs regarding the roles of women regarding household decision-making

	Beliefs regarding the participation of women in science
	Confidence to participate in public forums and planning sessions
Additional: Capacity development for gender equity	
	Number and percentage of women and men in civil society organizations trained in gender analysis of environmental impacts
	Number of training sessions with environmental agencies and other stakeholders on participatory techniques to involve women and men; number and percentage F/M
	Number of training and awareness sessions with environmental agencies and other stakeholders on gender issues in environmentally sustainable water resource development; and number and percentage F/M

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