

Supplementary material

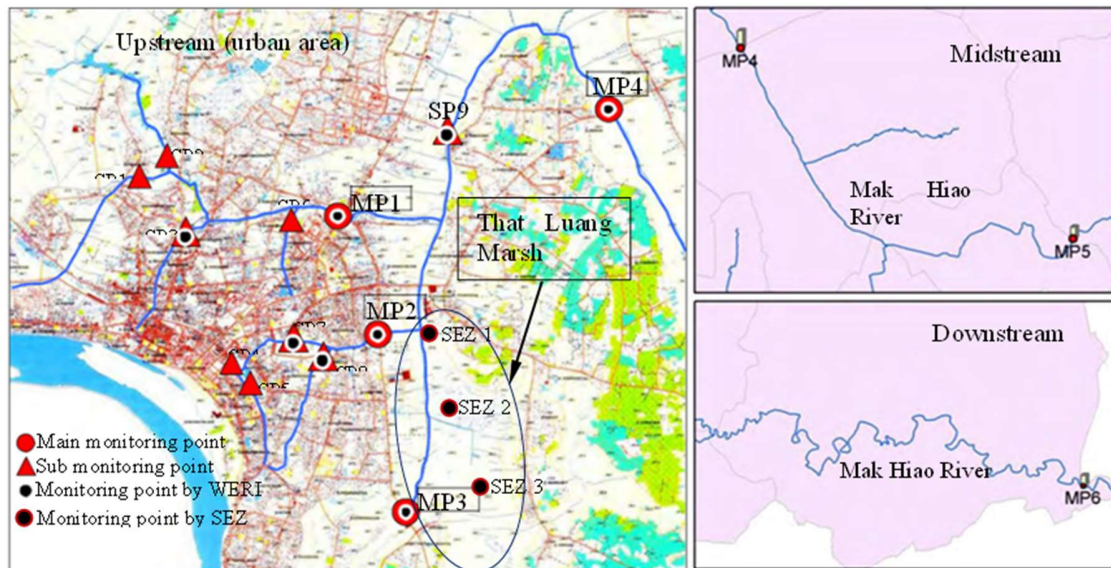


Figure S1. Location of discrete monitoring points by different projects in the center of Vientiane Capital.

Table S1. Satellite image and sources.

Satellite	Sensor	Resolution (m)	Acquisition date	Source
Landsat5	TM	30×30	27 March 2001	Collection 2 Level 2 from https://earthexplorer.usgs.gov/
Landsat5	TM	30×30	06 March 2005	
Landsat5	TM	30×30	20 March 2010	
Landsat8	OLI-TIRS	30×30	18 March 2015	
Landsat8	OLI-TIRS	30×30	31 March 2020	

Table S2. Confusion matrix results for LULC classification.

LULC class	Producer accuracy (%)					User accuracy (%)				
	2001	2005	2010	2015	2020	2001	2005	2010	2015	2020
Agriculture	75.76	90.00	82.14	90.00	81.82	83.33	90.00	76.67	90.00	90.00
Bare land	86.21	96.67	96.43	87.50	88.89	83.33	96.67	90.00	93.33	80.00
Built-up area	90.00	96.67	90.91	93.10	81.82	90.00	96.67	98.00	90.00	90.00
Vegetation	83.33	88.24	92.86	85.29	100.0	83.33	100.0	86.67	96.67	100.0
Waterbody	100.0	100.0	100.0	100.0	90.91	93.33	96.67	100.0	100.0	100.0
Wetland	86.67	92.59	78.79	100.0	87.50	86.67	83.33	86.67	83.33	70.00

Table S3. Flow rate at different monitoring points in Vientiane Capital.

No.	Monitoring point	Flow rate (m ³ /s) in 2009		
		Min	Mean	Max
1	SP1	0.070	0.218	0.750
2	SP2	0.050	1.492	7.200
3	SP3	0.047	0.091	0.180
4	SP4	0.081	0.308	0.560
5	SP5	0.064	0.074	0.085
6	SP6	0.055	0.134	0.400
7	SP7	0.200	0.426	0.700
8	SP8	0.034	0.048	0.078
9	SP9	0.092	2.998	10.000
10	MP1	0.470	2.290	8.800
11	MP2	0.440	1.438	4.700
12	MP3	0.050	0.494	0.910
13	MP4	0.150	4.418	16.000
14	MP5	0.650	10.152	46.000
15	MP6	0.300	12.974	56.000

Table S4. Nutrient concentration monitored by JICA.

No.	Monitoring point	NO ₃ ⁻ -N (mg/L) in 2009		
		Min	Mean	Max
1	SP1	0.050	0.238	0.570
2	SP2	0.000	0.280	0.900
3	SP3	0.100	0.410	0.900
4	SP4	0.100	0.558	1.520
5	SP5	0.100	0.478	1.120
6	SP6	0.100	0.388	0.670
7	SP7	0.000	0.278	0.570
8	SP8	0.050	0.650	2.500
9	SP9	0.200	1.004	2.930
10	MP1	0.100	0.504	1.350
11	MP2	0.000	0.954	2.250
12	MP3	0.100	1.030	2.250
13	MP4	0.500	0.982	2.020
14	MP5	0.200	1.074	2.250
15	MP6	0.220	1.068	2.250

Note: The data source was obtained from: JICA. *The Study on Improvement of Water Environment in Vientiane City Final Report*; JICA: Tokyo, Japan, 2011.

Table S5. Nutrient load from Vientiane Capital at different monitoring points.

No.	Monitoring point	NO ₃ ⁻ -N (kg/year) 2009		
		Min	Mean	Max
1	SP1	137.18	3016.17	13,481.64
2	SP2	-	20,763.30	102,176.64
3	SP3	296.44	1034.63	1873.24
4	SP4	536.11	6684.50	19,173.89
5	SP5	242.83	1069.01	2366.46
6	SP6	296.44	1720.04	5676.48
7	SP7	-	4017.69	12,582.86
8	SP8	53.61	813.00	2759.40
9	SP9	580.26	84,197.34	211,291.20
10	MP1	2207.52	27,653.92	97,130.88
11	MP2	-	30,476.39	66,698.64
12	MP3	157.68	15,477.87	28,697.76
13	MP4	9555.41	91,557.84	338,065.92
14	MP5	5865.70	197,992.4	826,873.92
15	MP6	2081.38	278,831.8	1,006,629

Table S6. Calibration parameters for the NDR model.

Parameter	Retention value	Default value	Optimum value
k	-	2	2
TFA	-	1000	100
NO ₃ ⁻ -N load	-	By LULC	By LULC
Critical length	-	12.5×12.5 m ²	12.5
Retention efficiency:			
Agriculture	0.56	-	-
Bareland	0.05	-	-
Built-up	0.15	-	-
Vegetation	0.80	-	-
Waterbody	0.25	-	-
Wetland	0.85	-	-

Note: TFA = Threshold Flow Accumulation.