

Mitigation of COD and TP by Implementing Total Pollutant Load Management System in the Shiwha Coastal Reservoir

Chang-Hee Lee and Bum-Yeon Lee

Department of Environmental Engineering & Energy
Myongji University



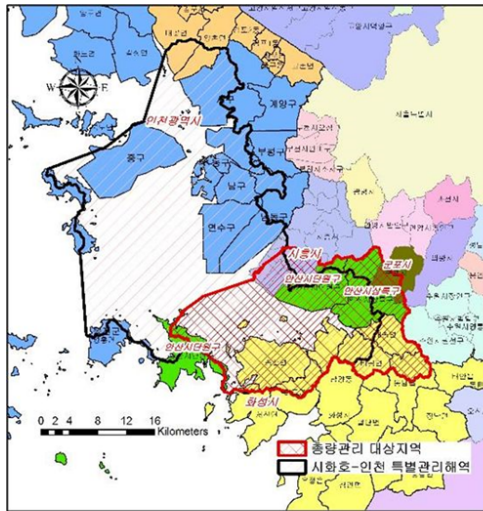
Contents

1. What is Total Pollutant Load Management System (TPLMS)?
2. Do we need TPLMS in the Shiwaha Coastal Reservoir(SCR)?
3. How is it working?
4. What will happen?
5. Conclusions

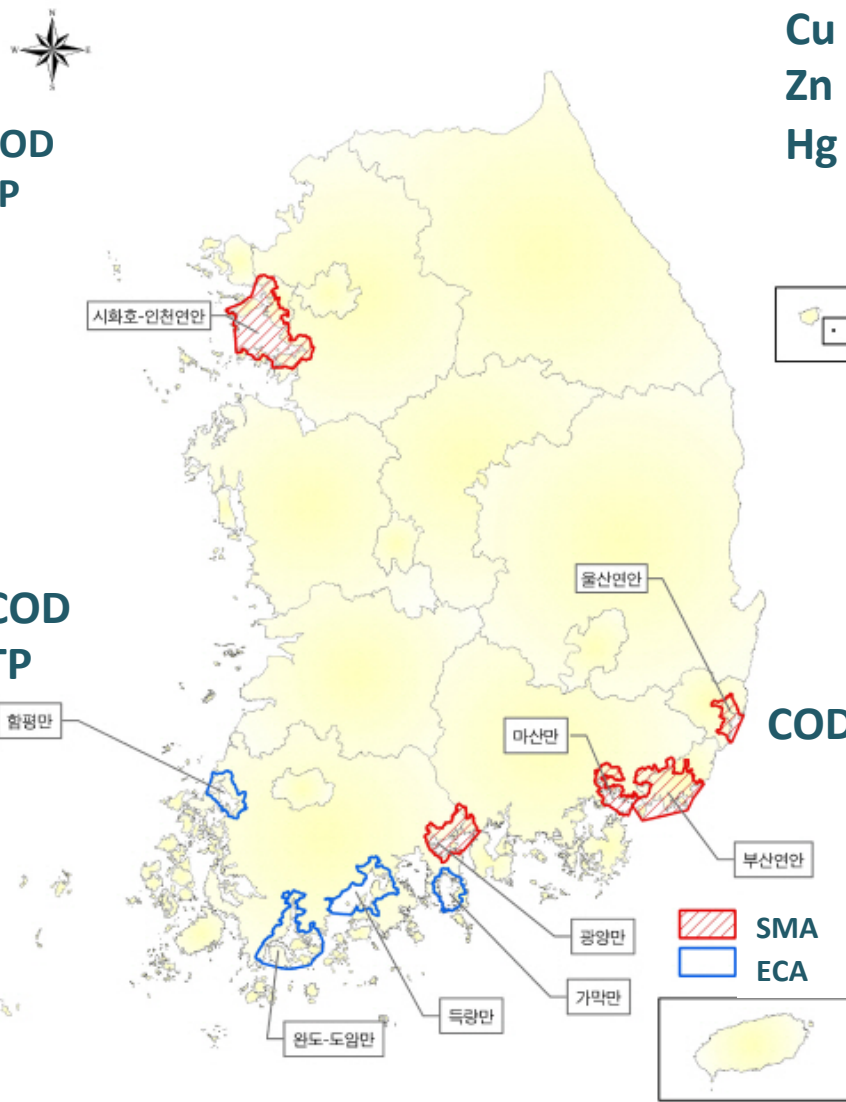
1. What is Total Pollutant Load Management System(TPLMS)?

- **Korean Version of Total Maximum Daily Load (TMDL) in the USA**
“A plan for restoring impaired waters that identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards (or water quality target)”
- **Implemented in the designated “Special Management Area(SMA)” based on Marine Environment Management Act**
 - Masan Bay(‘07~), Incheon-**Shiwha** Coastal Area(‘13~), Busan Coastal Area(‘15~), Ulsan Bay(‘18~), Gwangyang Bay(‘20~)

Special Management Area (SMA)

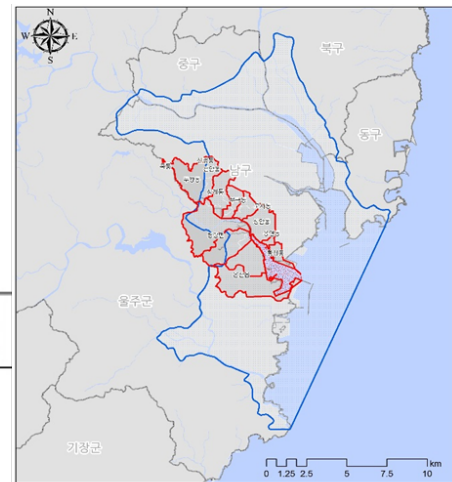


COD
TP

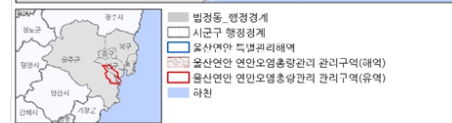


COD
TP

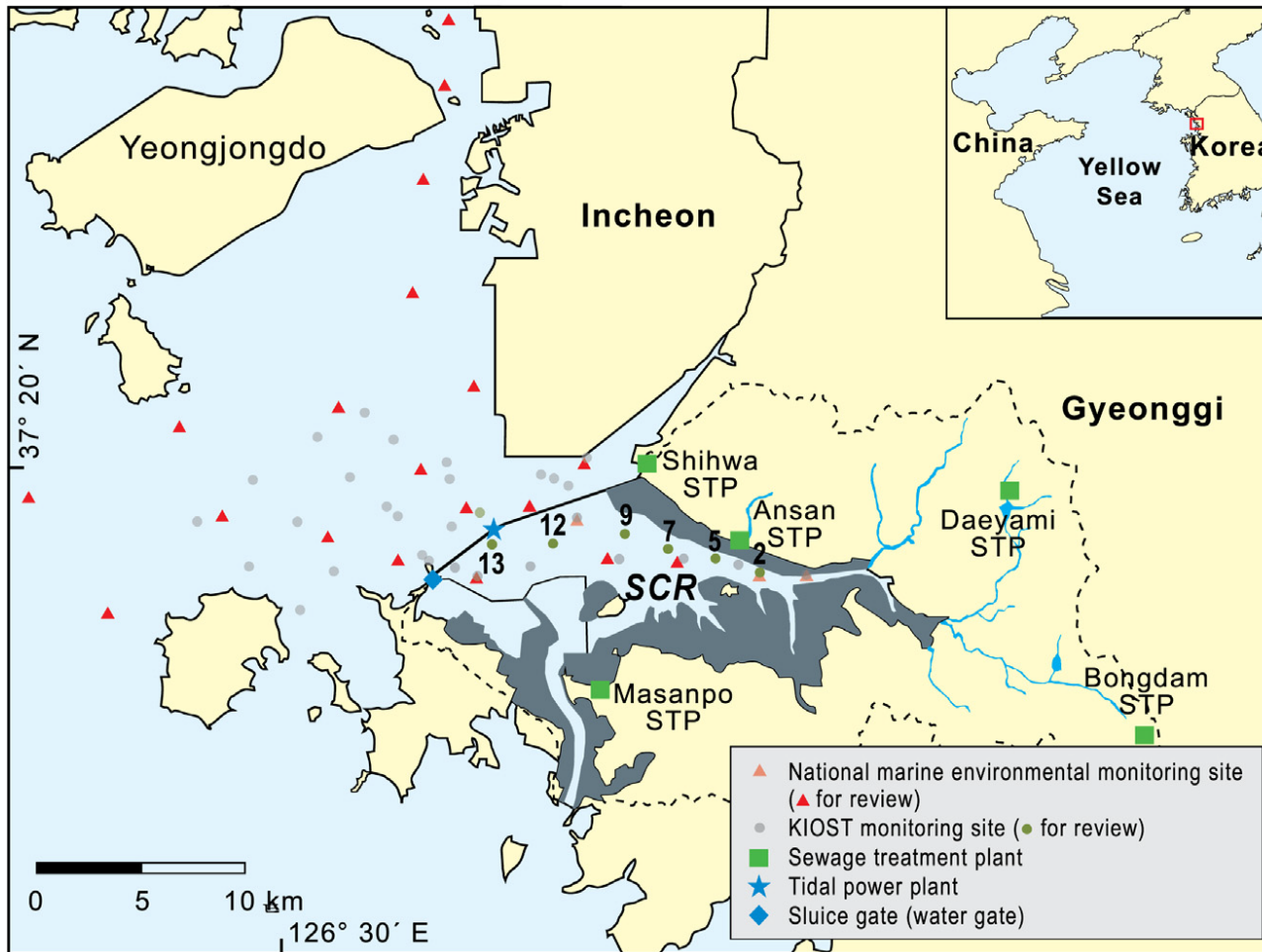
COD



Cu
Zn
Hg



2. Do we need TPLMS in the SCR?

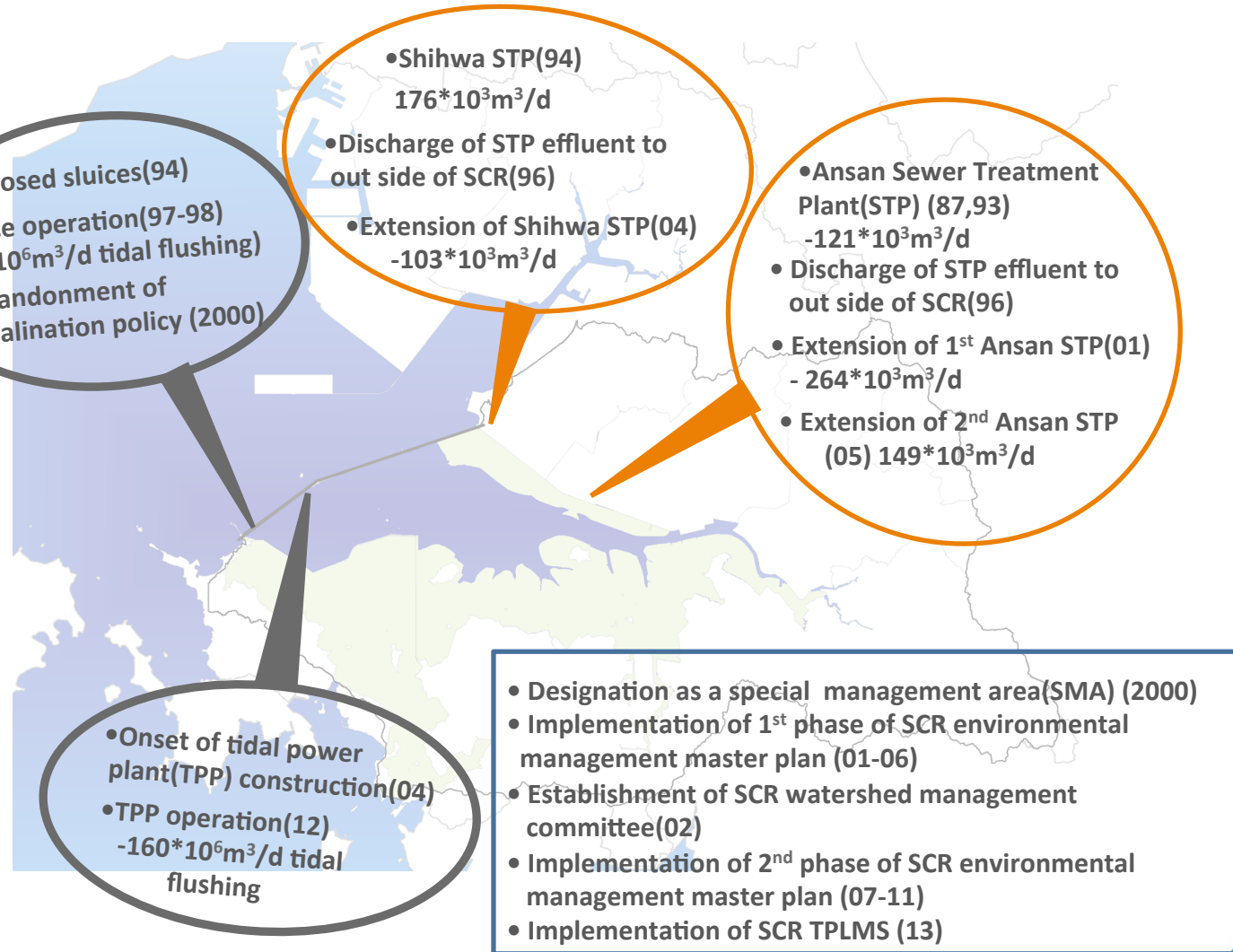


1990



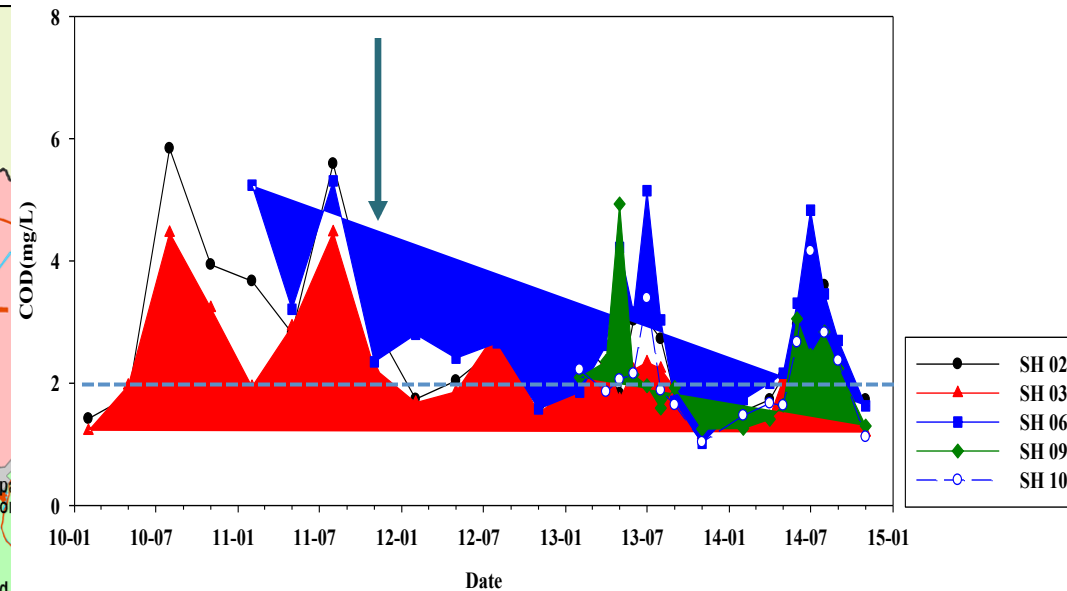
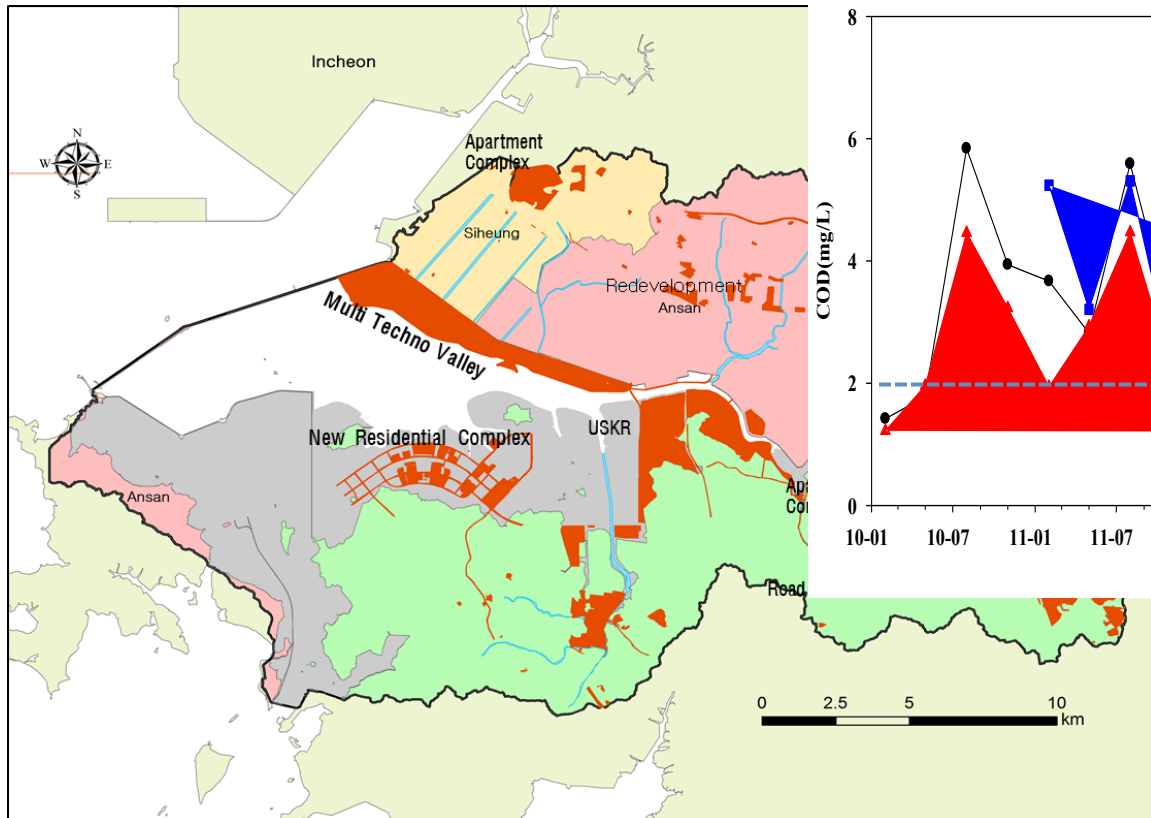
2000





- **US\$1.6billion** invested
- **Tidal Power Plant** (254MW/d)
- **TPLMS** Implementation
- But, the water quality is still not enough for **swimmable & fishable level**

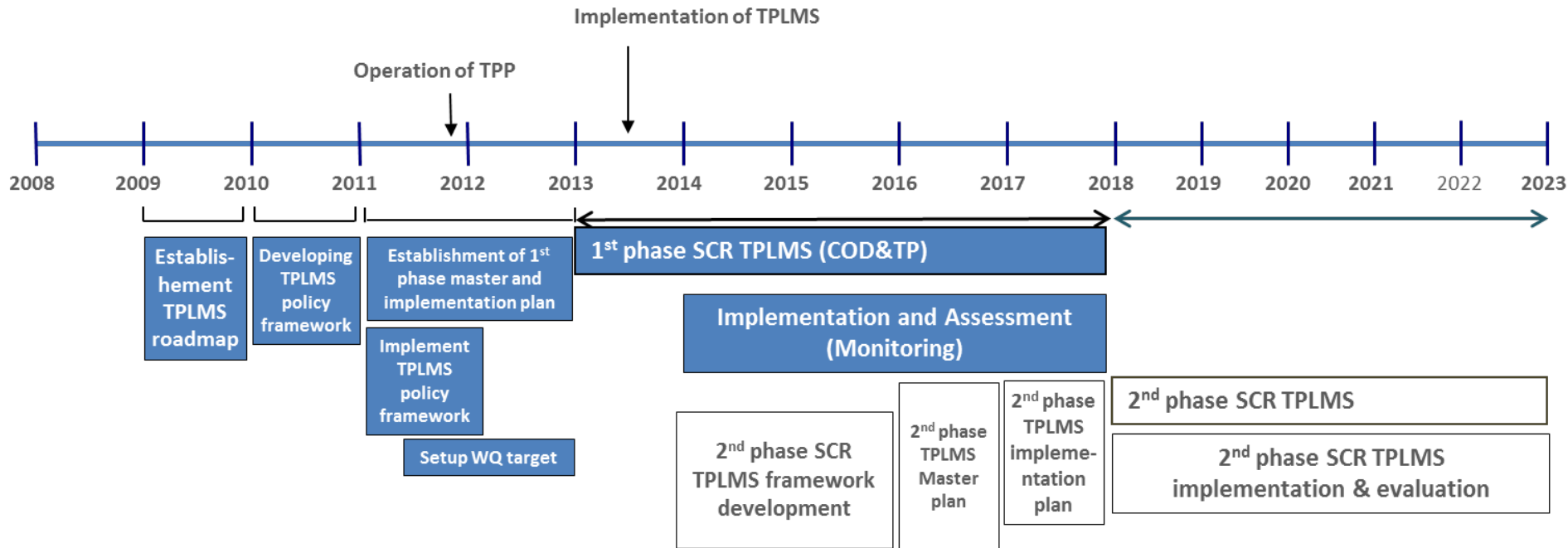
2. Do we need TPLMS in the SCR?



Water quality improved by TPP operation
 Considering anticipated development projects, water quality will degrade again!

High development pressure but little additional water control measures

3. How is it working?



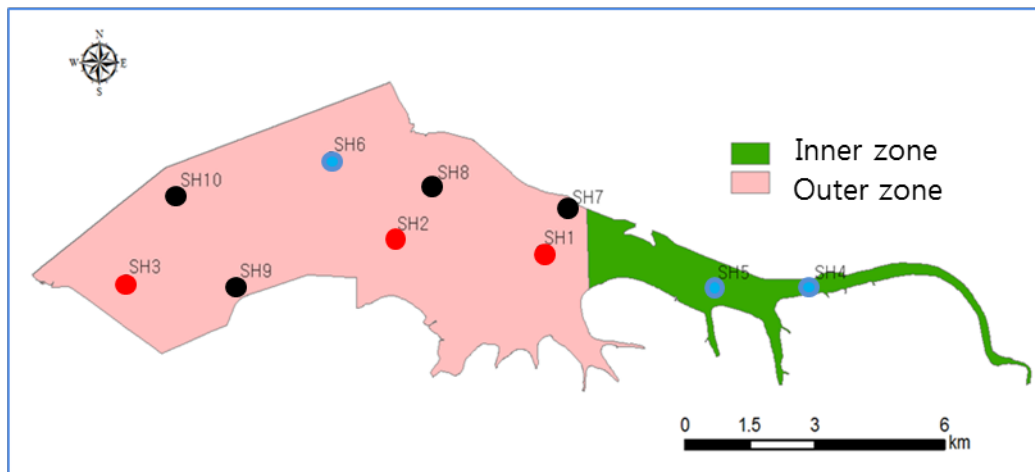
SCR TPLMS long-term water quality target(Before 20yr)

“Water quality for Swimmable and Fishable”

[COD 2.0mg/L, T-P 0.05mg/L]

<Water quality standard: 「 Enforcement Decree of the Framework Act on Environmental Policy 」 attached list 1 Environmental standard for marine water quality Ⅱ grade (2012.7. previous revision) >

3. How is it working?



- Existing Monitoring Station
- New Monitoring Station from '11
- New Monitoring Station from '13

1st Phase Water Quality Targets

Parameters (mg/L)	COD	TP
Inner zone	3.3	0.065
Outer Zone	-	-

Target pollutants
(COD, TP)
-Consider WQ problems & management condition

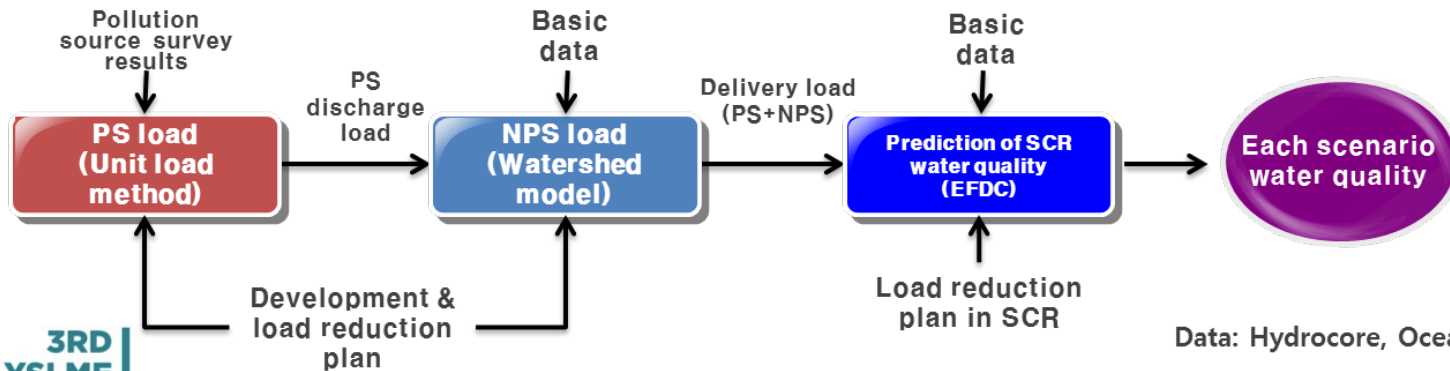
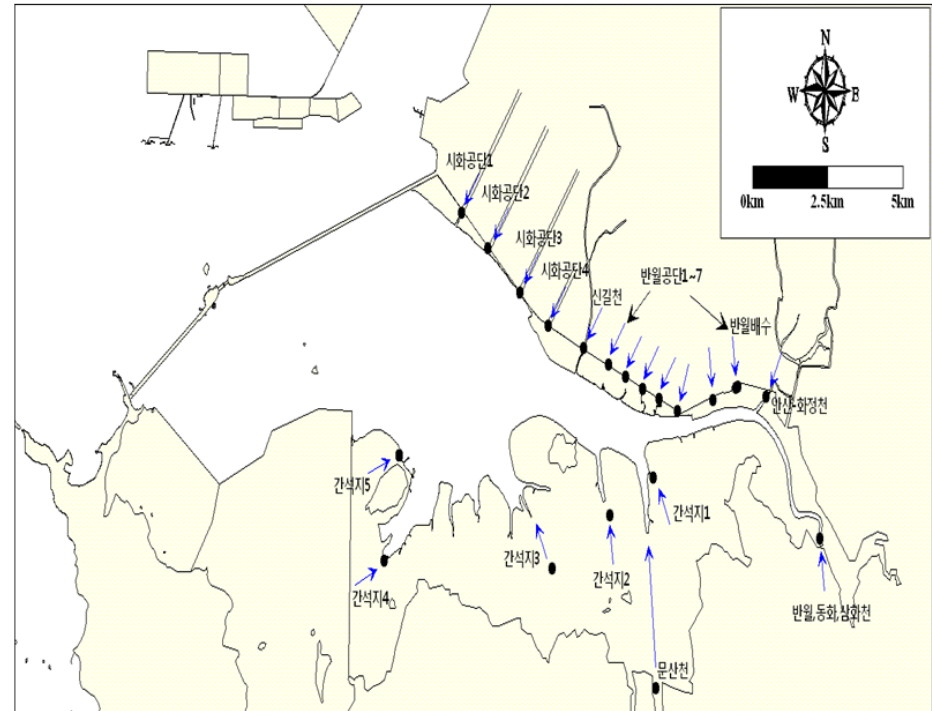
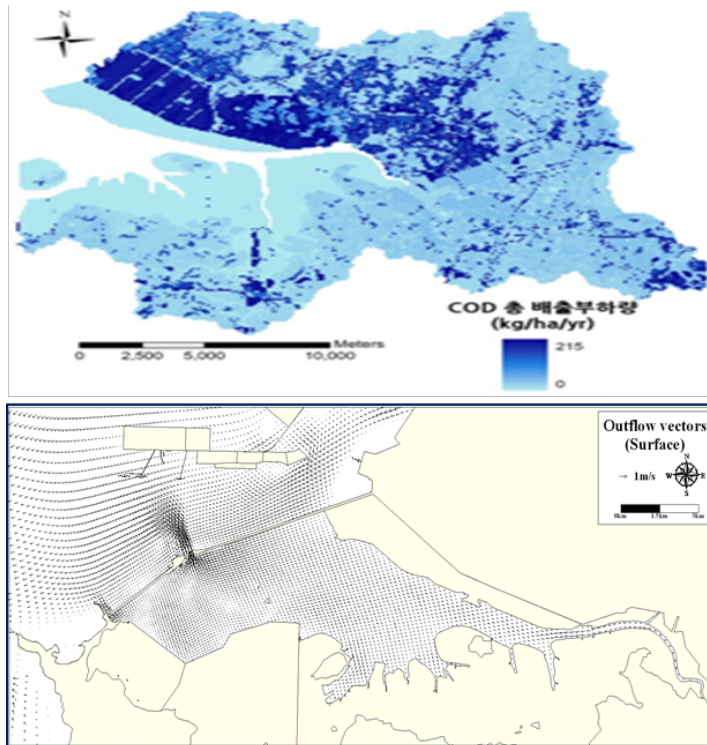
Target period
(May ~ Aug.)
-Consider temporal WQ change

Target area
(Middle-outer zone)
-Consider spatial WQ distribution

Lookout area
(inner zone)
-Consider available WQ monitoring data

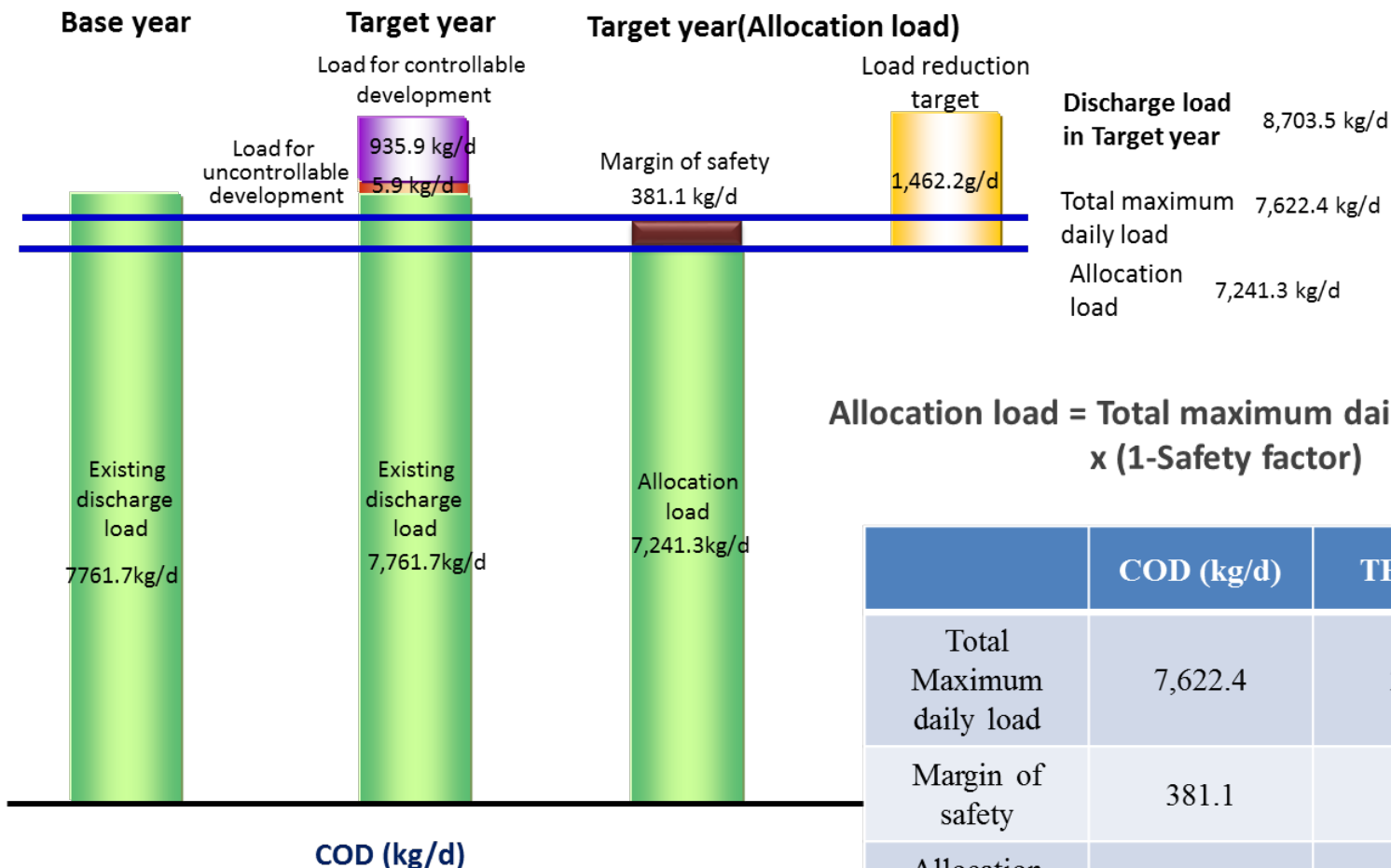
Calculation WQ target
(3-years moving average of sites 1,2,3 monitoring data)

3. How is it working?



Data: Hydrocore, Ocean R&S

3. How is it working?



Allocation load = Total maximum daily load x (1-Safety factor)

	COD (kg/d)	TP (kg/d)
Total Maximum daily load	7,622.4	203.1
Margin of safety	381.1	10.1
Allocation load	7,241.3	193.0

► Margin of safety = Total maximum daily load x safety factor(5%)

3. How is it working?

Discharge load (kg/d)		Load Allocation to Local Municipalities									
		Gunpo		Siheung		Ansan		Hwaseong		Sum	
		PS	NPS	PS	NPS	PS	NPS	PS	NPS	PS	NPS
Allocation load	COD	90.7	162.9	119.2	961.9	301.7	2,237.4	1,371.5	1,996.0	1,883.1	5,358.2
	TP	1.89	3.35	3.09	19.41	3.11	37.75	70.44	53.96	78.53	114.47

➤ PS : Point Source, NPS : Non-Point Source

Non-point source load >> Point source load

3. How is it working?



US\$

429.2 Millions\$

1.4 Millions\$

25.4 Millions\$

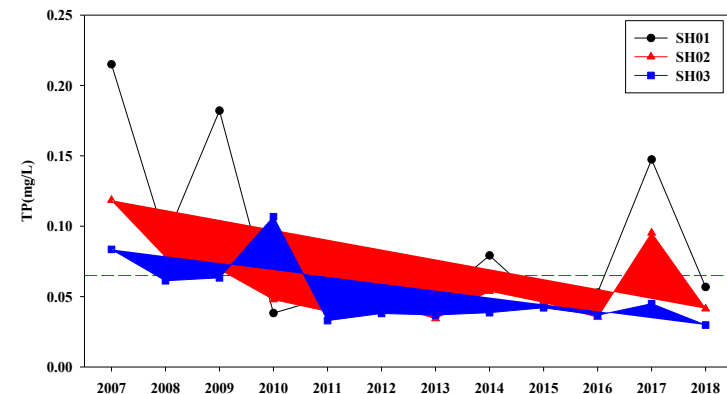
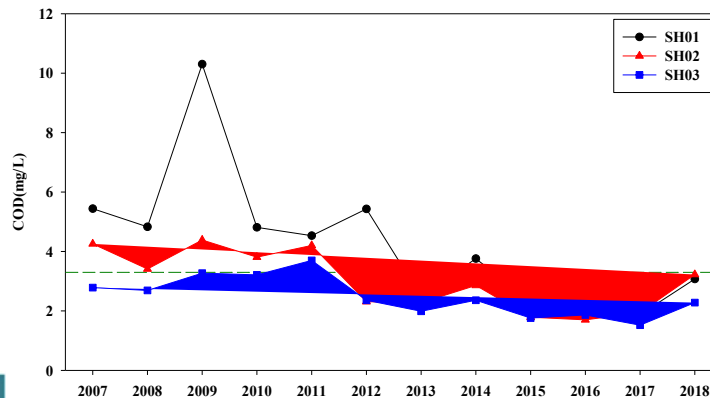
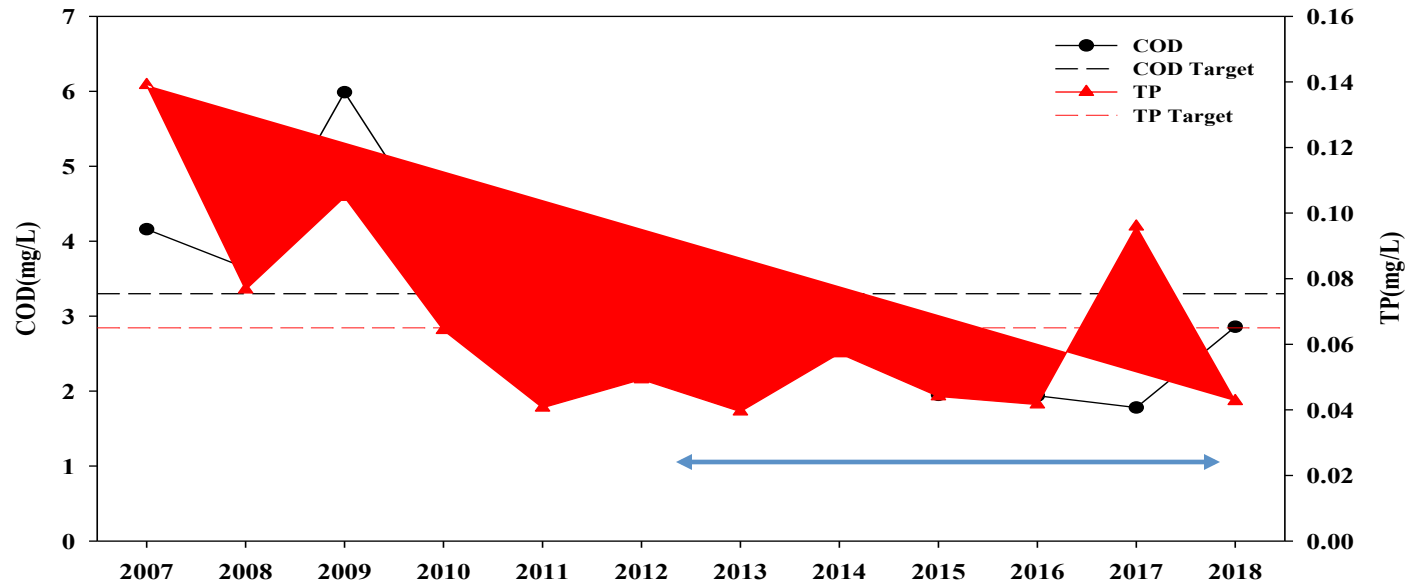
153.5 Millions\$

249.0 Millions\$

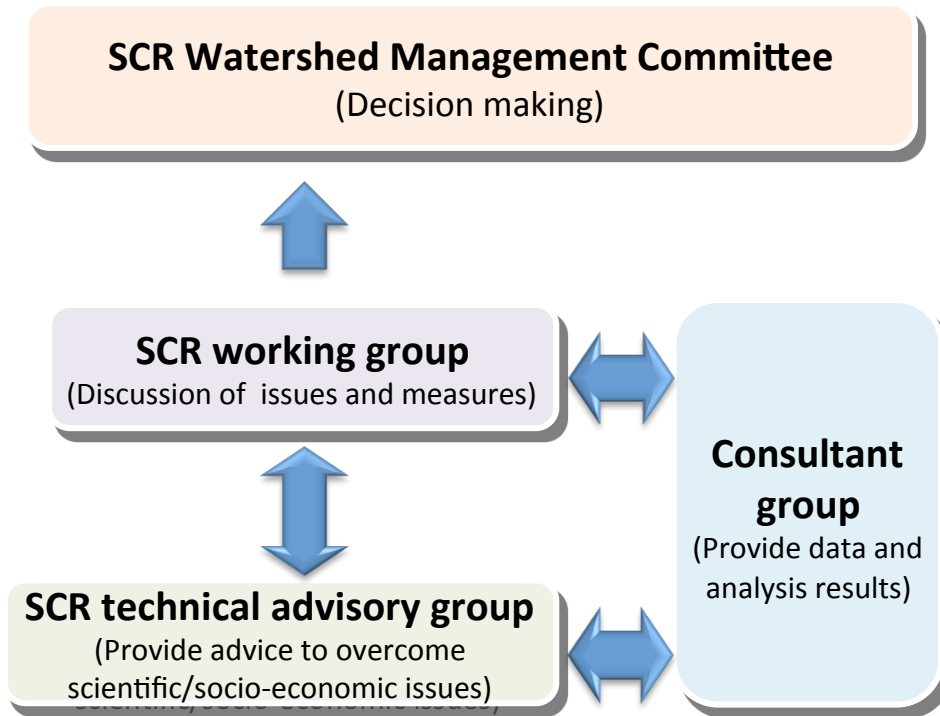
Measures	Gunpo		Siheung		Ansan		Hwaseong	
	COD	TP	COD	TP	COD	TP	COD	TP
Extension or changing of treatment area	489.4	12.06	-	-	-	-	348.5	13.56
Construction or extension of STP, advanced treatment	-	-	-	-	-	-	208.6	14.34
NPS treatment facilities	-	-	11.3	0.23	6.7	0.14	40.4	1.22
NPS treatment facilities (development area)	4.5	0.12	0.5	0.02	2.0	0.02	15.0	0.30
Wetland operation improvement	-	-	-	-	15.2	0.70	22.1	1.46
Natural purification in stream	-	-	-	-	13.9	0.24	-	-
Sewer maintenance	-	-	0.2	0.01	20.0	0.60	-	-
Road sweeping	5.2	0.07	17.2	0.54	30.1	0.28	15.0	0.20
Dredging contaminated sediment	-	-	-	-	282.5	14.20	-	-
Sum	499.1	12.25	29.2	0.80	370.4	16.18	649.6	31.08

3. How is it working?

- 1st phase water quality targets were accomplished!



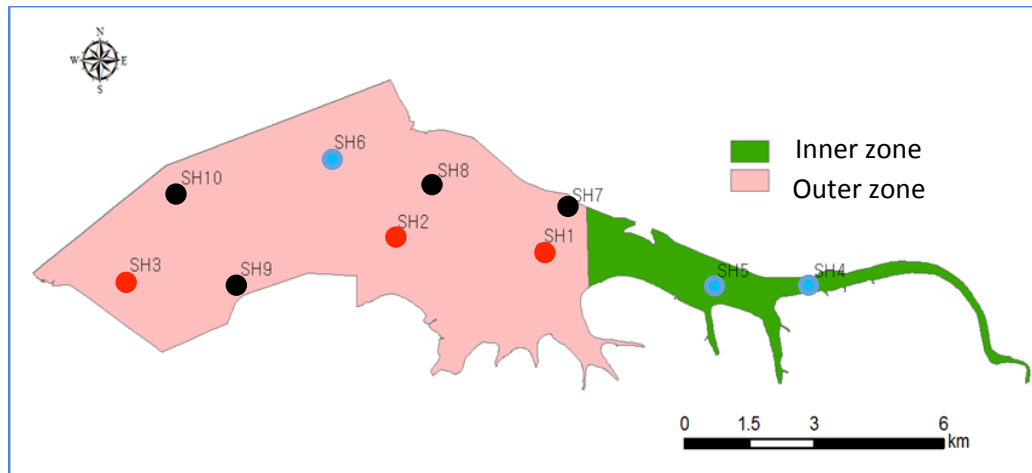
3. How is it working?



- Establishment of committee in watershed level → **Bottom-up approach** for management with stakeholders
- Stakeholder’s participation from planning to evaluation → **Roles and responsibilities sharing** for implementation of TPLMS
- Implementing the **adaptive management** → Discussion of scientific uncertainty to derive the best solution through technical advisory committee

4. What will happen (Challenges)?

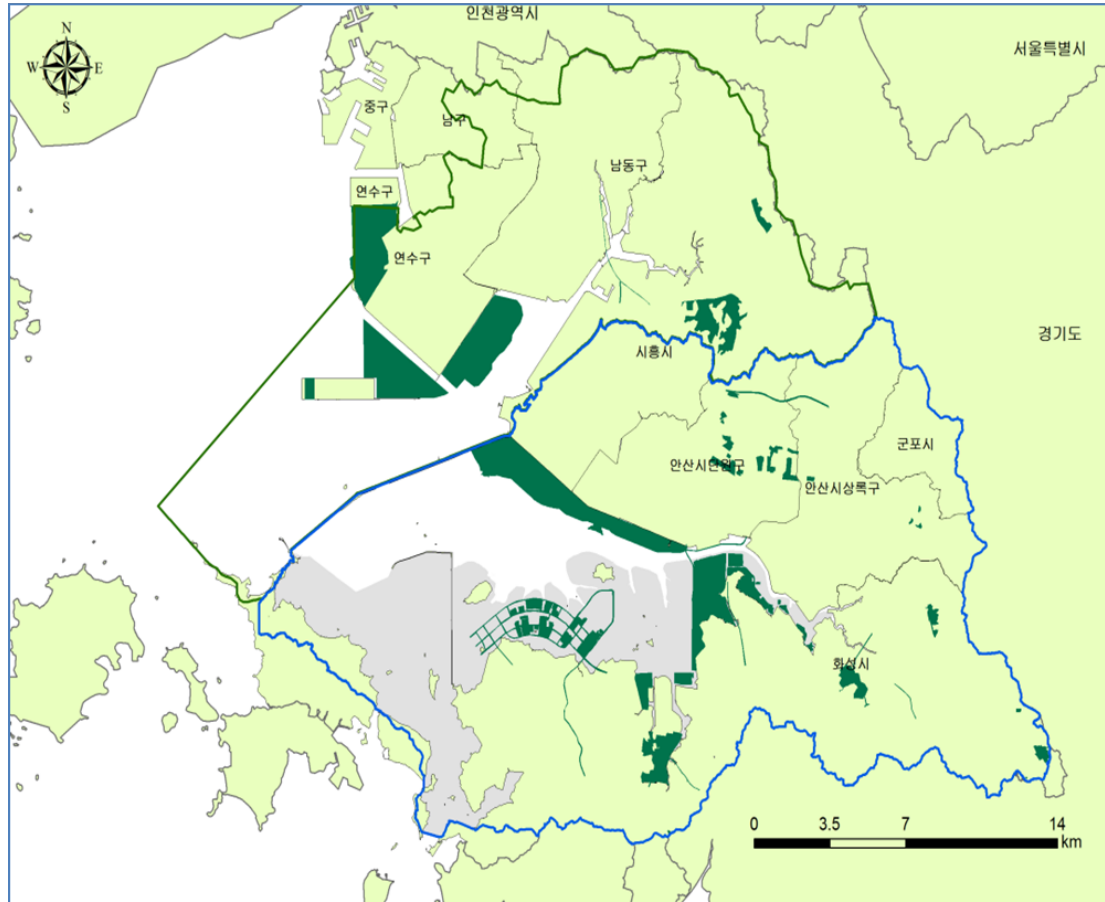
- 2nd phase TPLMS focus on the inner area where mixing is limited



- Existing Monitoring Station
- New Monitoring Station from '11
- New Monitoring Station from '13

Parameters (mg/L)	2 nd Phase Water Quality Targets		1 st Phase Water Quality Targets	
	Inner	Outer	Inner	Outer
COD	5.7	3.1	-	3.3
T-P	0.123	0.053	-	0.065

4. What will happen (Challenges)?

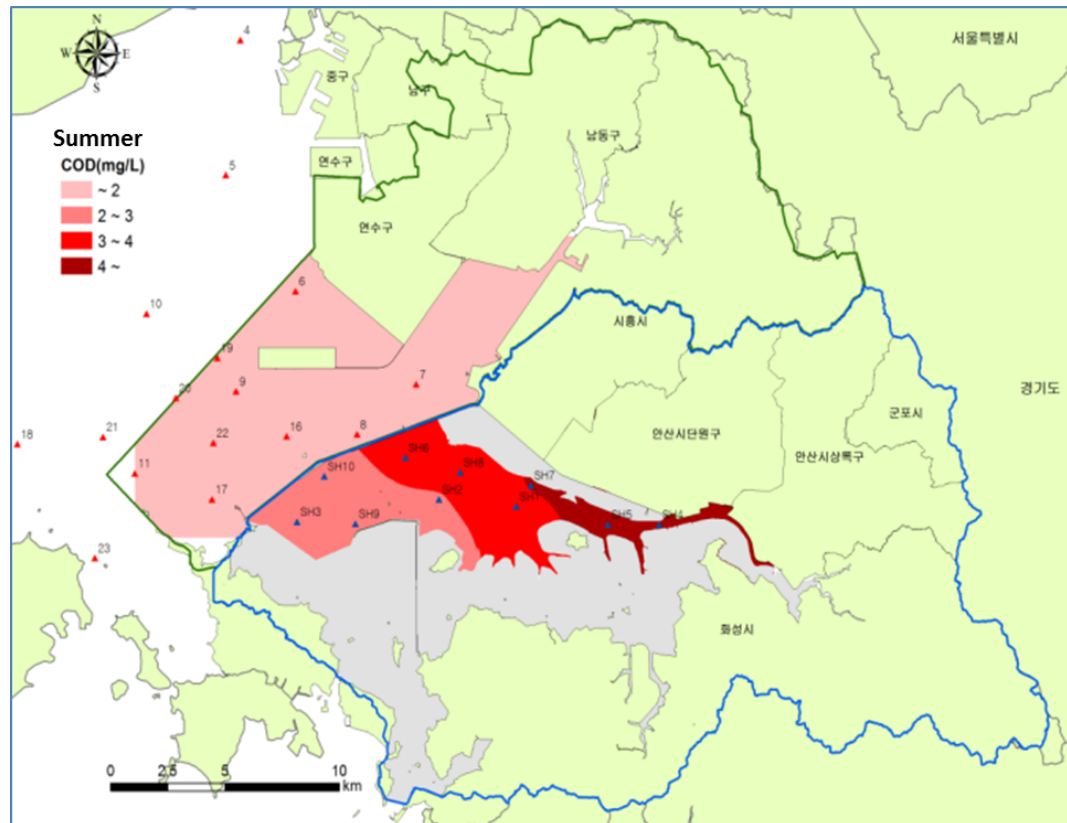


- large-scale development which was delayed by recent economic downturn, will be resumed during 2nd phase TPLMS
- Development control is difficult because of permits were already issued

- The pollutant load will increase by large-scale development projects
- If developer refused to agree, additional load reduction measures will be difficult to apply because the EIA processes have been done

Enhanced EIA consultation and Advanced measures for load reduction should be enforced in the early planning stages

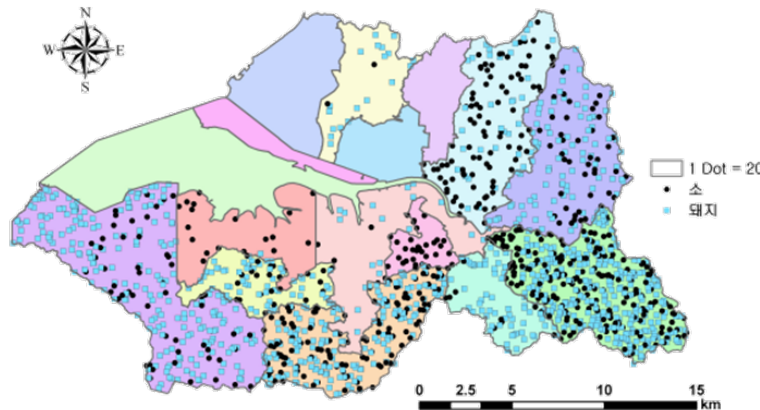
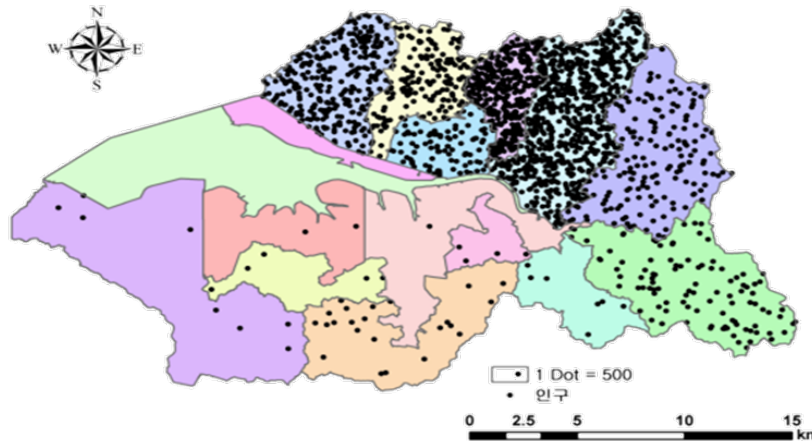
4. What will happen (Challenges)?



- Discharged of STP effluent to out side of SCR
- PS load reduction measures (Strengthen effluent regulation, water reuse and others) can not affected in SCR water quality improving
- NPS was main source to affect in SCR water quality
- Amount of NPS load reduction is generally small and applicable NPS measures are inefficient

Implementation of practical load reduction measures are required
such as designation of NPS management area

4. What will happen (Challenges)?



- Less financial support for load reduction facilities installation
- Authorities of major load management measures are belong to other ministries: PS treatment facilities (MOE), NPS treatment in agriculture (MAFRA)

- MOF do not have own incentive for TPLMS support
- Lack of connection between MOF department (e.g. coastal management, permission of private uses of public water, resource development) and TPLMS

Require establishment of effective cooperating system with MOE and other ministries, and development of MOF own incentive to support TPLMS implementation

5. Conclusions

- Implementation of TPLMS was required to improve water quality even though the planned development projects are conducted
- 1st phase of TPLMS was successful mainly because of background effects(dilution effects of tidal power plant operation) and delayed large scale development projects because of the recent economic setback
- 2nd phase of TPLMS are more challenging because
 - water quality targets were additionally set in the inner area where tidal mixing is limited
 - load reduction measures for nonpoint sources are inefficient(high cost & low reduction amount)
- Pollution source control measures (ex: easy development pressure) and innovative nonpoint source control measures (ex: designation of nonpoint source management area) are required