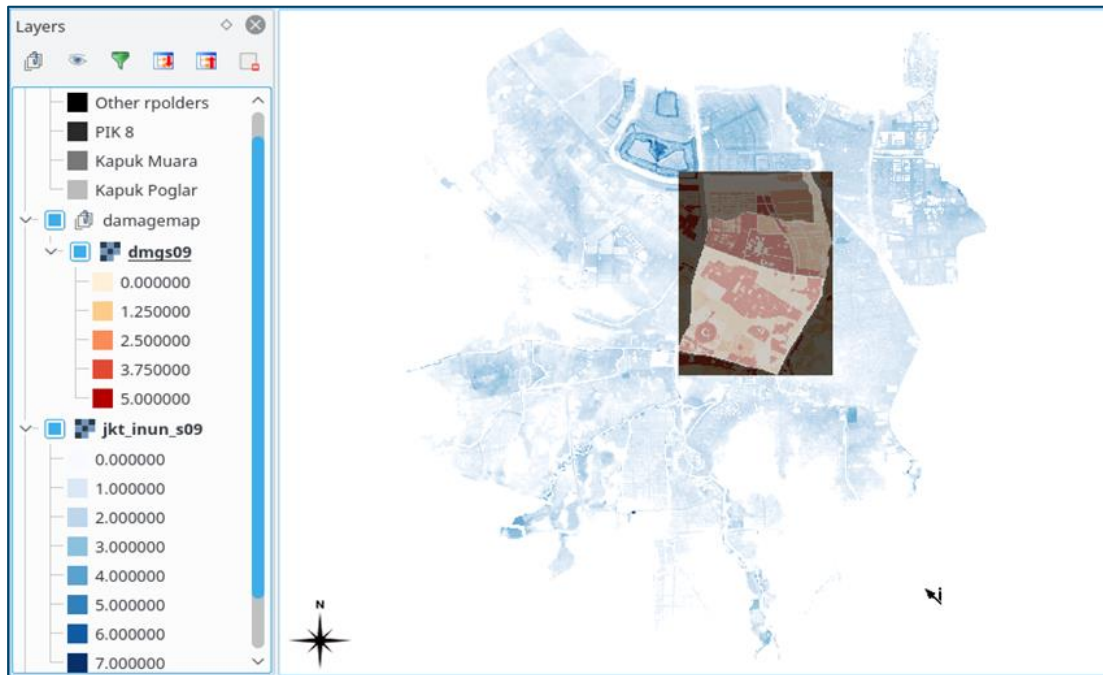


# Hydrodynamic modelling for flood reduction and climate resilient infrastructure development pathways in Jakarta

## Summary Report on Analysis of Different Risk Assessment





This report has been prepared under the DHI Business Management System certified by DNV to comply with ISO 9001 (Quality Management), ISO 14001 (Environmental Management), OHSAS 18001 (Health and Safety Management)



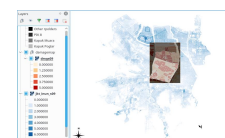


# Hydrodynamic modelling for flood reduction and climate resilient infrastructure development pathways in Jakarta

## Summary Report on Analysis of Different Risk Assessment

(Final Draft)

Prepared for           CTCN - UNEP  
Represented by        Ms. Sandra Bry



Project manager	Dr. Budy Wiryawan
Project number	65800016
Approval date	15-07-2017
Revision	1
Classification	Open/Restricted/Confidential

*This page is intentionally left blank*

# 1 Summary of flood risk

Flood risk is defined as functions of hazard, exposure and vulnerability (Kron, 2005). Hazard map is produced by Mike hydrodynamic model. We selected rainfall events based on important flood cases based on reported mortality by National Disaster Management Office (BNPB) (BNPB, 2016) ranging from the lowest on 21 December 2012 to the most significant event for Jakarta (2 February 2007) and for Angke-Pesangrahan catchments (16 January 2013) where our study area is situated. Exposure uses land use map 2009 by the government of Jakarta. Vulnerability uses curves available in Budiyo et al. (2015). We present flood risk as flood damage (in thousand USD) based on scenarios of flood hazard produced by hydrodynamics model in Table.

**Table 1.1** Nine hazard model scenarios employed in the flood risk study, employing three important events and the projection on 2030 and 2050 using 2007 rainfall

Scenario	Flood Event (Rainfall)	Tide (Peak)	Subsidence based from 2012 year – Lidar DEM	Mortality	Scenario
s01	2 Feb 2007 (31 Jan-05 Feb)	Actual tide (+0.500 m)	With modeled subsidence of 2007	18	s01
s02			DEM 2012		s02
s03	16 Jan 2013 (15-19 Jan)	Actual tide (+0.276 m)	DEM 2012	22	s03
s04			With modeled subsidence 2013		s04
s05	21 Dec 2012 (20-24 Dec)	Actual tide (+0.286 m)	DEM 2012	1	s05
s06	2050 (50-yr RP + 41% CC Factor)	+0.235 m MHHW + 0.375 SLR	DEM 2012		s06
s07			Subsidence 2025		s07
s08	2030 (50-yr RP + 33% CC Factor)	+0.235 m MHHW + 0.225 SLR	DEM 2012		s08
s09			Subsidence 2025		s09

The calculation uses Damagescanner-Jakarta found in Budiyo et al. (2015). Polder dimension (area and perimeter) follows Jakarta Spatial Planning/RUTR 2030 (Government of Jakarta Regulation 1, 2012), in which information is based on digitized version available in Budiyo et al. (2017). The study area covers three polders i.e. Pantai Indah Kapuk (PIK) 8, Kapuk Muara and Kapuk Poglar. Figure 1.1 shows flood damage map resulting from Damagescanner model. The damage map covers area of the three polders, seen as the reddish area in the centre of hazard map. The three sequential polders displayed from top to bottom within the reddish area. Polder PIK 8 is typical of residential area operated privately and thus secluded from other polders. The other two polders carry mixed use, majority for unmanaged residential area consisting of slump and mid class housing as well as commercials and industries.

From Figure 1.1, we extracted flood damage for three polders as presented in Table 1.2. The table shows at low flood return period (s05) damage at two top most polders are zero. The remaining Kapuk Poglar polder have produced damage since the river overtopping that results inundation on the three polders is started at the south-eastern area of the polder. For all scenarios, Kapuk Poglar experiences the most damage while

PIK 8 experience the lowest. The lesson on future damage (s06-s09) at PIK 8 that is purely residential area with good management remain constant varying from USD 20-21 million. On the other hand, a mixed used polders carries bigger variation between USD 57-65 million for Kapuk Muara polder and USD 84-97 million for Kapuk Poglar polder. The narrow and wide variations on damage in the future send a clear message for the need of a better polder management.

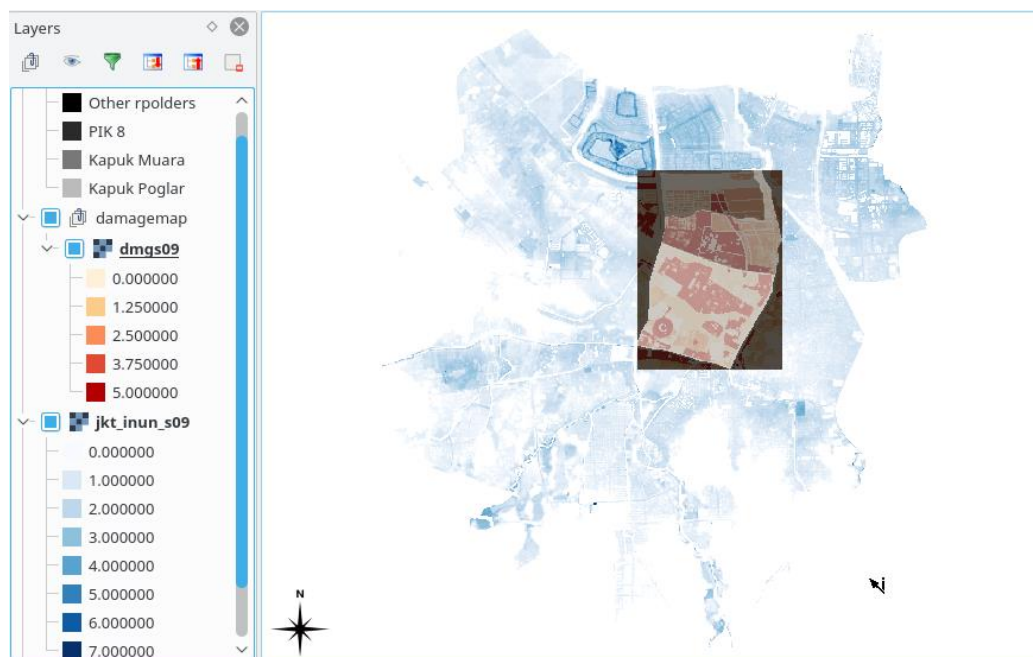


Figure 1.1 Flood damage map of the three polders overlaid on top of hazard map for s09 scenario.

Table 1.2 Summary of flood damage (thousand USD) for all scenarios.

	Scenarios	Polder		
		Pantai Indah Kapuk 8	Kapuk Muara	Kapuk Poglar
1	s01	10,089	33,829	52,392
2	s02	13,536	44,882	72,005
3	s03	49	28,449	33,673
4	s04	7,544	31,770	37,360
5	s05	0	0	267
6	s06	19,926	58,536	87,323
7	s07	20,975	64,965	96,752
8	s08	19,610	57,032	84,460
9	s09	20,532	63,750	95,013

In the light of Polder Plan 2030, our flood risk analysis suggest new study to whether retain to manage the three polders individually as the plan foresees or to combine polders of the same characteristics/functions (e.g. Kapuk Muara and Kapuk Poglar) in order to plan flood risk decrease. Indeed, current damage for private polder PIK is about 10% of the remaining polders. In terms of polder management PIK 8 has operated sufficient retention pond. Field study also reveal PIK 8 polder fact has been leveraged from its original land base. The polder also discharge some effluent into Kapuk Muara polder. The latter bring suggestion that separating the PIK 8 polder from the remaining polders requires synthesis of new regulation of privately operated polder to maintain the seclusion to prevent burdening the effluent to adjacent polder.

From the field study, we also suggest revision on polder delineation found in Polder Plan 2030 to follow street lines and stream dikes. Subsequently, this will change polder risk and consequently hydraulics regulation of the polders. We believe such revision will not change the option on polders management either the seclusion or inclusion of private polders, as well as combination or separation of private polder and public polders. The kind of management depends on the selection of polder management approach within the master plan, which could take into account the ecology, hydraulics, or socio-economic system.

*This page is intentionally left blank*

## 2 References

1. BNPB. "Data Dan Informasi Bencana Indonesia," 2016. <http://dibi.bnpb.go.id/>.
2. Budiyono, Y., Aerts, J., Brinkman, J., Marfai, M. A., and Ward, P.: Flood risk assessment for delta mega-cities: a case study of Jakarta, *Nat. Hazards*, 75, 389–413, doi:10.1007/s11069-014-1327-9, 2015.
3. Budiyono Y, Aerts JCJH, Tollenaar D, Ward PJ (2016) River flood risk in Jakarta under scenarios of future change. *Nat Hazards Earth Syst Sci* 16:757–774. doi: 10.5194/nhess-16-757-2016
4. Budiyono, Y., Marfai, M. A., Aerts, J., de Moel, H., and Ward, P.: Flood risk in polder systems in Jakarta: present and future analysis, in Djalante, R., Djalante, R., M. Garschagen, F. Thomalla, and R. Shaw (editors). *Disaster Risk Reduction in Indonesia - Progress, Challenges, and Issues*. Springer, Berlin, 2017.
5. Kron, Wolfgang. "Flood Risk = Hazard \* Values \* Vulnerability." *InternatiWater International* 30, no. 1 (March 2005): 58–68.
6. Perda DKI Jakarta 1 (2012), Peraturan Daerah Provinsi Daerah Khusus Ibukota Jakarta Nomor 1 Tahun 2012 tentang Rencana Tata Ruang Wilayah 2030, Jakarta, 2012.

*This page is intentionally left blank*