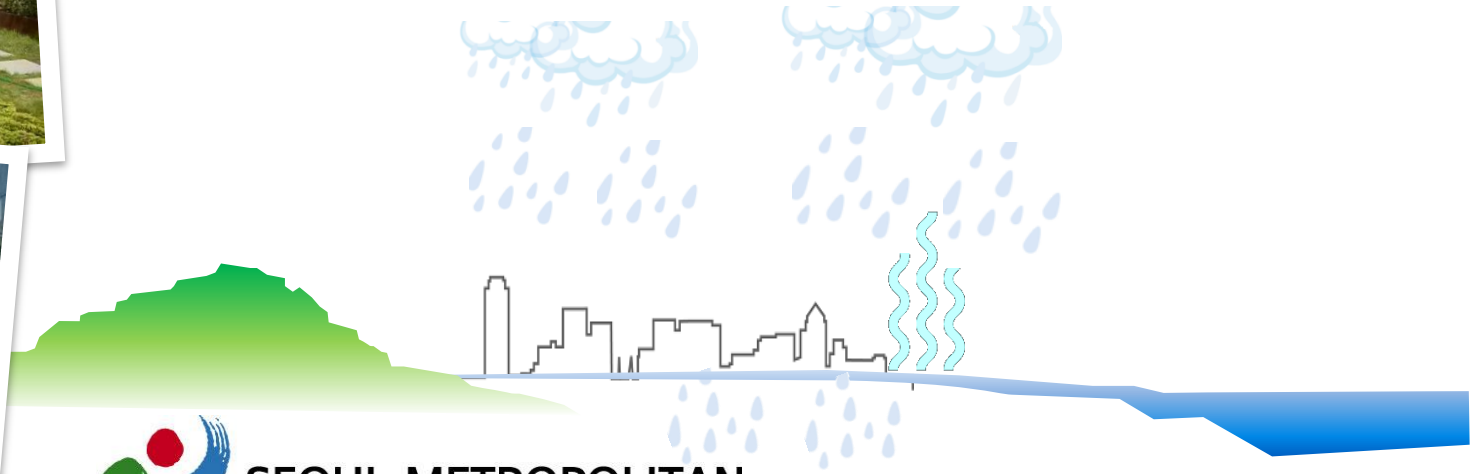
희망서울
함께 만드는 서울, 함께 누리는 서울

Water cycle policies and the Restoration of CHEONG GYE CHEON water stream in Seoul



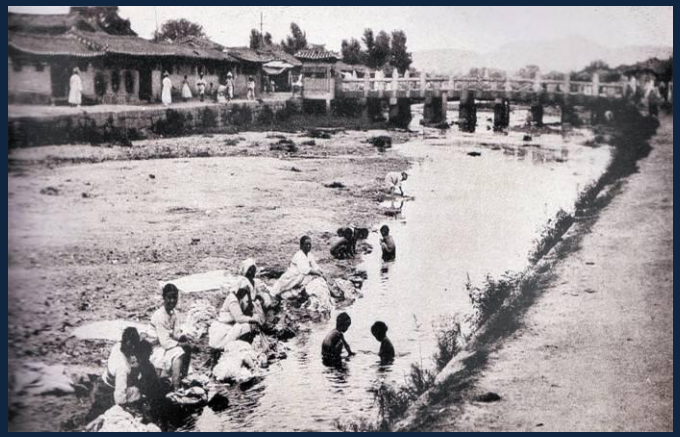
SEOUL METROPOLITAN GOVERNMENT

Jae Chan Ahn

Seoul at a glance

- Capital city of Korea for over 600 years
- Area : 605.6 km^2
- Population : 10.3 M

Urbanization of Seoul



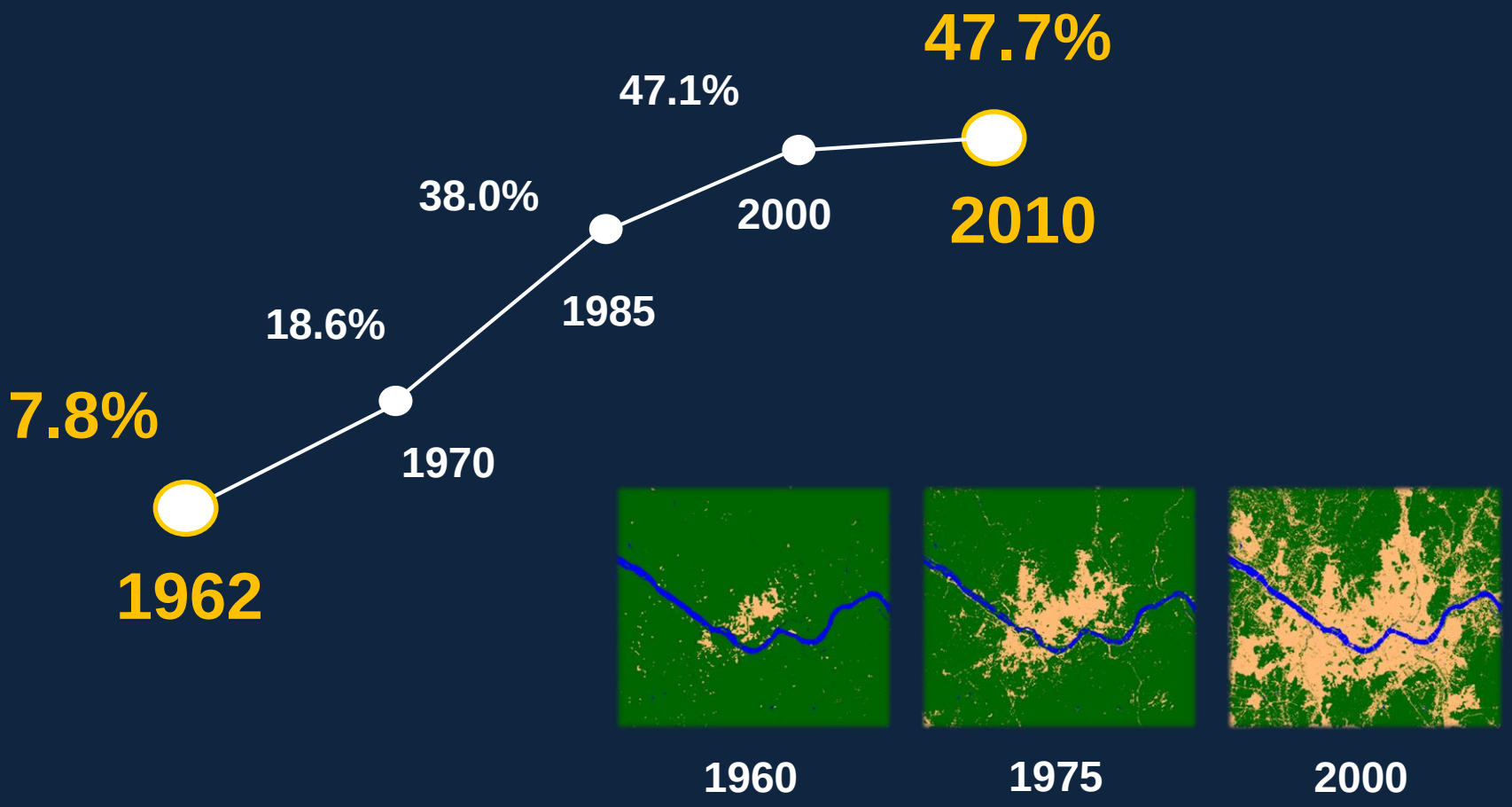
Cheong Gye stream

Jamsil in 2013

Gangnam district after Korean War, 1950's

Gangnam district in 2013

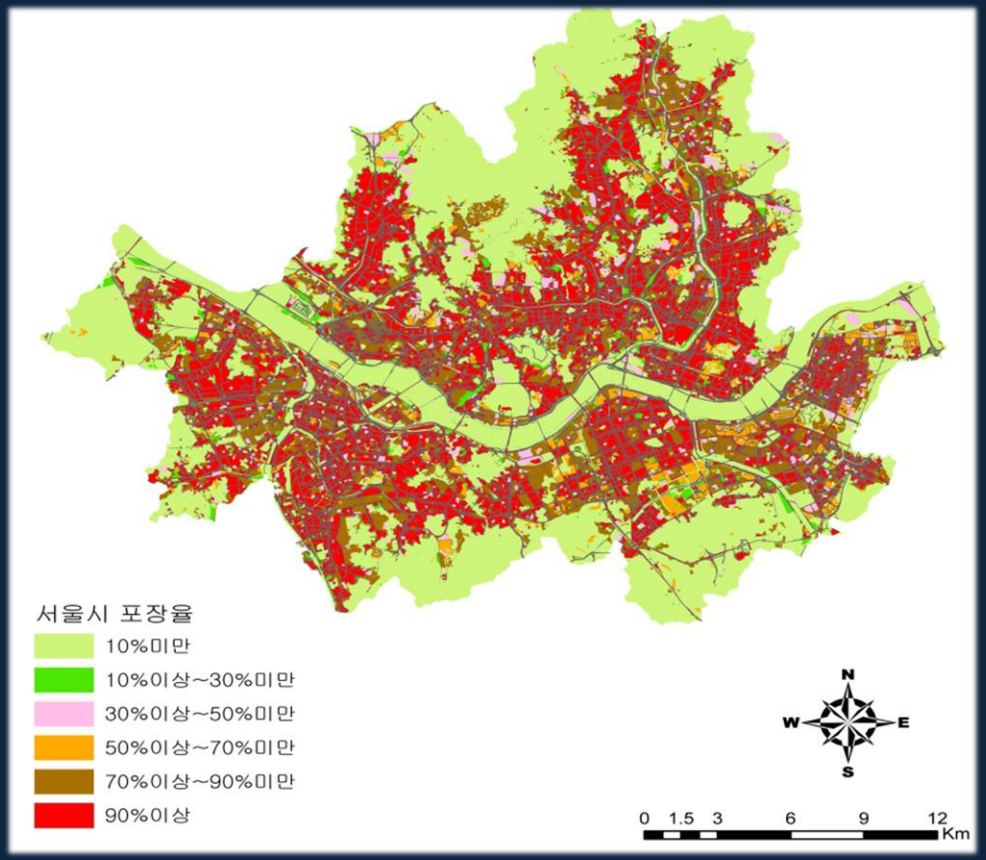
Increase in impervious surfaces due to urbanization



Impervious ratio of Seoul (%)

Increased impervious surfaces due to urbanization

Paved ratio

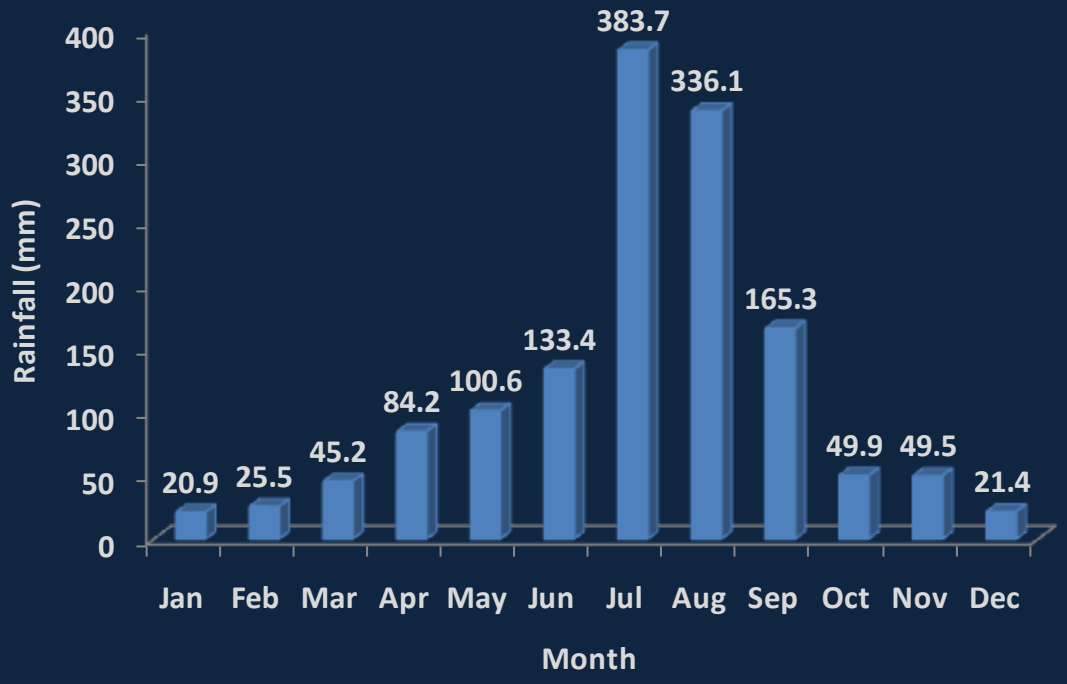


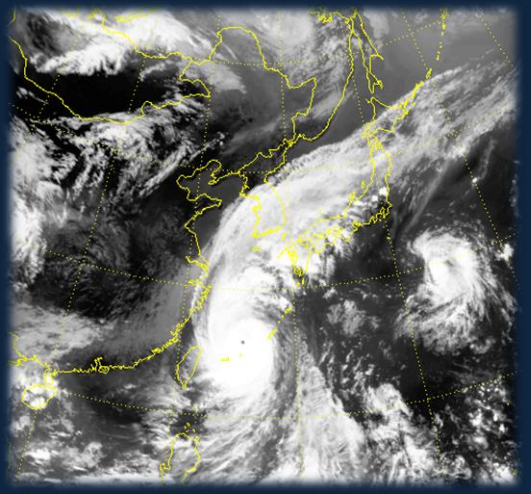
Natural water cycle changes

Precipitation in Seoul

A severe imbalance in the average monthly precipitation over the year (ca. 1,400 mm)

- 50.8% in July and August (720 mm) vs.
  4.8% in Dec to Feb (67.8 mm)

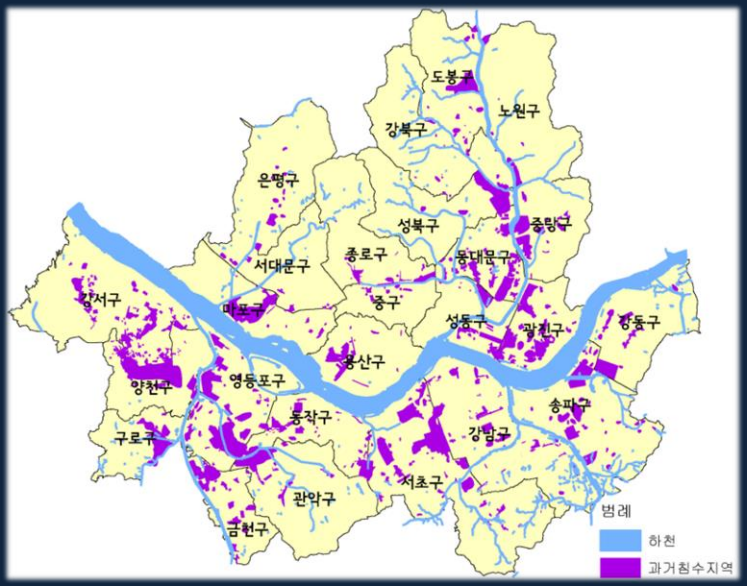




Increased surface runoff → **Increased risk of flooding**

10.6% in 1962 → **51.9% in 2010**

Flood zones in the past



Infiltration reduction → **Dry streams**

Average groundwater level declined 0.37m during the last 10 years

Increased stormwater runoff → **River pollution**

CSOs 4000 Mm³/yr

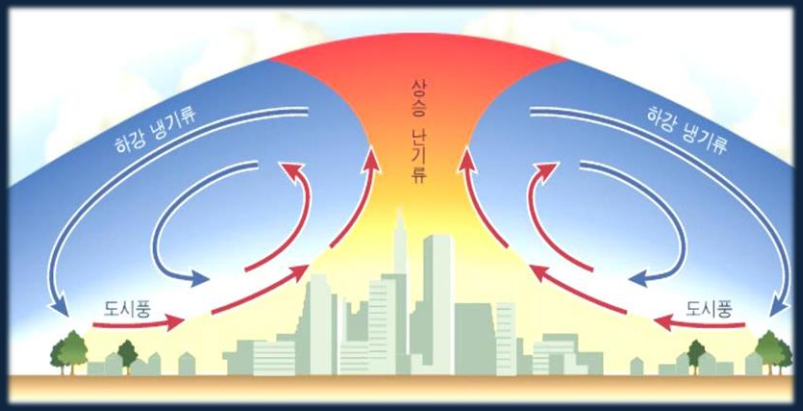
Urban heat island phenomenon due to reduced evapotranspiration

The average temperature over 100 years

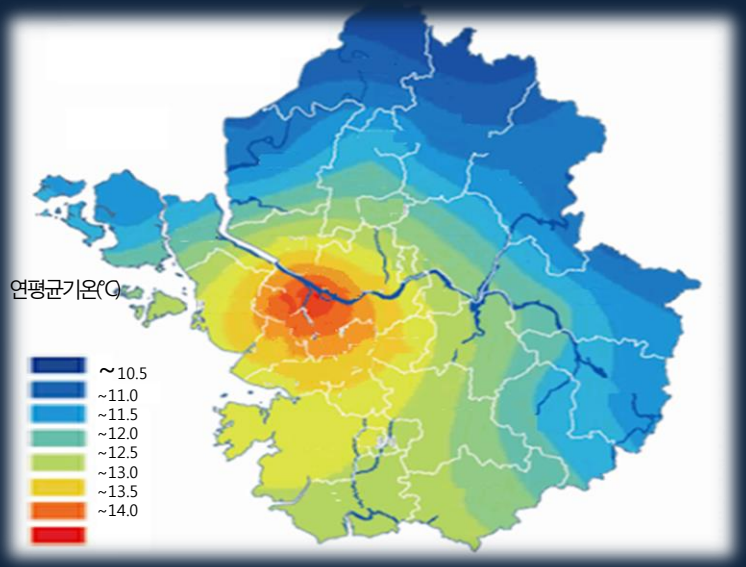
has increased

by 0.74 ℃ on the globe

by 2.5 ℃ in Seoul



Temperature distribution in Seoul and its suburbs



Group discussion on the books relate to rain, June 2012

Public hearing on urban water cycle, Oct 2012

Task Force meeting

Water Policy Committee, June 2013

Symposium on water cycle May 2013

Expert Advisory Committee, Nov 2012

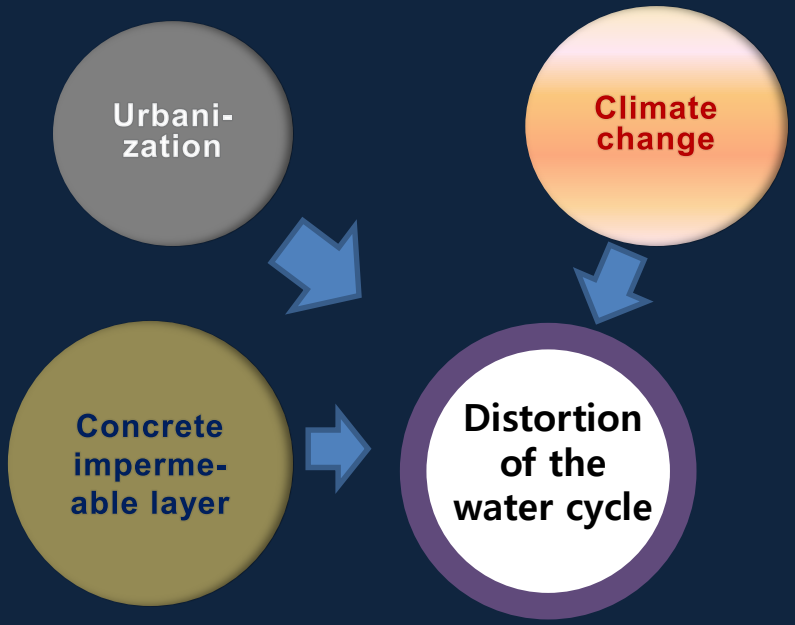
Adoption of citizens' experiences, June 2013

Best practices survey May 2013

Paradigm shift in water management

As is

Rapid discharge of rainwater through the sewer

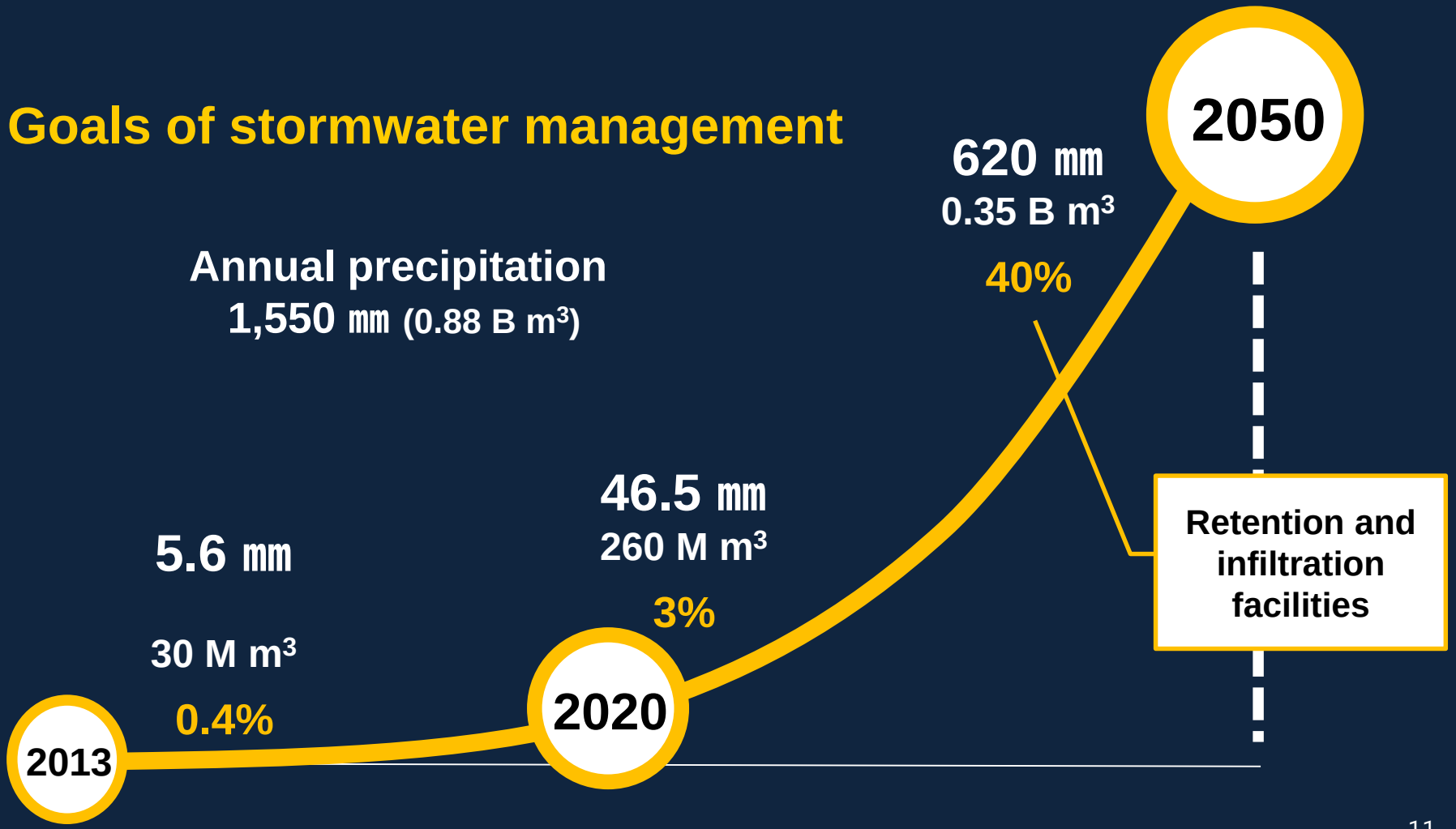


To be

Distributed water circulation management through LID

Restoration of the water cycle

2050 Vision for the water cycle restoration



Short-term goals for the water cycle restoration

1. Initiated in public spaces

From Gray to Green infrastructure

Gray infrastructure

permeable Pavement

Infiltration Planter

Rain Garden

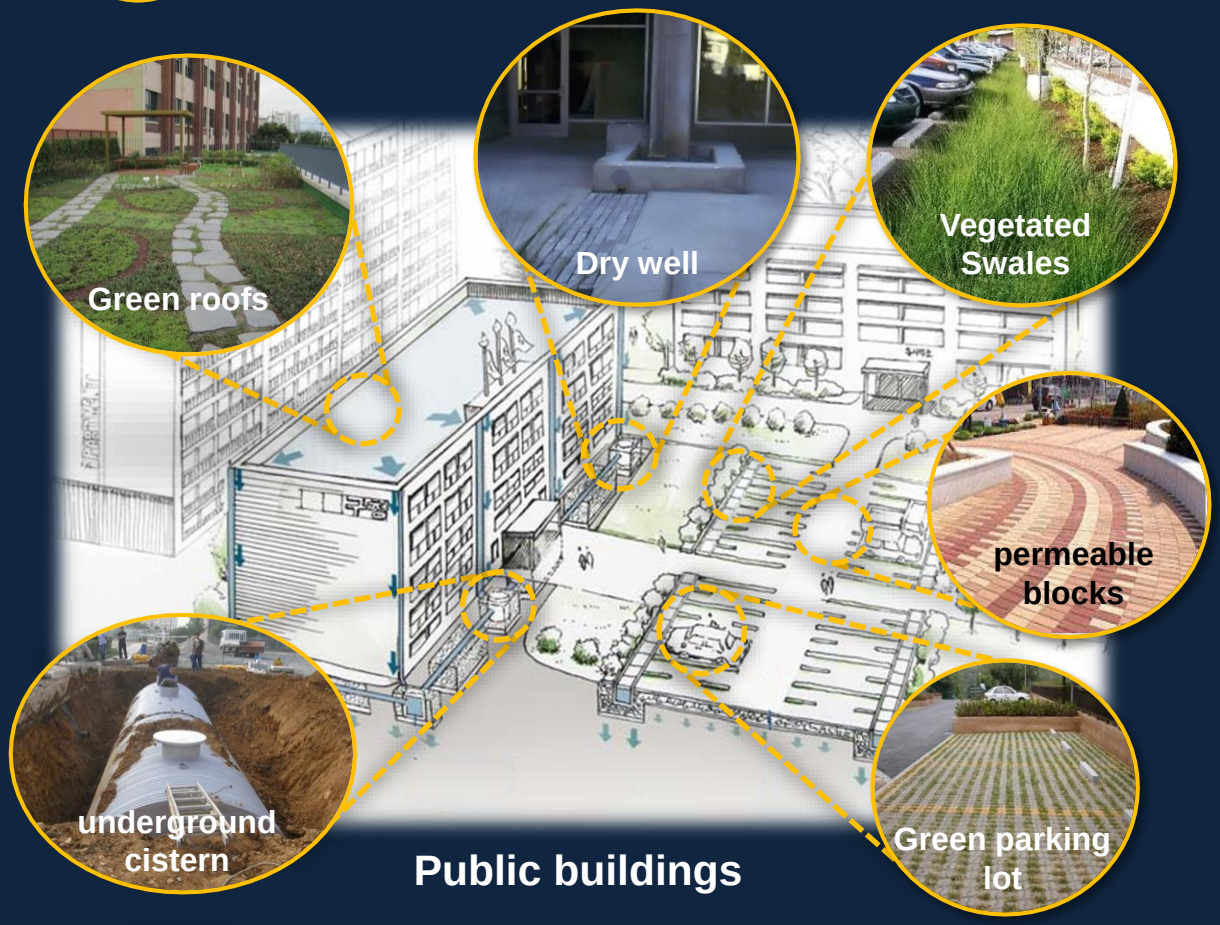
Infiltration Rain gutters

Vegetated Swales

Green infrastructure

1. Initiated in public spaces

Install stormwater facilities to the public buildings



Mandatory for new construction

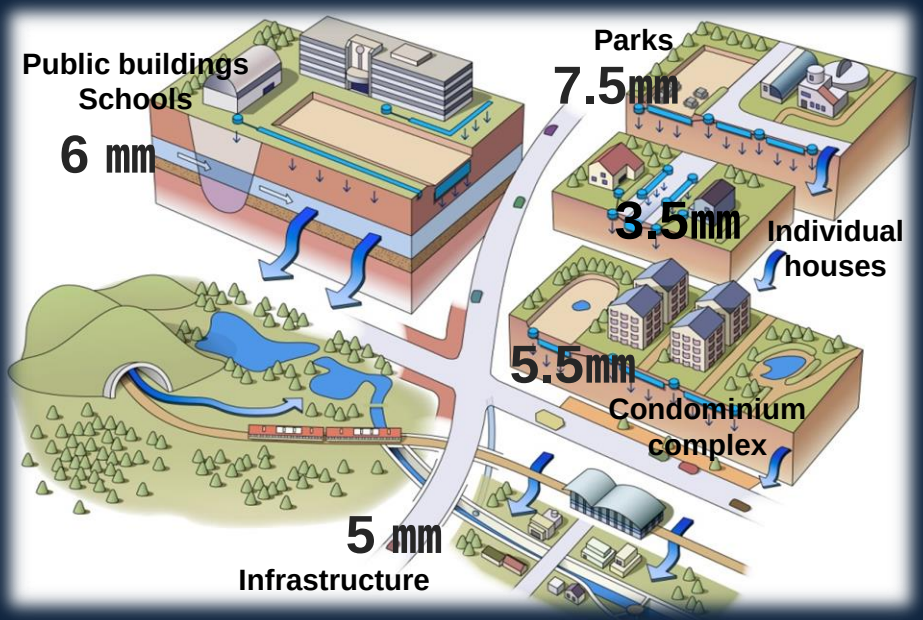
The City Ordinance assigned the amount of rain water reserved according to the site areas

Gradual adoption to the existing public buildings

2. Applied to reconstruction/ reformed zones

Incorporation of Low Impact Development (LID) into Municipal stormwater program

Imposed amount of reserved rainwater



Grade areas

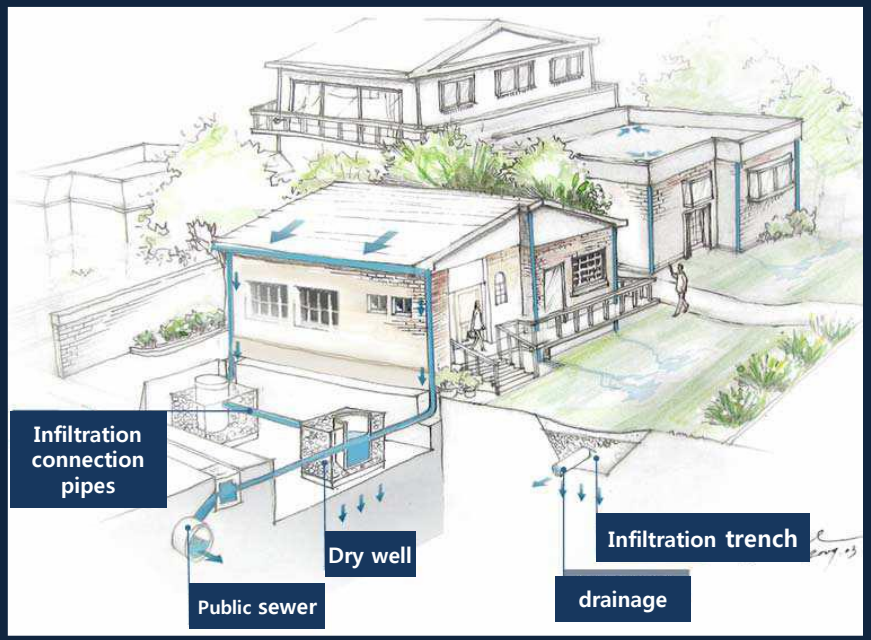
Priority areas

- Disaster areas
- Vulnerable areas for flood
- flooded areas

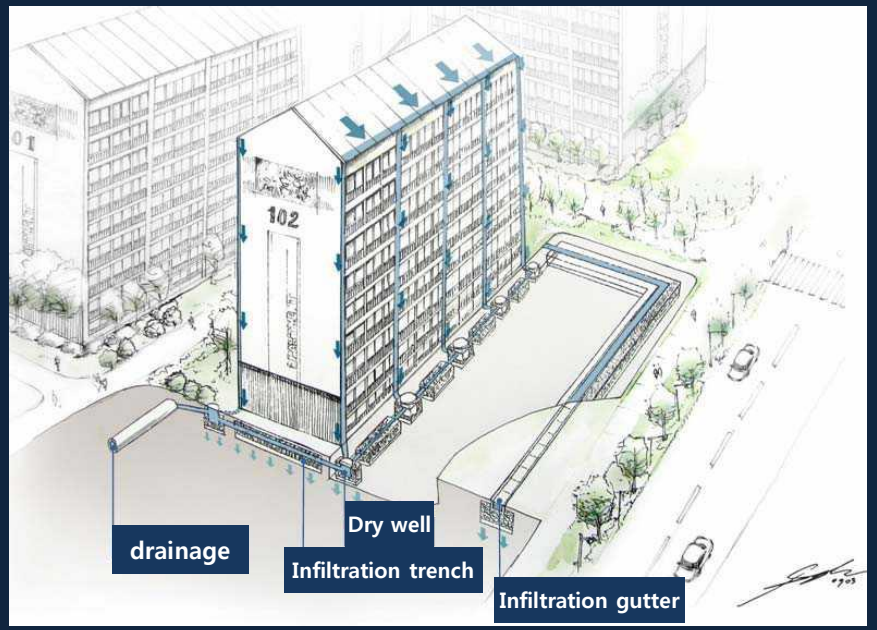
2. Applied to reconstruction/ reformed zones

Incorporation of Low Impact Development (LID) into Municipal stormwater program

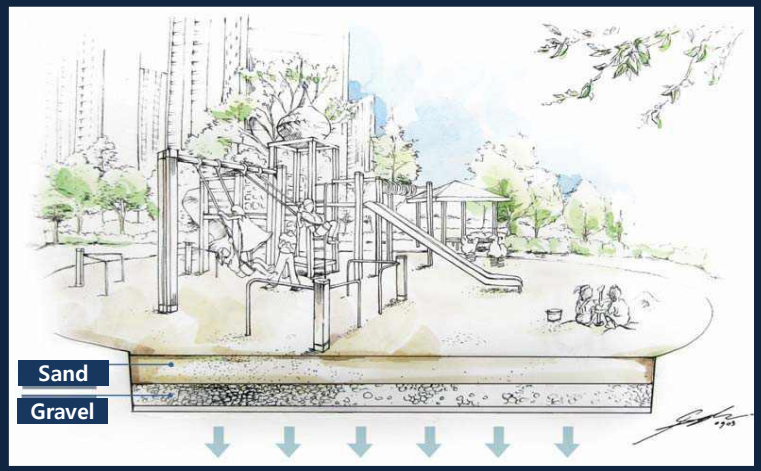
Individual houses



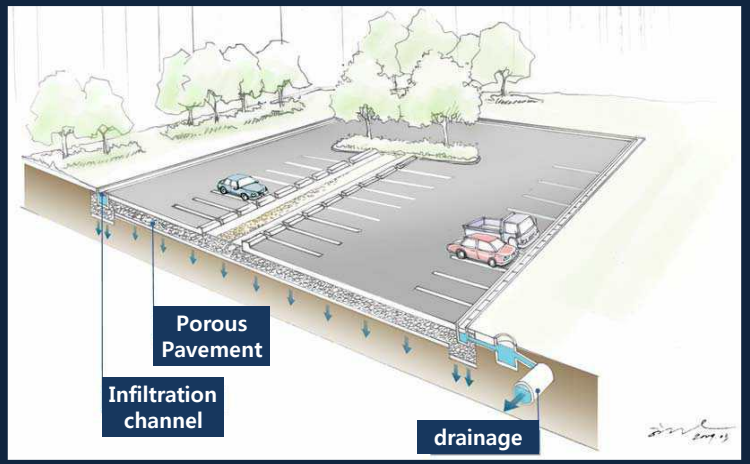
Condominium complexes



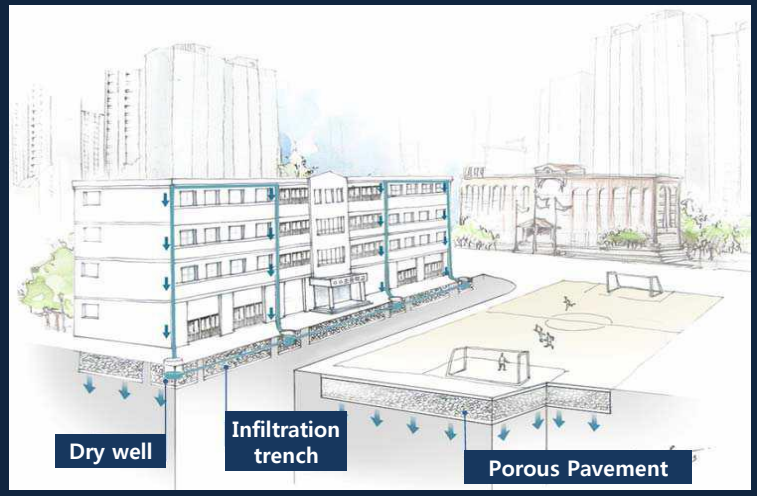
Playgrounds for children



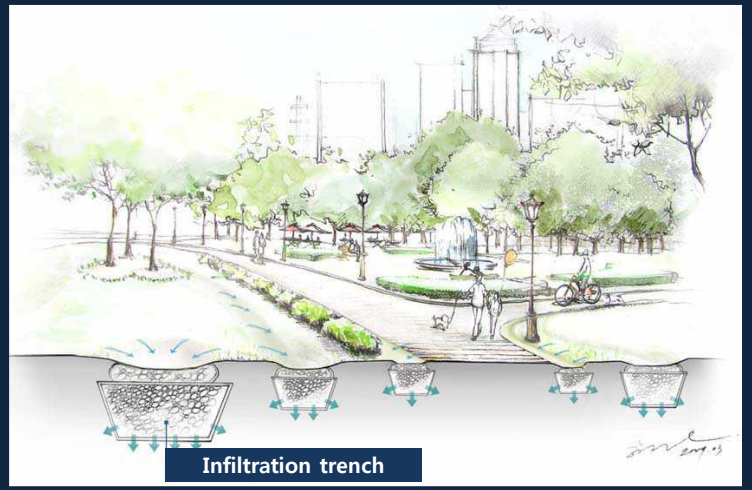
Parking lots



Schools



Parks



2. Applied to reconstruction/ reformed zones

Pilot projects in model sites

New residential areas

Eunpyung new town

Chung Gye Cheon area

Drainage Mound

2. Applied to reconstruction/ reformed zones

Regulations and Water cycle management system

Regulations on impervious surfaces

- Introduction of pervious surface ratio
- Building materials & construction
- Support for design consultation

Action plans

- Task Force
- Guidelines

Information management

- Construction of DB
- Related studies

3. Support for private sector

Proactive support for private facilities

Installation of rain barrels

- **Subsidies ; water barrels**

  50~90% of installation cost

16 sites
2012

37 sites
2013

70 sites
2014

Facilities management

Support for O&M

Maintenance education

3. Support for private sector

Stormwater facilities and consultation

Installation of various storm water facilities

Infiltration trench

Infiltration rain gutter

permeable blocks

Rain-Doctor program

Rain-Doctor's Consultation

Meeting

4. Research & Development

New model development through joint researches

MOU with research institutes

Solution

Investment

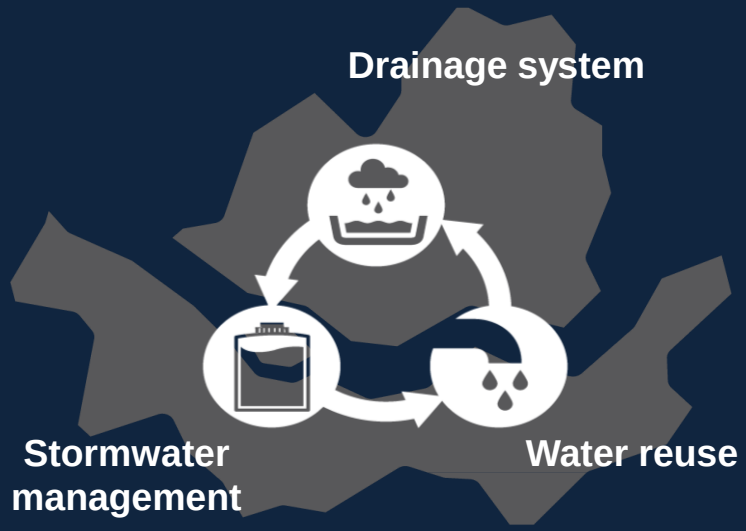
Technolog

Research

Report

PR

Seoul-type model development



5. Through public-private partnerships

Public involvement

Rain village projects

Promotion of Best practices for stromwater management

Citizens Committee for Water Cycle

- 40 members
- 3 subcommittees:
  Stormwater, Water reuse, Ground water

5. Through public-private partnerships

Communication

EXPO on Water cycle

Tour program

White book

Municipal Ordinance
Water Cycle Restoration and Low Impact Development

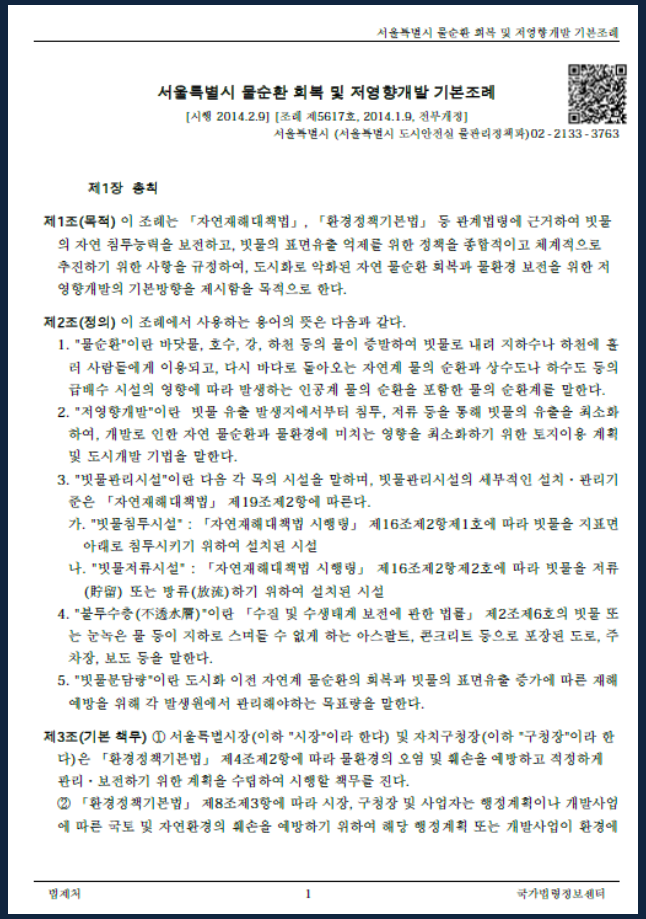
Purpose

Restoration of water cycle and the environment through LID

Main Contents

- **Responsibility and accountability of water pollution prevention & environmental damage**
- **Stormwater management plan every 10 years**
- **Prior consultations and Subsidies**
- **Mandatory projects for stormwater management Assignment of rainwater amount reserved**
- **Installation and operation of the Citizens Committee for Water Cycle**

Ordinance effective as of 9th Feb, 2014



서울특별시 물순환 회복 및 저영향개발 기본조례

서울특별시 물순환 회복 및 저영향개발 기본조례

[시행 2014.2.9] [조례 제5617호, 2014.1.9, 전부개정]
서울특별시 (서울특별시 도시안전실 물관리정책과)02 - 2133 - 3763

제1장 총칙

제1조(목적) 이 조례는 「자연재해대책법」, 「환경정책기본법」 등 관계법령에 근거하여 빗물의 자연 침투능력을 보전하고, 빗물의 표면유출 억제를 위한 정책을 종합적이고 체계적으로 추진하기 위한 사항을 규정하여, 도시화로 악화된 자연 물순환 회복과 물환경 보전을 위한 저영향개발의 기본방향을 제시함을 목적으로 한다.

제2조(정의) 이 조례에서 사용하는 용어의 뜻은 다음과 같다.

1. "물순환"이란 바닷물, 호수, 강, 하천 등의 물이 증발하여 빗물로 내려 지하수나 하천에 흘러 사람들에게 이용되고, 다시 바다로 돌아오는 자연계 물의 순환과 상수도나 하수도 등의 급배수 시설의 영향에 따라 발생하는 인공계 물의 순환을 포함한 물의 순환체를 말한다.
2. "저영향개발"이란 빗물 유출 발생지에서부터 침투, 저류 등을 통해 빗물의 유출을 최소화하여, 개발로 인한 자연 물순환과 물환경에 미치는 영향을 최소화하기 위한 토지이용 계획 및 도시개발 기법을 말한다.
3. "빗물관리시설"이란 다음 각 목의 시설을 말하며, 빗물관리시설의 세부적인 설치·관리기준은 「자연재해대책법」 제19조제2항에 따른다.
   가. "빗물침투시설" : 「자연재해대책법 시행령」 제16조제2항제1호에 따라 빗물을 지표면 아래로 침투시키기 위하여 설치된 시설
   나. "빗물저류시설" : 「자연재해대책법 시행령」 제16조제2항제2호에 따라 빗물을 저류(貯留) 또는 방류(放流)하기 위하여 설치된 시설
4. "불투수층(不透水層)"이란 「수질 및 수생태계 보전에 관한 법률」 제2조제6호의 빗물 또는 눈녹은 물 등이 지하로 스며들 수 없게 하는 아스팔트, 콘크리트 등으로 포장된 도로, 주차장, 보도 등을 말한다.
5. "빗물분담량"이란 도시화 이전 자연계 물순환의 회복과 빗물의 표면유출 증가에 따른 재해예방을 위해 각 발생원에서 관리해야하는 목표량을 말한다.

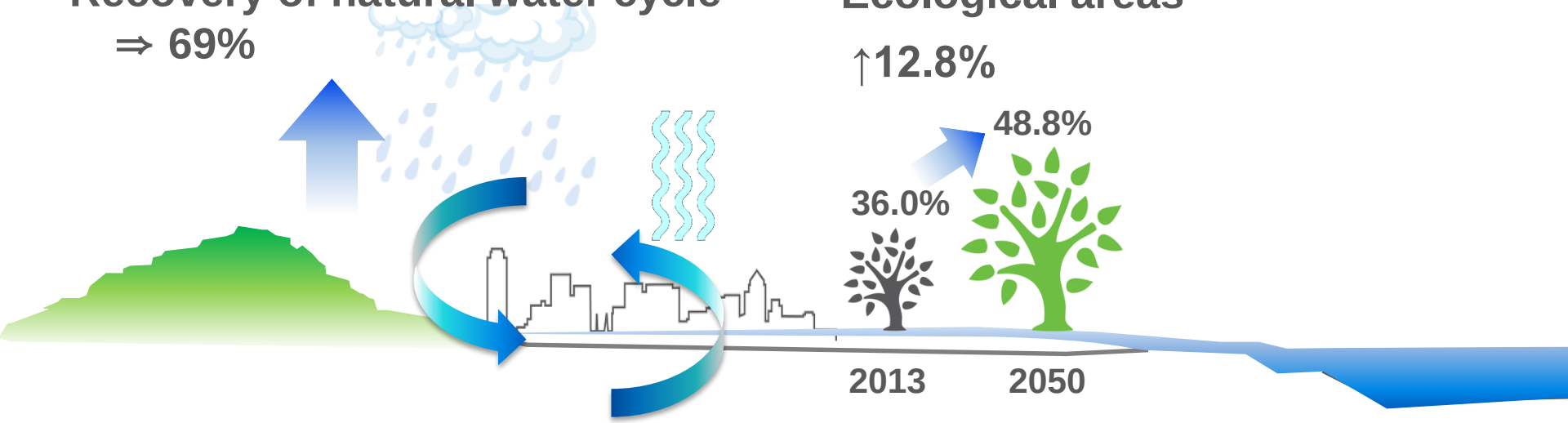
제3조(기본 책무) ① 서울특별시장(이하 "시장"이라 한다) 및 자치구청장(이하 "구청장"이라 한다)은 「환경정책기본법」 제4조제2항에 따라 물환경의 오염 및 훼손을 예방하고 적정하게 관리·보전하기 위한 계획을 수립하여 시행할 책무를 진다.
② 「환경정책기본법」 제8조제3항에 따라 시장, 구청장 및 사업자는 행정계획이나 개발사업에 따른 국토 및 자연환경의 훼손을 예방하기 위하여 해당 행정계획 또는 개발사업이 환경에

법제처 1 국가법령정보센터

Restoration of water cycle & ecology in 2050

Recovery of natural water cycle
⇒ 69%

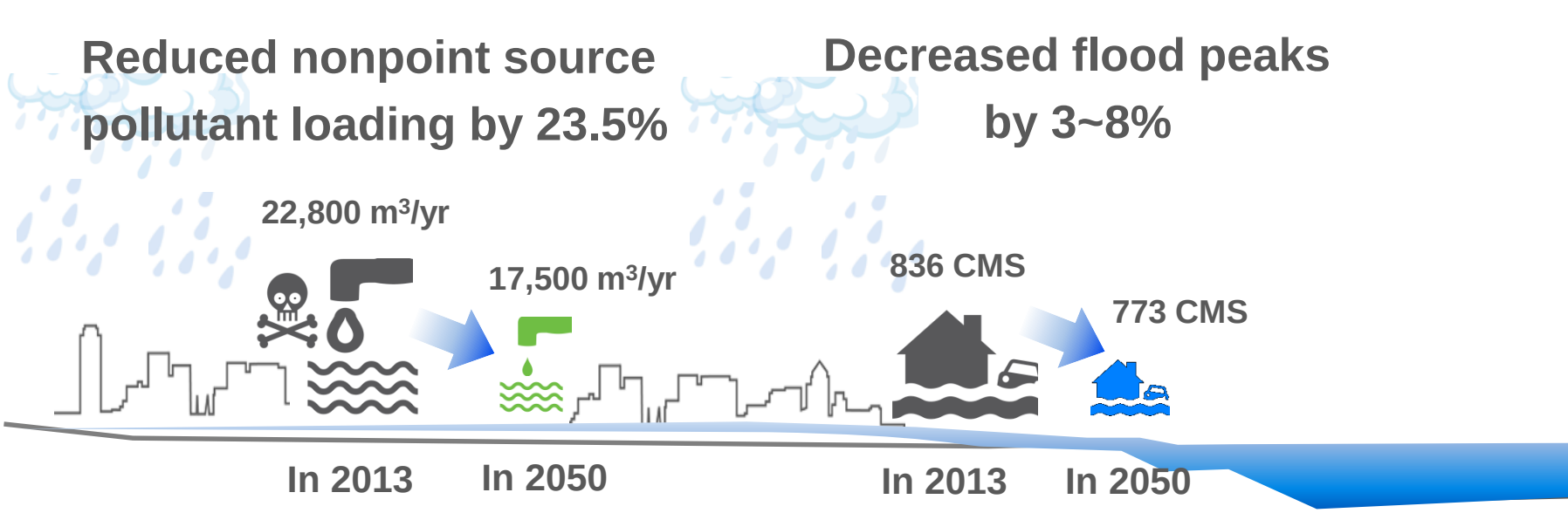
Ecological areas
↑12.8%



Decreased direct surface runoff by 21.9%

Increased deep infiltration by 2.2 times

Mitigation of impacts associated with urban stormwater runoff



Reduction of non-point source pollutants and flood risk

A Revolution in Seoul

Cheong Gye Cheon Restoration Project

Before

After

Cheong Gye Cheon

- **Length: 13.7 km**
- **Width: 20~85 m**
- **Catchment Area : 61 km^2**

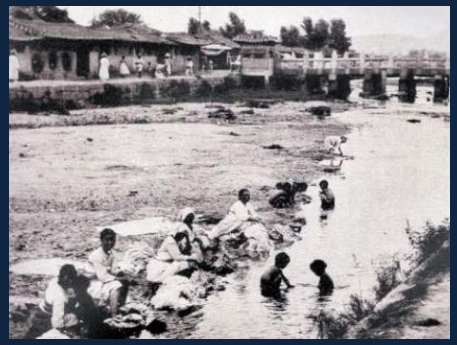
Cheong Gye Cheon

청	계	천
Cheong	Gye	Cheon
Clear	Brook	Stream
Clean	Creek	

History

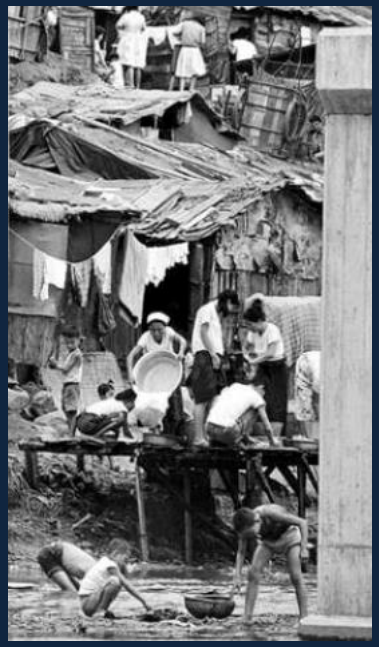
Early 20C

Washing, swimming



- **After Korean Water**

Water Contamination



- **1958~1977**

Covering & Construction of a Highway

Cheong Gye Cheon Area

Korea's biggest commercial area

Over 6,000 buildings
100,000 small shops
and 1,500 street vendors

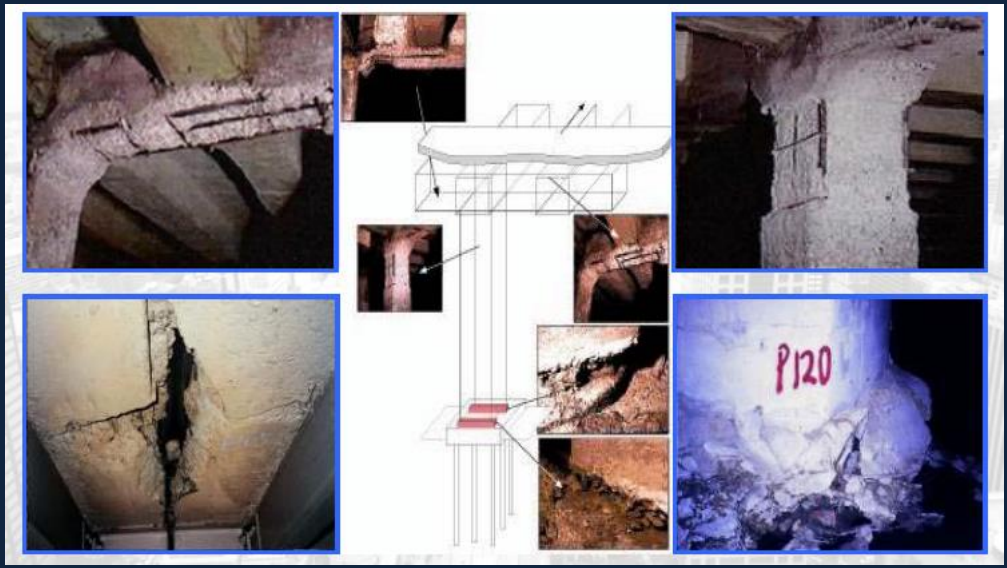
Declining old CBD

- Business headquarters moved to Gangnam, a new Center Business District
- 40,000 population and 80,000 employment reduced in 10 yrs in the area
- Cheong Gye Cheon lost industrial competitiveness

Cheong Gye Cheon Area

Safety problems

- **Inspections resulted in safety grading overall C, partially D or E**
- **Only small cars were allowed from 1997**
- **Maintenance cost soared; 50M USD during 1994~1999**



Decision to restore *July 2002*

- **Paradigm shift of urban management**
  - Development ▶▶▶ High quality of life
  - Environment-friendly city
- **Fundamental solution to safety problems**
- **Recovery of history and culture**
- **Revitalisation of downtown area**
  - Balanced regional development

Project summary

- **Scope: 5.84 km**
- **Budget: USD 386M in 2003,**
- **Duration: Jul 2003 ~ Sep 2005(27months)**
- **Contract: Design-build contract**
  - **invitation for bid: Feb 2003**
  - **bidding: Jun 2003**
  - **starting work: Jul 2003**
  - 3 **construction sections**

Organization

Restoration Center

: plan, execution, cooperation w/stakeholders

Citizens Committee

: restoration principle, public opinion, PR

Seoul Development Institute

: policy, survey, feasibility, research

Conflict management: *Traffic*

- **Cheong Gye Road & the highway**

  170,000 vehicles/day

- **Traffic disaster warned**

  by media and interest groups

- **Project delay**

Conflict management: Traffic

- **Special action for public transportation**
  - **Exclusive bus lanes**
  - **Designate downtown as the area private cars avoided**
  - **Detour**
- **Loading/offloading building materials for stores at night**
- **Traffic distribution near the area**

Conflict management: *Store owners*

- Traffic congestion
- Access difficulties
- Noise & dust due to demolition/construction
- Business decline

Conflict management: *Store owners*

- **Installed consultation offices at the market and conducted detailed surveys for 60,000 stores**

- Continuous interviews and regular meetings: 7,200 persons

Trust formation through continuous communication and integrity of governmental employees

Conflict management: *Store owners*

- Minimize inconvenience for business
  - Provide parking spaces and reduce parking fee
  - Promote stores
- Financial support
  - Low-interest loans
  - Grants for the market remodeling
- The City government purchased products for official use from the stores
- Provide a business centre in an outer area
- Arrange a special market place of 7,500 m^2 for street vendors

Landscape design

Concepts

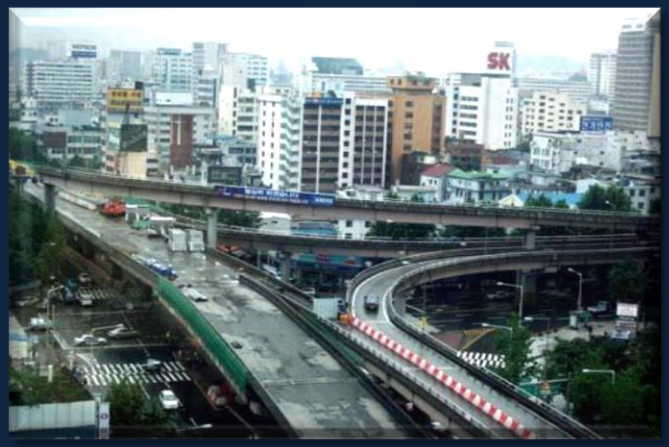
- New green belt with waterfront: West to East
- Gradual transformation from urban landscape to natural environment
- Create ecological biotope and environment
- Thematic places: waterfall and fountains

Bridge design

- Minimize flow resistance
- Create as cultural places
  - artistic landmarks
- Number of bridges: 22
- International design competition

Demolition

- **Covered structure and highway: 5.4 km**
- **Waste (concrete + asphalt): 872,000tons (96% recycled)**

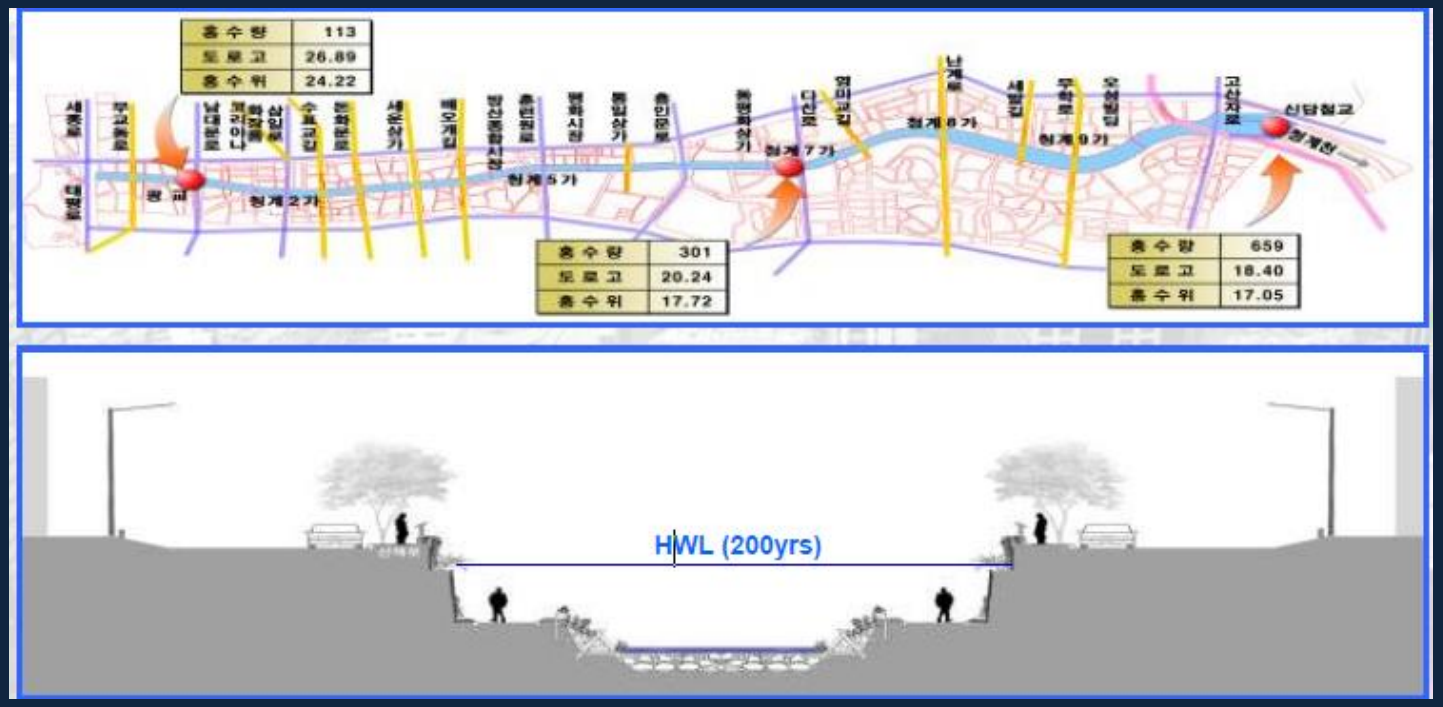


Waterway design

- **Capacity: 200 yrs- frequency rainfall (118 mm/hr)**

Flood level: estimated by a numerical model

and corrected using a hydraulic model



Construction

- **Sewer, road & bridge construction (Sep 2004)**

Construction

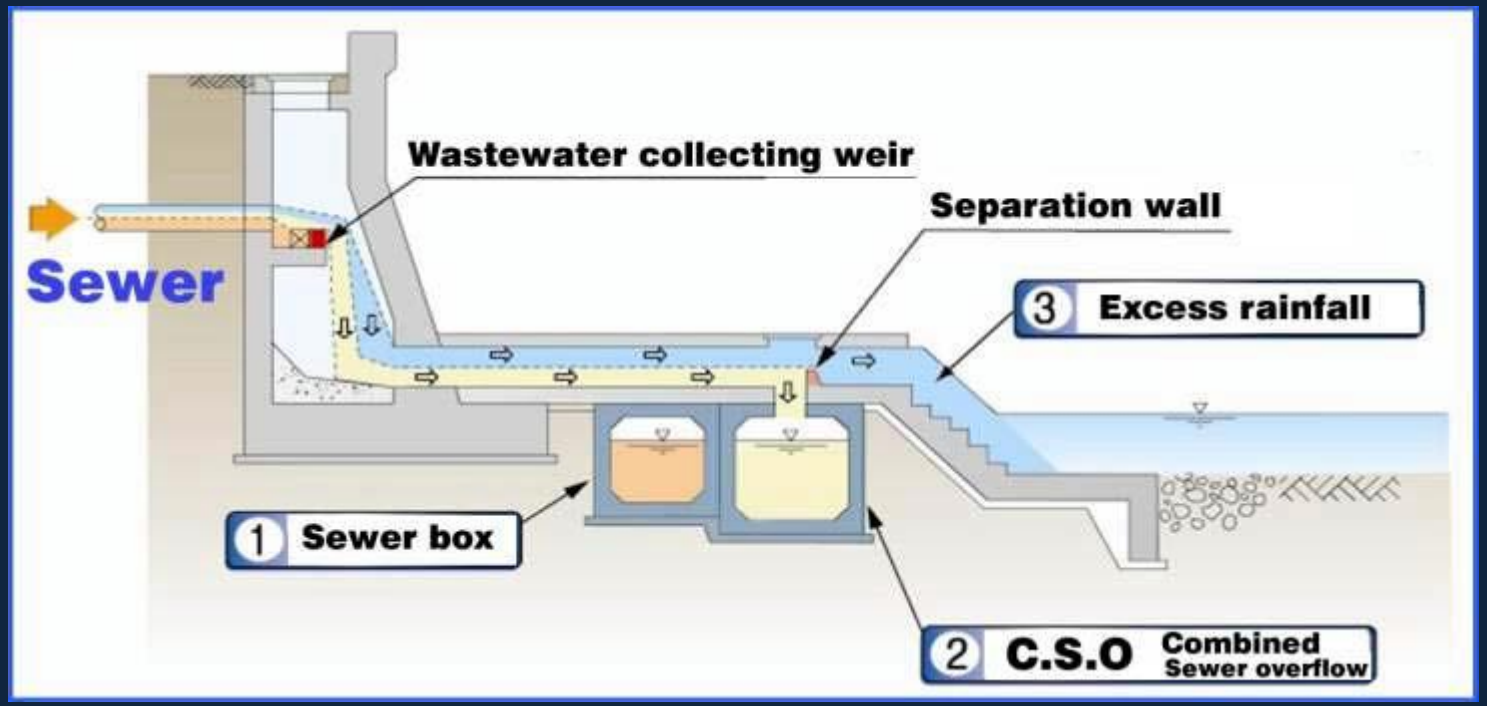
- **Landscaping for the recovered area (May 2005)**

Historic relics restoration

- Preserve or restore historic relics
- Consider current situation: flood, traffic, shops
- Involve specialists
- Site survey: Feb 2003 to June 2004
- Restore 600 yr old bridge:
  Gwangtong gyo
  150 m upstream
  from the original site
- Restore Supyo gyo and
  Ogansu gyo: future plan

Sewer system

- **Combined sewer system for rainfall and wastewater**
- **Capacity : 3 times of estimated wastewater**



Water supply

- **Width: more than 20% of main waterway width**
- **Depth: more than 40 cm**
- **Flow velocity: 0.24 m/sec**
- **Water sources**

  - the Han river: 120,000 m^3/d

  - Underground water from subway stations: 22,000 m^3/d
- **Water quality: better than the 2nd grade**

BOD ≤ 3mg/L SS 25 ≤ mg/L COD ≤ 5 mg/L

Total P ≤ 0.1 mg/L

1st Water supply 1 Jun 2005

Test run and final touch Jun ~ Sep 2005

Opening 1 Oct 2005

Monitoring *Traffic*

- **Speed in CBD**

  Morning peak: 17~18 km/hr

  Evening peak: 12 km/hr

  not very much worsened

- **Vehicle flow: 1.56M ▶ 1.27M (-18.6%)**
- **Subway commuters: +13.7% in Central area**

Vehicle oriented streets ▶ Pedestrians

Monitoring *Environment*

- **Air quality**

  NO_2 69.7 ▶ 46.0 ppb (-34%)

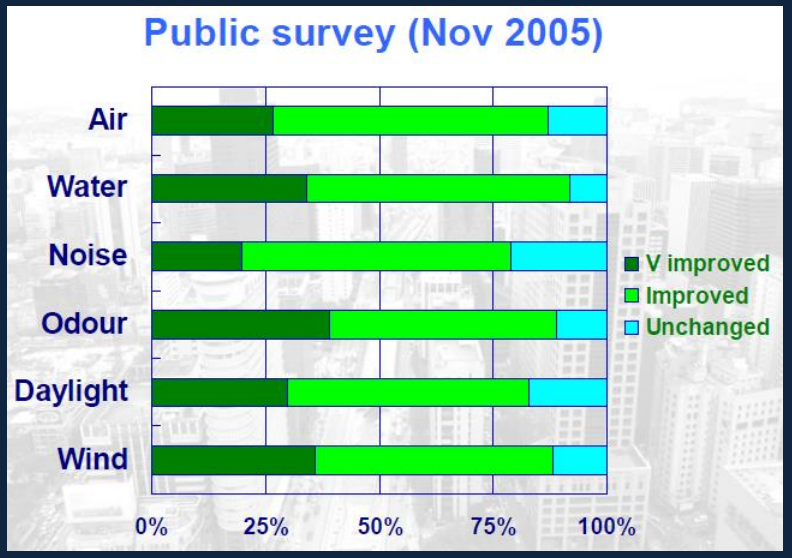
  PM_{10}: 74.0 ▶ 60.0 μg/m^3 (-19%)

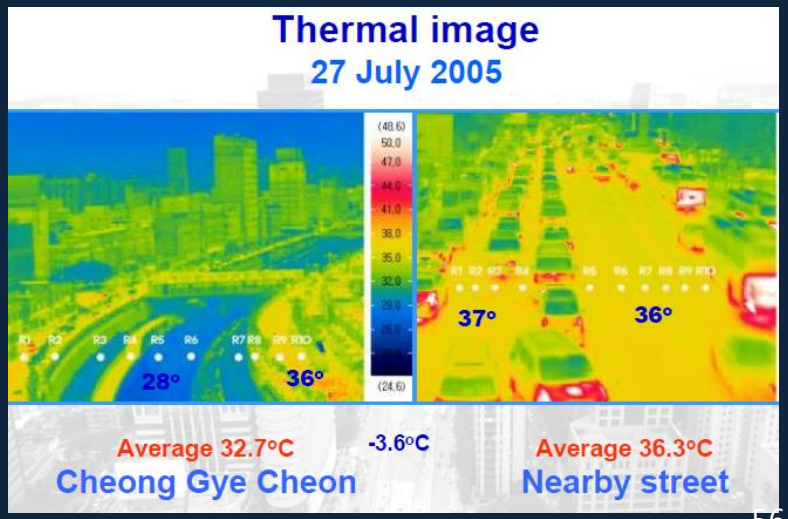
- **Water quality**

  BOD 100~250 ▶ 1~2 mg/L

- **Noise level reduced**
- **Wind corridor created**
- **Heat island effect relieved**

Environmental quality improved





Monitoring *Ecosystem*

- **Fish: 3 ▶ 14** **Insects: 7 ▶ 41** **Birds: 18 species**





Conserve biological diversity* : 98 ▶ 788 *species

145 M visitors during 2005~2012

One of the best places to visit in Seoul

Cheong Gye Cheon in the future

- **Identity as the 600 yr old Capital**
- **A global business district with economic vitality**

Harmony between preservation & development

Further Information

http://english.sisul.or.kr/grobal/cheonggye/eng

anjchan@seoul.go.kr

Thank you for your attention!