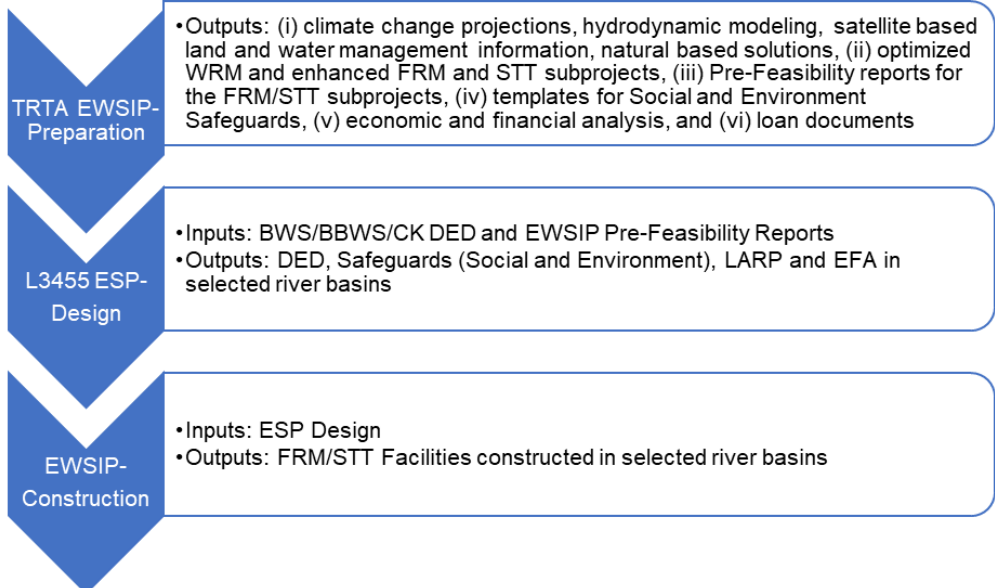


FRM Profile

Subproject	FRM-BDP-Belawan
River basin	Belawan Ular Padang
Main river	Belawan River
District/Province	North Sumatra
Agency in charge	BWS Sumatera II (BWS SII)
Proposed work description	<p>The infrastructure components to be constructed along the Belawan River system will allow i) reduction in flood water levels and ii) retention of flood volumes to reduce flood exposure to households and agriculture areas.</p> <p>The engineering consultant engaged under ADB Loan 3455 will prepare the detailed engineering design based on the agreed basic design and concept prepared under the TRTA. The L3455 will conduct detailed surveys (topography, geotechnical, bathymetry, social, and environmental) that might slightly impact on the design. No change on design that trigger category A for environment safeguards will be made.</p> <p>Flood Risk Management (FRM) plans shall be prepared and implemented at the river basin scale by reflecting national priorities/initiatives and international best practices (i.e., EU Flood Directive, WMO approaches and Prevention, Preparedness and Response to manmade and natural disasters (PPRD) East study). Some of the guiding principles are presented in Appendix D of the FRM technical pre-feasibility report to serve as the basis of developing Guidelines for FRM plans in Indonesia during development of detailed engineering design plans through L3455.</p> <p>Upstream Watershed Management practices will be described in further detail during the detailed engineering design stage (through L3455) in collaboration with the international project partner, International Fund for Agricultural Development (IFAD). In this context, site-specific actions will be evaluated and proposed, with the support of IFAD, to enhance stability and sediment yield characteristics in the upstream parts of the watershed. Some of the preliminary practices are described in Appendix E of the FRM technical pre-feasibility report to highlight joint functioning of various technologies as one system at the watershed scale.</p> <p>The FRM subprojects will include i) raise in levee/bank elevations, ii) storage reservoirs, iii) detention basins, and iv) port enhancement. Nature-based solutions are recommended to replace hard engineering designs and introduced into new enhanced solutions. The main features of BWS SII proposals and EWSIP enhancements are described below.</p> <p>BWS SII proposals for flood protection dikes and walls include:</p> <ul style="list-style-type: none"> i) Protection along 48.4 km of Belawan River from midstream to downstream (Subproject ID B2a) ii) Protection along 10.6 km of Belawan Port (Subproject ID B2b). <p>EWSIP proposals for detention basins include:</p> <ul style="list-style-type: none"> i) Multi-benefit use of flood and raw-water supply with reservoir storage at upstream of Sungai Tengah (Subproject ID B3a) (surface area of approx. 16 ha, depth of 10 m, and temporary storage volume of 1.6 Mm³) ii) Two detention basins in Sungai Belawan (Subproject ID B3b and B3c) (Basin-1: surface area of approx. 20 ha, depth of 2 m, and temporary storage volume of 0.4 Mm³; Basin-2: surface area of approx. 53.5 ha, depth of 2 m, and temporary storage volume of 1.1 Mm³) iii) Detention basins and channel improvements along Sungai Badera (Subproject ID B3d) (surface area of approx. 2.8 ha, depth of 2 m, and temporary storage volume of 0.06 Mm³); also on the downstream, Sungai Badera connects with enlarged Siombak Lake (to provide smaller flood storage for Sungai Badera and Sungai Deli) iv) Two detention basins and channel improvements along Sungai Krio (Subproject ID B3e) (surface area of approx. 7 ha, depth of 2 m, and temporary storage volume of 0.1 Mm³)

	<p>v) Nature based solutions along the Belawan River channel (Subproject ID B3f) with natural bank protection from Km 0 to Km 7.8, raise the BWS improved bank levels in Belawan River (Km 44 to Km 46.5 and Km 49 to Km 54), where side slopes of channels around bends with 1:1 to be implemented by using gabions or vetiver grass, and natural vegetative protection along straight channel sections in a 3m x 3m cell shape filled in with vetiver and local species grasses in between</p> <p>vi) Belawan Port enhancement (Subproject ID B3g) using geotubes and geogrids to develop light port facilities.</p> <p>NBS along the watershed should consider catchment management in mountain and hill zones should focus on improving poor agricultural practices to more sustainable cropping and cultivation practices. Relocation of houses and factories to higher ground or behind proposed Belawan floodwalls should also be considered, because the problem will become more critical in the future as climate change effects flood and tide levels. A soft measure (as proposed by EWSIP) without implications for structural interventions include; upgrade in the flood warning system by placing greater intensity of water level sensors connected by SCADA to BWS SII control center for flood forecast and early warning.</p>																																							
EWSIP added value	<p>EWSIP outputs are strategically linked to the BAPPENAS quick-win programs as defined below:</p> <table><tr><th>BAPPENAS Programs</th><th>EWSIP Outputs</th></tr><tr><td>Program 1: Smart Water Management</td><td>Output 1: Planning for water resources optimized</td></tr><tr><td>Program 2: Water for Food Security and Nutrition</td><td>Output 2: RWS infrastructure and services improved</td></tr><tr><td>Program 3: Multipurpose Storage for Water, Food, Flood, and Energy</td><td>Output 2: RWS infrastructure and services improved</td></tr><tr><td>Program 4: Disaster Resilience Infrastructure</td><td>Output 3: FRM enhanced</td></tr><tr><td>Program 5: North Java Integrated Coastal Development</td><td>Output 3: FRM enhanced</td></tr><tr><td>Program 6: Green Infrastructure</td><td>Output 1: Planning for water resources optimized</td></tr><tr><td>Program 7: Water Safety Plan</td><td>Output 1: Planning for water resources optimized</td></tr></table>	BAPPENAS Programs	EWSIP Outputs	Program 1: Smart Water Management	Output 1: Planning for water resources optimized	Program 2: Water for Food Security and Nutrition	Output 2: RWS infrastructure and services improved	Program 3: Multipurpose Storage for Water, Food, Flood, and Energy	Output 2: RWS infrastructure and services improved	Program 4: Disaster Resilience Infrastructure	Output 3: FRM enhanced	Program 5: North Java Integrated Coastal Development	Output 3: FRM enhanced	Program 6: Green Infrastructure	Output 1: Planning for water resources optimized	Program 7: Water Safety Plan	Output 1: Planning for water resources optimized																							
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Alignment with spatial plan	The subproject is consistent with the spatial plan of North Sumatra Province year 2003-2018 ¹ .																																							
Potential Involuntary Resettlement impact	<p>The subprojects are expected result in Land Acquisition (LA) as documented below. The final LA requirements for all subprojects shall follow detailed site-specific surveys to be implemented during the detailed engineering design stage through L3455.</p> <table><tr><th>ID</th><th>FRM Subprojects</th><th>Estimate for LA area (ha)</th></tr><tr><td></td><td>BWS SII Proposals</td><td></td></tr><tr><td>B2.a</td><td>Belawan River improvements Type 2</td><td>12</td></tr><tr><td>B2.b</td><td>Belawan Port</td><td>2.5</td></tr><tr><td></td><td>Sub-total for BWS SII</td><td>14.5</td></tr><tr><td></td><td>EWSIP Proposals</td><td></td></tr><tr><td>B3.a</td><td>Flood storage of Tengah River Ty 4</td><td>20</td></tr><tr><td>B3.b</td><td>Belawan detention basin 1</td><td>20</td></tr><tr><td>B3.c</td><td>Belawan detention basin 2</td><td>53.5</td></tr><tr><td>B3.d</td><td>S Badera detention basins and channel improvements</td><td>14.8</td></tr><tr><td>B3.e</td><td>S Krio detention basins and channel improvements</td><td>19</td></tr><tr><td></td><td>Sub-total for EWSIP</td><td>127.3</td></tr><tr><td></td><td>Total estimate for land acquisition</td><td>141.8</td></tr></table> <p>There are no documents on land acquisition, socio-economic conditions and resettlement needs along the project corridor (i.e., AMDAL, LARP, LARAP, IP&IR, etc.).</p>	ID	FRM Subprojects	Estimate for LA area (ha)		BWS SII Proposals		B2.a	Belawan River improvements Type 2	12	B2.b	Belawan Port	2.5		Sub-total for BWS SII	14.5		EWSIP Proposals		B3.a	Flood storage of Tengah River Ty 4	20	B3.b	Belawan detention basin 1	20	B3.c	Belawan detention basin 2	53.5	B3.d	S Badera detention basins and channel improvements	14.8	B3.e	S Krio detention basins and channel improvements	19		Sub-total for EWSIP	127.3		Total estimate for land acquisition	141.8
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¹<http://perpustakaan.bappenas.go.id/lontar/opac/themes/bappenas4/templateDetail.jsp?id=13715&lokasi=lokal>, last accessed in June 2019.

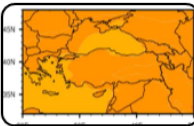
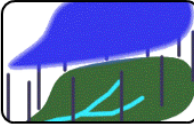
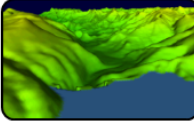
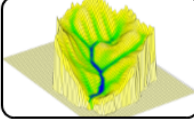
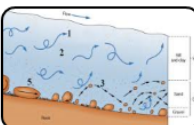
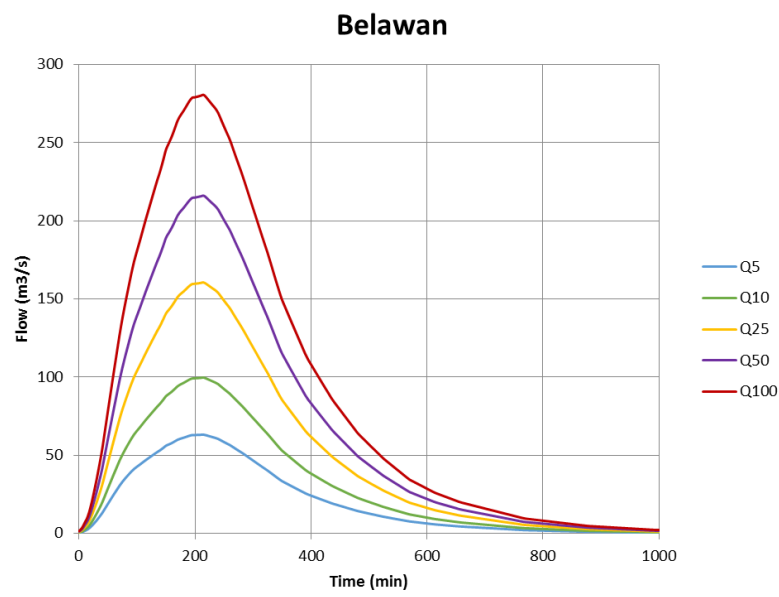
Potential Indigenous People impact	<p>The preliminary findings indicate that the proposed subproject doesn't cross any Indigenous People (IP) area.</p> <p>The final status on the potential for crossing areas with IP should be evaluated by i) reviewing the BRWA (Indigenous Territory Registration Agency) database², ii) reviewing the AMAN (Indigenous Peoples Alliance of the Archipelago) database³, and iii) site-specific surveys.</p>
Potential Environment impact	<p>The subproject works are not expected to cross any protected area (forest/swamp), biodiversity sanctuary or protected forest as indicated in the Indicative Moratorium Maps 15th Revision, which are published as per the Forestry Ministerial Decree of the Republic of Indonesia Number: SK.8599/MENLHK-PKTL/IPSDH/PLA.1/12/ 2018 (Scale 1:250.000)⁴.</p> <p>There are no documents on environmental impacts (i.e., IEE, AMDAL, etc.).</p> <p>The potential to cross any protected area (forest/swamp), biodiversity sanctuary or protected forest should be evaluated through site-specific surveys by the Contractor during Detailed Engineering Design. No change on design that trigger category A for environment safeguards will be made.</p>
Estimated cost and implementation period	<p>The implementation period is 2020 – 2025.</p> <p>The project costs include i) RpM 705,025 for the infrastructure by the BWS SII and ii) RpM 381,631 for the proposals by EWSIP.</p> <p>O&M costs are annual and to be calculated as 2% of infrastructure implementation costs through the lifecycle of proposed infrastructure over 30-years.</p>
Readiness FS/DED/IEE-EIA/LARP/Bidding documents	<p>DED is available for the infrastructure proposed along the Belawan River by the BWS Sumatera II. Enhancement of the existing DED and Safeguards documentation will be proposed for preparation as part of ADB ESP packages (Loan 3455).</p> <p>The documents that are available include: i) DED (SID Sungai Belawan Kota Medan dan Kabupaten Deli Serdang, tahun 2012).</p>
Linkages between EWSIP and ESP	<p>The linkages between the TRTA, Engineering Services Project (ESP), and construction under EWSIP are schematized below:</p>  <pre> graph TD A[TRTA EWSIP-Preparation] --> B[L3455 ESP-Design] B --> C[EWSIP-Construction] </pre> <ul style="list-style-type: none"> TRTA EWSIP-Preparation <ul style="list-style-type: none"> •Outputs: (i) climate change projections, hydrodynamic modeling, satellite based land and water management information, natural based solutions, (ii) optimized WRM and enhanced FRM and STT subprojects, (iii) Pre-Feasibility reports for the FRM/STT subprojects, (iv) templates for Social and Environment Safeguards, (v) economic and financial analysis, and (vi) loan documents L3455 ESP-Design <ul style="list-style-type: none"> •Inputs: BWS/BBWS/CK DED and EWSIP Pre-Feasibility Reports •Outputs: DED, Safeguards (Social and Environment), LARP and EFA in selected river basins EWSIP-Construction <ul style="list-style-type: none"> •Inputs: ESP Design •Outputs: FRM/STT Facilities constructed in selected river basins

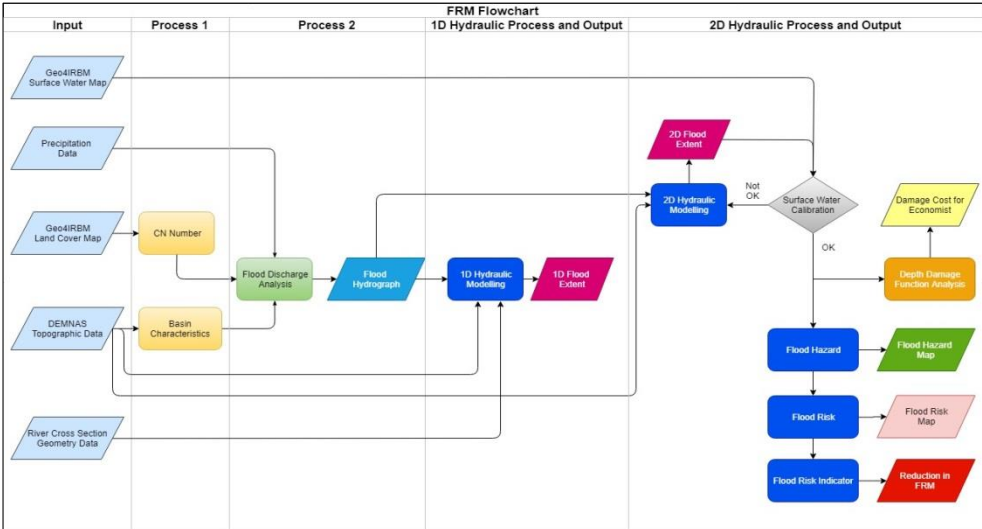
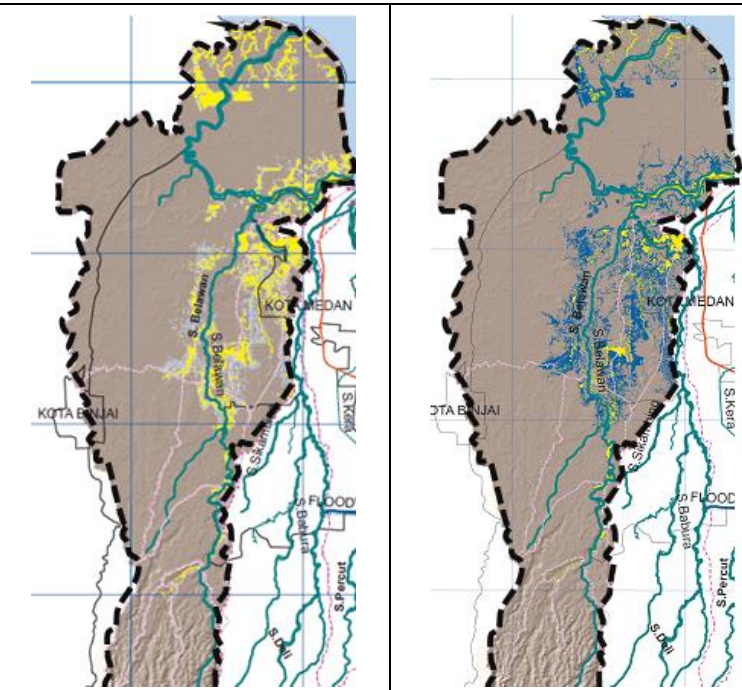
² <http://brwa.or.id/sig/>, last accessed in June 2019.

³ <http://www.aman.or.id/peta/>, last accessed in June 2019.

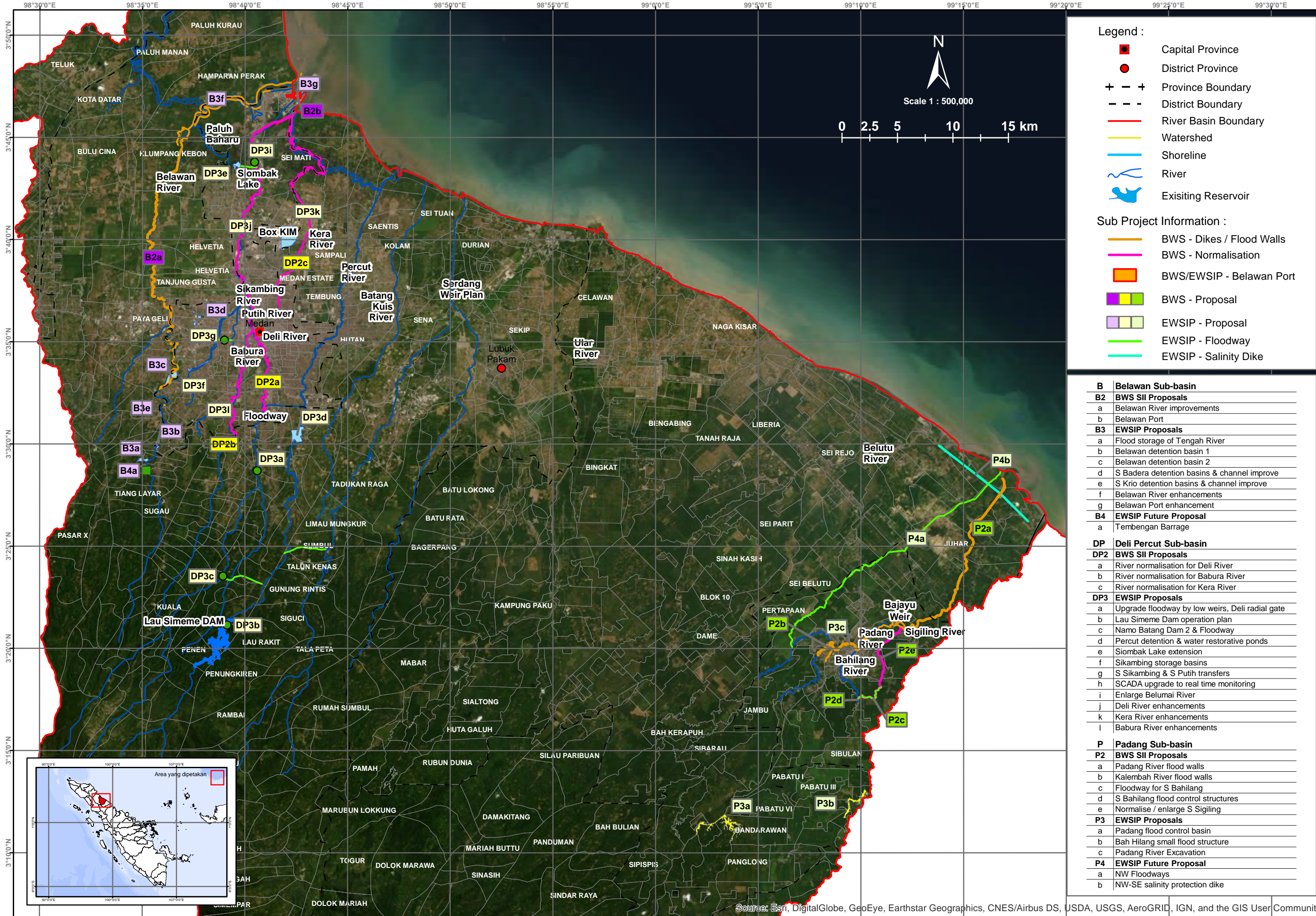
⁴ <http://webgis.dephut.go.id:8080/kemenhut/index.php/en/map/pipib/61-pippib/330-indicative-moratorium-map-15th-revision>, last accessed in July 2019.

FRM Numerical Modelling Processes

Numerical models in IFRM	<p>ESP Consultant shall follow the numerical modelling processes in integrated flood risk modelling (IFRM) as highlighted below:</p> <div><div><p>Climate Change Modelling</p><ul style="list-style-type: none">- <i>Scope:</i> Climate change projections and anomalies- <i>Database:</i> Temperature, Precipitation and Evaporation (ADB)</div><div><p>Hydrologic Modelling</p><ul style="list-style-type: none">- <i>Scope:</i> Evaluation of Rainfall to Runoff processes- <i>Database:</i> Hydromet. network (BBWS/PUSAIR), LULC (ESA)</div><div><p>Hydraulic Modelling</p><ul style="list-style-type: none">- <i>Scope:</i> Evaluation of Runoff to River hydraulics (1D/2D)- <i>Database:</i> Flow gage network, DEM (BIG), Validation (ESA)</div><div><p>Erosion Modelling</p><ul style="list-style-type: none">- <i>Scope:</i> Sediment yield from the watershed- <i>Database:</i> RUSLE / MUSLE parameters</div><div><p>Sediment Yield and Watershed Management</p><ul style="list-style-type: none">- <i>Scope:</i> Sediment yield along the watershed system- <i>Database:</i> Sediment characterization, FAO–WOCAT (World Overview of Conservation Approaches and Technologies)</div></div>																		
Flood Hydrographs	<p>ESP Consultant shall generate flood hydrographs (as depicted below) for existing/future conditions by using the Soil-Conservation-Service (SCS) Curve Number (CN) unit hydrograph approach. The existing/future land use and land cover data sets and climate change data sets (representing the changes in precipitation and temperature in 2030 and 2050) shall be used.</p> <div><p style="text-align: center;">Belawan</p><table><caption>Approximate Peak Flow Values for Belawan Hydrograph</caption><tr><th>Return Period (Q)</th><th>Peak Flow (m³/s)</th><th>Time to Peak (min)</th></tr><tr><td>Q5</td><td>~60</td><td>~200</td></tr><tr><td>Q10</td><td>~100</td><td>~200</td></tr><tr><td>Q25</td><td>~160</td><td>~200</td></tr><tr><td>Q50</td><td>~220</td><td>~200</td></tr><tr><td>Q100</td><td>~280</td><td>~200</td></tr></table></div>	Return Period (Q)	Peak Flow (m³/s)	Time to Peak (min)	Q5	~60	~200	Q10	~100	~200	Q25	~160	~200	Q50	~220	~200	Q100	~280	~200
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Flood Hydraulics	<p>The main objective of 1-dimensional hydraulic models is to i) identify existing level of flood protection (Scenario 1) along the river, ii) evaluate the proposed concepts by the BWS DED (Scenario 2), and iii) evaluate the level of enhancement required for the flood protection services (Scenario 3). This evaluation was performed both in the context of existing hydrologic conditions (storm precipitation) and future conditions with climate change (Scenario 4).</p> <p>2-dimensional hydraulic models shall be developed along the entire river basin by using the DEMNAS DEM available by the BIG. The hydraulic models shall be evaluated/validated through a combination of tools including i) BNPB database for disaster data for historical floods, ii) historical flood maps available with the BWS/BBWS, iii) Google Earth time series images to explore flood impacts, and iv) European Space Agency (ESA) satellite images of historical water extent.</p>
Flood Risk Maps - Processes	<p>ESP Consultant shall develop flood risk maps through the exposure, vulnerability and hazard processes and by using 1-dimensional and 2-dimensional hydraulic models.</p>  <pre> graph LR subgraph Input GeoIRBM_Surface[GeoIRBM Surface Water Map] Precipitation[Precipitation Data] GeoIRBM_LandCover[GeoIRBM Land Cover Map] DEMNAS_Topographic[DEMNAS Topographic Data] River_Cross_Section[River Cross Section Geometry Data] end subgraph Process_1 [Process 1] CN_Number[CN Number] Basin_Characteristics[Basin Characteristics] end subgraph Process_2 [Process 2] Flood_Discharge_Analysis[Flood Discharge Analysis] Flood_Hydrograph[Flood Hydrograph] end subgraph FRM_Flowchart [FRM Flowchart] direction LR subgraph 1D [1D Hydraulic Process and Output] 1D_Hydraulic_Modeling[1D Hydraulic Modeling] 1D_Flood_Extent[1D Flood Extent] end subgraph 2D [2D Hydraulic Process and Output] 2D_Hydraulic_Modeling[2D Hydraulic Modeling] 2D_Flood_Extent[2D Flood Extent] end end GeoIRBM_Surface --> Flood_Discharge_Analysis Precipitation --> Flood_Discharge_Analysis GeoIRBM_LandCover --> CN_Number DEMNAS_Topographic --> Basin_Characteristics River_Cross_Section --> 1D_Hydraulic_Modeling CN_Number --> Flood_Discharge_Analysis Basin_Characteristics --> Flood_Discharge_Analysis Flood_Discharge_Analysis --> Flood_Hydrograph Flood_Hydrograph --> 1D_Hydraulic_Modeling 1D_Hydraulic_Modeling --> 1D_Flood_Extent 1D_Flood_Extent --> 2D_Hydraulic_Modeling 2D_Hydraulic_Modeling --> 2D_Flood_Extent 2D_Flood_Extent --> Surface_Water_Calibration{Surface Water Calibration} Surface_Water_Calibration -- Not OK --> 2D_Hydraulic_Modeling Surface_Water_Calibration -- OK --> Damage_Cost[Damage Cost for Economist] Damage_Cost --> Depth_Damage_Func[Depth Damage Function Analysis] Depth_Damage_Func --> Flood_Hazard[Flood Hazard] Flood_Hazard --> Flood_Risk[Flood Risk] Flood_Risk --> Flood_Risk_Map[Flood Risk Map] Flood_Risk_Map --> Flood_Risk_Indicator[Flood Risk Indicator] Flood_Risk_Indicator --> Reduction_in_FRM[Reduction in FRM] </pre>
Flood Risk Maps - Outcomes	<p>The outcomes shall be represented for i) agriculture areas and ii) people/buildings at the river basin scale, as shown below.</p>  <div data-bbox="1257 1391 1485 1861"> <p>LEGEND</p> <p>Administrative Boundary</p> <p>Regency/City Boundaries</p> <p>Road Network</p> <p>Toll Road</p> <p>Water Body</p> <p>Coastline</p> <p>Reservoir/Lake/Swamp</p> <p>Main River</p> <p>Floodway</p> <p>Watershed</p> <p>Watershed Boundaries</p> <p>Flood Risk Level</p> <p>Low</p> <p>Medium</p> <p>High</p> <p>Very High</p> </div>

EWSIP - FRM INDICATIVE MAP FOR BELAWAN-DELI-PERCUT-PADANG SYSTEM SUB PROJECT



Legend :

- Capital Province
- District Province
- Province Boundary
- District Boundary
- River Basin Boundary
- Watershed
- Shoreline
- River
- Existing Reservoir

Sub Project Information :

- BWS - Dikes / Flood Walls
- BWS - Normalisation
- BWS/EWSIP - Belawan Port
- BWS - Proposal
- EWSIP - Proposal
- EWSIP - Floodway
- EWSIP - Salinity Dike

B	Belawan Sub-basin
B2	BWS SII Proposals
a	Belawan River improvements
b	Belawan Port
B3	EWSIP Proposals
a	Flood storage of Tengah River
b	Belawan detention basin 1
c	Belawan detention basin 2
d	S Badera detention basins & channel improve
e	S Krio detention basins & channel improve
f	Belawan River enhancements
g	Belawan Port enhancement
B4	EWSIP Future Proposal
a	Tembengan Barrage
DP	Deli Percut Sub-basin
DP2	BWS SII Proposals
a	River normalisation for Deli River
b	River normalisation for Babura River
c	River normalisation for Kera River
DP3	EWSIP Proposals
a	Upgrade floodway by low weirs, Deli radial gate
b	Lau Simeme Dam operation plan
c	Namo Batang Dam 2 & Floodway
d	Percut detention & water restorative ponds
e	Siombak Lake extension
f	Sikambing storage basins
g	S Sikambing & S Putih transfers
h	SCADA upgrade to real time monitoring
i	Enlarge Belumai River
j	Deli River enhancements
k	Kera River enhancements
l	Babura River enhancements
P	Padang Sub-basin
P2	BWS SII Proposals
a	Padang River flood walls
b	Kalembah River flood walls
c	Floodway for S Bahilang
d	S Bahilang flood control structures
e	Normalise / enlarge S Sigiling
P3	EWSIP Proposals
a	Padang flood control basin
b	Bah Hilang small flood structure
c	Padang River Excavation
P4	EWSIP Future Proposal
a	NW Floodways
b	NW-SE salinity protection dike

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community