Reference Guideline for Restoration by Eco-Compatible Approach in River Basin ver.1

Separate Volume



ARRN Asian River Restoration Network

Asian River Restoration Network

This separate volume was prepared as a supporting material of the “Reference Guideline for Restoration by Eco-Compatible Approach in River Basin ver.1” published in March 2009.

“Reference Guideline for Restoration by Eco-Compatible Approach in River Basin ver.1”

Download URL: http://www.a-rr.net/publication/reference_guideline/docs/ARRN_Guideline1_eng.pdf

Contents

The geographical features of each country and changes in river environment improvement

Rivers in China

Survey of Rivers

In China, there are more than 50,000 rivers with a basin area of over 100 km^2, about 1,500 of them with a basin exceeding 1,000 km^2. Rivers can be classified into two categories: those discharging into seas (outflowing rivers), and the inland rivers which run to depressions in the interior.

The main river systems in China consist of seven major rivers: The Yangtze, Yellow, Songhua, Pearl, Liaohe, Haihe and Huaihe rivers.

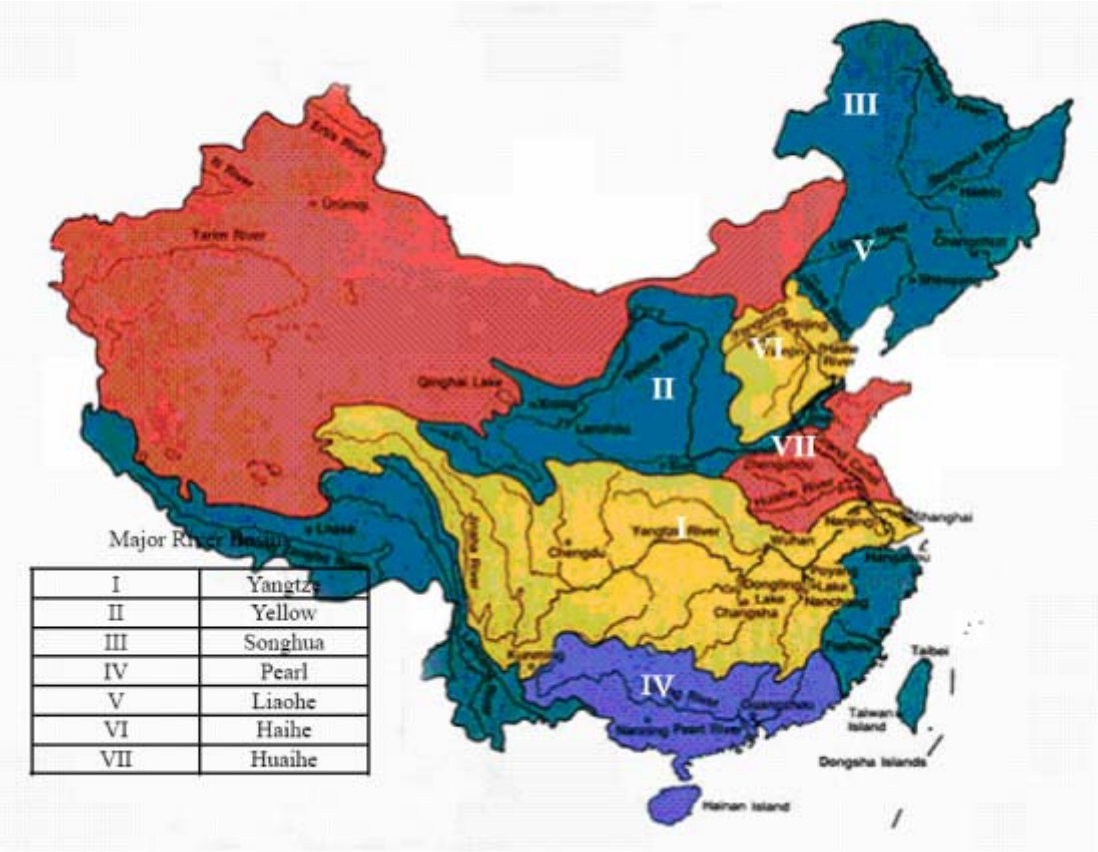


Table1 Date of Seven Major Rivers in Chana

River	River Length (Km)	Basin Area ($10^3 km^2$)	Average Annual Runoff (Km^3)
Yangtze	6,300	1808.5	975.7
Yellow	5,464	752.4	59.2
Songhua	2,308	557.2	74.2
Pearl	2,214	453.7	336.0
Liaohe	1,390	229.0	14.8
Haihe	1,090	263.6	22.8
Huaihe	1,000	269.3	61.1

The main institutions involved in water resources management

the Ministry of Water Resources (MWR)	Responsible for water resources survey and assessment, rural water planning and development, and management and protection of water resources. The Ministry of Water Resources directly supervises the Water Resources and Hydroelectric Power Construction Corporation, and administers 13 higher education institutions and 7 regional basin commissions;
the Local Water Resources Management Department	Responsible for water administration at provincial level. Each province has a Water Resource Bureau responsible for planning, survey, design, construction, operation and management of irrigation, drainage, flood control works, and rural hydro-electricity. Water resources bureaus at the prefecture and county levels are directly responsible for the construction and maintenance of main and secondary canals, associated irrigation and flood control structures, and medium-sized reservoirs;
the Ministry of Geology and Mineral Resources	Cooperates with the MWR in the management of groundwater resources;
the Ministry of Agriculture	Responsible for state agricultural water conservation, construction and management;
the Ministry of Construction	Responsible for urban water conservancy including groundwater exploitation and protection.

Recent river management in China

- Chinese specialists have proposed to take account of ecological and environmental water demand in water resources reallocation since 1980s~1990s to cope with the issues of river zero-flow and water pollution.
- China's water law was enacted in 1988, and principles, general guidelines, and technical standards for water resources management were established.
- In the late 1990s, water sectors of China began to explore the measures to restore rapidly degraded river ecosystems by means of emergency water diversion and achieved initiatory success.
- On September 6 of 2004, Wang Shucheng, the then minister of the Ministry of Water Resources, brought forward for the first time that river basin commission should become the prolocutor of rivers to maintain the healthy life of rivers.
- On August 2009, Chinese Premier Wen Jiabao subscribed the State Council Order (No. 559) of Provisions for Environmental Impact Assessment of New Projects, which demand that environment impact assessment should be conducted on relevant planning of land utilization and exploitation planning of regions, watersheds and sea areas.

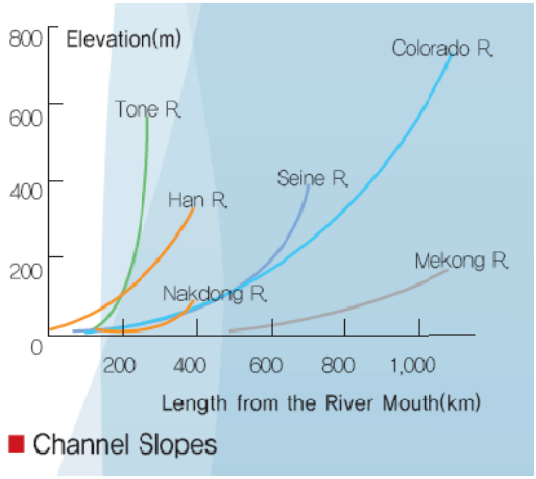
Rivers in Korea

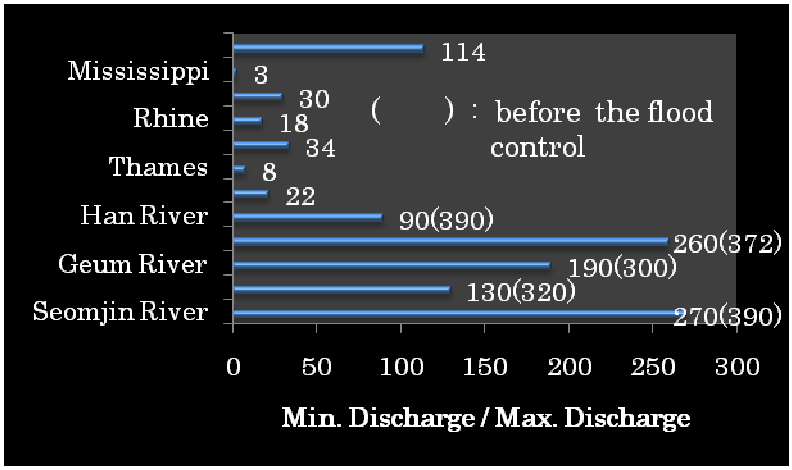
Geographical Characteristics

Most of rivers in Korea flow into the Yellow Sea and South Sea because the east side, where the Taebaek Mountains is, is higher than the west side.

The Han River has the largest basin area and annual discharge in Korea but the longest one is the Nakdong River. Among the ten major rivers in Korea, the Seomjin River has the highest precipitation per unit area in the basin.

Major characteristics of the rivers in Korea are as follows. Firstly, the length of the rivers is relatively short and the channel slopes are steep. Secondly, flooding occurs quickly and peak flood discharge is large. Finally, flow variations are large.



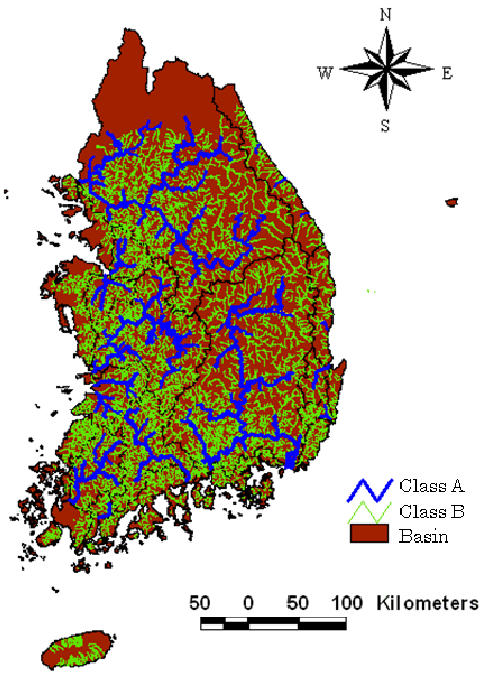


River Administrator

The rivers in Korea are divided into Class A and B defined by the River Act and others defined by small stream regulation Act.

<River Classification in Korea>

Class	No. of River (Length, km)	Administrator
A	61 (2,978.79)	Ministry of Land, Transport and Maritime Affairs (MLTM)
B	3,771 (26,830.50)	Local Government
Others	Not counted	Ministry of Public Administration and Security(MPAS)



Transition of River Management in Korea

1966 ~ Multi-purpose dam plans for flood control, water use and energy development in response to increasing demand for water resources

1976 ~ Comprehensive River Basin Development Plan of the four major rivers, Han River, Nakdong River, Geum River, Youngsan River

1981 ~ Stable water supply, reduction of natural disasters, improvement of Hydro - power resources

1991 ~ Reasonable development, effective use and management of water resources

In the late 1980's: Close-to-Nature river improvement was introduced

1991 ~ 1996: the research on 'River Environment Manage -ment Techniques', developed "Guidelines for Eco-Friendly River Management (revised in 2002)

1995 ~ 1998: river environment improvement projects in Yangjae stream

Yangjae stream

1997 ~ Efficient use and management by active demand management and eco-friendly and sustainable water resources development

1999.8: enacted the River Act

1998 ~ 2006: river environment improvement projects(Ohsan, Gyeongan, Streams etc.)

2001 ~ Sound water use and safe, friendly water environment creation

2002: revised "Guidelines for River Design"

2003~2005: river restoration of Chunggye Stream

2004.1: enacted the River Act

2005: revised "Guidelines for River Design"

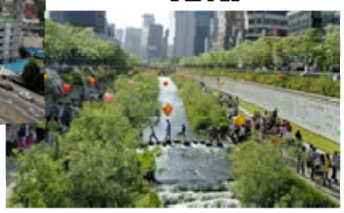
2005~2011: Creating an Eco-friendly River for Each City(50 sites)

2010: Establishing Comprehensive River Improvement Plan(4 major rivers)

Chunggye stream

Before

After



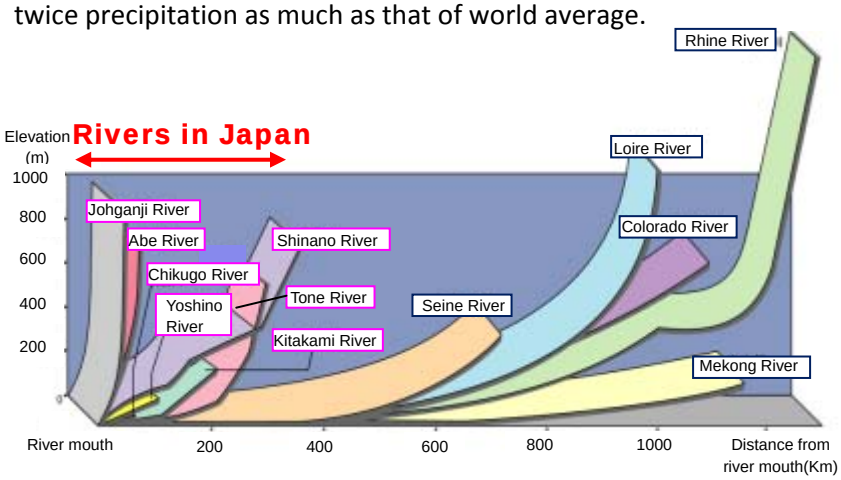
Nakdong river (4 Major Rivers Restoration Projects)

vinyl house removal

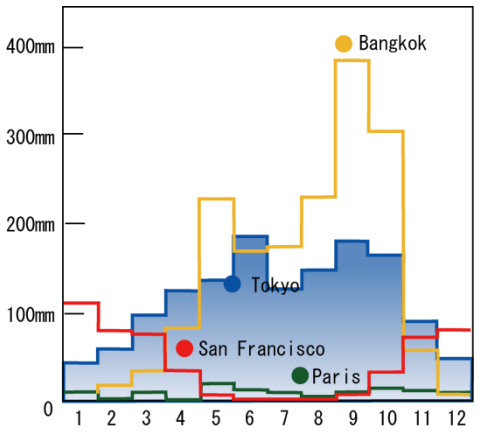
Rivers in Japan

Geographical Characteristics

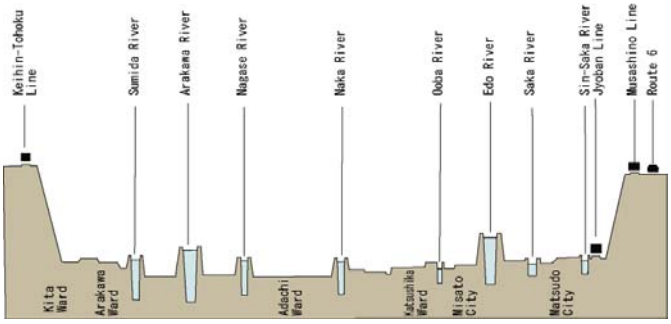
About 70% of Japan is mountains, so rivers are short and steep and flow rapidly and violently. Moreover, Japan has twice precipitation as much as that of world average.



Comparison of longitudinal slope of rivers in Japan and main rivers in overseas



Comparison of precipitation of large cities

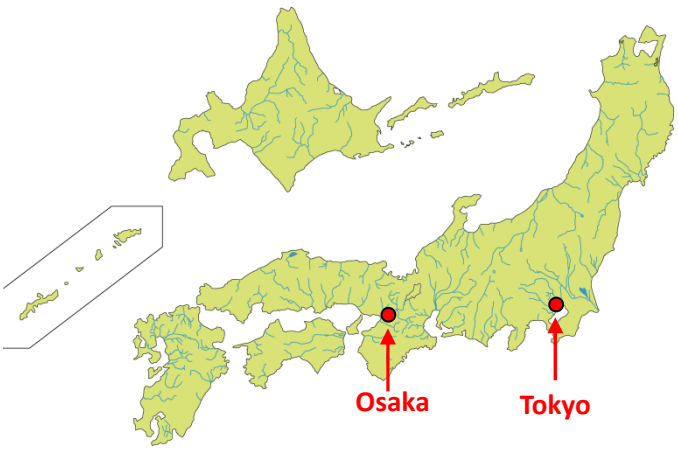


Most of Japanese cities are susceptible to floods because they lie in lowland which are below flood water level of rivers.

River Administrator

In Japan, 109 river systems that are especially important in terms of national land conservation and the nation's economy are defined as Class A water systems, and they are managed mainly by the Ministry of Land, Infrastructure, Transport and Tourism (partly by prefectures). Furthermore, other river systems that play an important role in the public interest are called Class B river systems. Class B and other river systems except for Class A river systems are managed mainly by prefectures.

	Number	River Administrator
Class A River System	109	・MLIT ・Prefecture goverment
Class B River System	2,713	・Prefecture goverment
Other	Not counted	・Prefecture goverment ・Cities ・towns ・villages



Class A River System

Transition of River Management in Japan

Year	Main Event of River Management
1947	Kathleen Typhoon
1947	Establishment of Ministry of Construction (The present Ministry of Land, Infrastructure, Transport and Tourism)
1957	Act on Specified Multipurpose Dams
1959	Isewan Typhoon
1958	Urgent Flood Control Act
1964	Amendment to River Law (Water utilization was enhanced)
1970	Water Pollution Control Law
1981	An ideal method of the river environmental management (River Council report)
1982～	Basic Plan of River Environment Control
1987～	Beginning of Community river improvement model project
1990～	Beginning of Nature-Oriented River work
1990～	Beginning of National Censuses on River Environment
1991～	Beginning of River Improvement for Easy Upwash of Fish
1993	Basic Environment Law
1995	An ideal Method of the Future River Environment (River Council report)
1996～	Beginning of Project of Construction of Waterside plaza
1997	Amendment to River Law (River environment improvement and river improvement were enhanced)
1997	Law for Environmental Assessment
2002	Law for the Promotion of Nature Restoration
2004	Rules for permitting the Use of River Zones (Beginning of Citizen-based City Planning on Practical Use of Rivers)
2004	Invasive Alien Species Act
2004	Landscape Law
2006	Amendment to Nature-Oriented River work (Beginning of Nature-Oriented River management)

Direction of river management

1940s～1950s
The frequency of floods
The investment to flood prevention projects

1950s～1960s
The approach to issues of water resources and water quality in high economic growth

1980s～
Beginning of the river environmental management

River improvement integrated with town planning

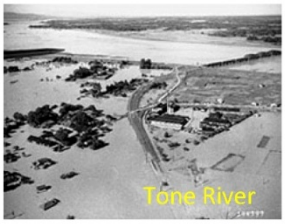
River management focusing on organisms

Citizen participation in river management

Efforts for the entire river system

Nature Restoration

Creation of scenic national land

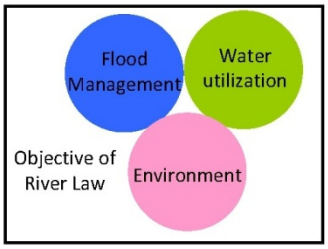


Kathleen Typhoon in 1947

Water quality deterioration

Community river improvement model project

Nature-Oriented River work



River Law was revised in 1997.

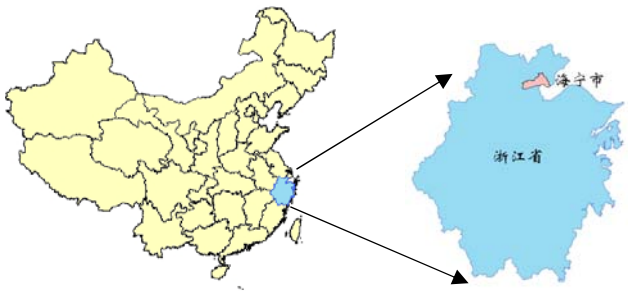
River Restoration

Citizen-based City Planning on Practical Use of Rivers

Case Studies of River Restoration

Xinjiangtang stream

Stream length: 32400m



Background of river restoration

Xinjiangtang stream is a plain river network, which usually has moderate flow velocity. Problems such as sedimentation, water and soil loss, shrinkage of water area, water quality deterioration are ubiquitous in Xinjiangtang stream. Moreover, navigation in the stream gradually faded away in recent years.

Bank erosion in Xinjiangtang stream is mainly due to surface soil erosion caused by rain wash and slope collapse caused by wave scour.

According to preliminary statistics, of the all river sludge, 60% comes from slope collapse, 30% is from surface soil loss and 10% is from decomposed material of plant.

Project Planning and Design

- In combination with the implementation of a research program financed by the Ministry of Water Resources, from 2004 to 2005, China Institute of Water Resources and Hydropower Research was involved in the construction of a pilot project for the ecological restoration of Xinjiangtang stream in Haining County of Zhejiang Province by supplying technical consultation to local water sector.
- The planning and design of Xinjingtang stream follows the concept of design with nature to achieve the multi-purposes.
- Present platform morphological patterns are kept and only a few local modifications are conducted to meet special requirements. The natural meandering and width of the river channel are maintained. Floodplain and riparian wetlands are rehabilitated. Natural cross-section profile is preserved as much as possible. Compound or trapezoid cross section is adopted only in particular conditions.

KEYWORDS

multi-natural river-making, river ecosystem, biodiversity

●By the implementation of these comprehensive measures, the results of Xinjiangtang river restoration project accord with primary design. The standard of flood control is improved; riverbank erosions are effectively controlled; water quality is improved; aquatic animals and riparian vegetation grow well and the project budget is greatly saved.

●By analysis and comparison with historical river treatment achievement, the life cycle is about 10 to 20 years with the only use of traditional river dredging. However, river dredging together with slope protection by use of ecological engineering technology can stabilize channel morphology effectively, and the life span is about 35 to 40 years which nearly double the old life cycle according to preliminary analysis.

●The future management should pay more attention to river dredging, which can save investment and the river training will embark on a more effective circle.

The present Xinjiangtang

The present Xinjiangtang

Zhuanhe River

Stream length: 3700m

Background of river restoration

- The Zhuanhe River, a segment of the north-ring water system, connects the Summer Palace and the Chaoyang Park. Zhuanhe River is an urban river system. Zhuanhe River was covered up from 1975 to 1982, and the river training project started from 2002 to restore the original appearance of its history.
- Along with the development of social economy and people's constant pursuit for better living environment, people have put forward comprehensive requirements on the training of urban lake and river in many aspects including flood prevention, water quality improvement, ecology conservation and restoration as well as cultural landscape etc.
- During the Tenth Five-year Plan period, Beijing focused on the training of water system in central urban and the investments were increased compared with the past years. In addition to traditional river training objectives, i.e. flood control and drainage, new objectives are added in the aspects of landscape and ecological rehabilitations in order to realize the harmonious coexistence of human and natural water.

Project Planning and Design

- Its training follows the planning and design principles of maintaining its natural meandering and width. Stones and wood-like concrete piles, porous and pervious materials and live vegetation are applied for riverbank protection and erosion control.
- The flood control standard is designed with 20 years-flood and checked with 100 years-flood. Wastewater discharge is under strict control and the water surface is expanded to 15-25m.
- To develop tourism, the river is open to navigation. To this end, a new lock, 13 bridges, two docks, and a sluice are completed.

KEYWORDS
water quality improvement, flood control, landscape

The effect and current situation of river restoration

- Six scenic spots including historical and cultural parks, ecological parks, water scenes with stacked stones, waterfront veranda, hydrophilic land and green channel are formed along the river.
- By the principle of maintaining the current status non-disturbance the basis, the bridge built in the Liao Dynasty is restored.
- After river restoration of Zhuanhe River, the biological diversity is significantly improved, and the fish, frogs and other species come back to this river. Vegetation and human landscape are recognized by the majority of the residents.

Chunggye-Stream

River length: 13750m, Area: 50.96 km^2

Background of river restoration

- The Chunggye Stream, which flows in downtown Seoul, was filled up with trash, ground and sand swept from the bare mountains and severely contaminated with wastes from shabby makeshift houses built alongside in 1940 to 1950s. It became a symbol of poverty and slovenliness, being filled up with trash and wastes.
- During industrialization and modernization in 1960 and 1970s, the stream was covered with concrete and a 5.6 km-long, 16 m-wide elevated highway was completed over the stream in 1971 after four working years.
- A multitude of large and small tool, lighting, shoes, clothes, secondhand book stores were opened one after another along the concrete-covered stream, attracting some endless lines of customers. Every day there were hundreds of thousands of vehicles passing through the covered stream and the elevated highway. The area eventually became the busiest and noisiest sector in Seoul. Then, in the 1990s it came to be regarded as a source of intense traffic, health and environmental issues.

Around 1950

After 1971

Efforts for river restoration

- First, Seoul metropolitan government removed the elevated highway and restored the dead stream under highway. The project was worked for 3 years from 2003 to 2005, with the budget of 291million US$ aiming for the restoration of history, culture and environment of Seoul.
- As Chunggye Stream river rarely has water in normal, the water of amount 120 thousand m^3 per day is supplied from Han River and underground water in subway stations. As a result, the water depth of 30~40cm can be maintained.
- Another efforts were made to excavate and restore historical objects and sites in this stream as well as in some other areas of the city.

KEYWORDS
open space in downtown, long history and splendid cultures. green area.

Current situation and future prospects of river restoration

- Seoul has a clean water flow and a clean environment for fishes and plants in downtown. Besides, two-lane roads were built on each side of the stream. The 22 bridges and the paths made on both side of stream help people take a rest alongside or nearby.
- This work is making people regain the past pride of those living at the heart of nation's long history and splendid cultures.
- Removal of covered concrete and restoration of stream gives the citizens the good open space and nature in downtown area and enhancement of the quality of life.
- The City of Seoul are planning to expand green areas in residential area to 810 acre and to widen and develop access roads to the Han river. Also, the city has set the connective projects to build up a citizen's square and downtown culture/tourism belt designed to turn the downtown into a place for tourists, along with the Chunggye Stream river.

River Management Division Seoul Metropolitan Government

Reference Materials/Site
(English)→http://www.sisul.or.kr/grobal/cheonggye/eng/WebContent/index.html
(Korean) →http://www.cheonggyecheon.or.kr/

Osan Stream

River length: 29.5km, Area: 152.83km^2

Background of river restoration

- Urbanization and industrialization, which started in the early 1960s, especially accelerated the degeneration of river ecosystems. Pavements with non-percolated material such as asphalt and concrete in urban areas caused lack of groundwater recharge and thus lack of stream flow recharge.
- In 1994, Osan Stream was selected as a pilot project site and the project was completed in 2003.

Efforts for river restoration

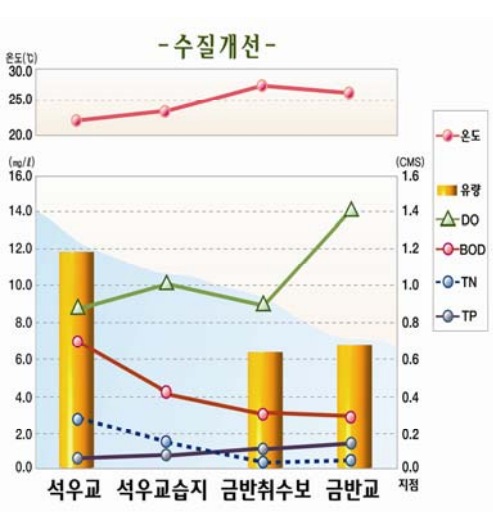
- The river was improved to a close-to-nature river using natural materials.
- Parking lots were removed to make an ecological park and farming was banned on the flood plane.
- Gently sloping levees(1:5)were constructed and ecosystem was restored.

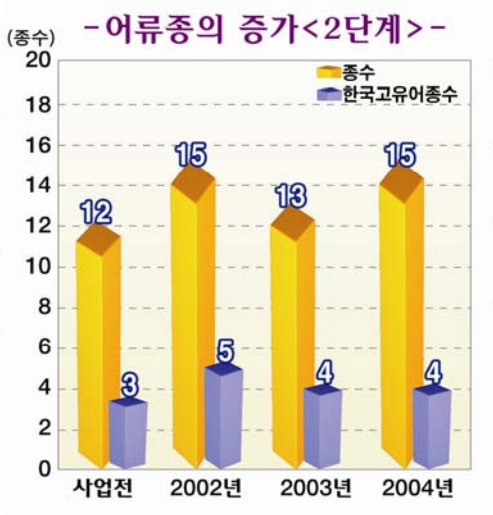
Improvement of Concrete parking lots

Improvement of ecosystem by gently sloping levees

Current situation and future prospects of river restoration

- The BOD of the Osan Stream reached 2-5ppm, and it has remained stable to meet environmental standards after the project.
- Response of local residents has increased due to greatly increased use of waterfront park.
- Government is monitoring to develop technologies about various environmental methods.





Stepping stone

Foot protection stone

Yangjae Stream

River length: 15.6km, Area: 0.5km^2

Background of river restoration

- The Yangjae Stream, originating from a hilly and mountainous region, is located at the southwest part of the metropolitan Seoul, and flows though Gwacheon City. When large-scale housing projects were performed in 1970s, the river was straightened to provide flood protection.
- Because of urbanization, the BOD of the Yangjae Stream river reached 15mg/l and the river became a sewer-converted river.
- Yangjae Stream "park river" project was carried out in 1995, to meet increasing interests in natural environments of local residents as living standards were improved.

Efforts for river restoration

- The local government carried out the environment improvement project and some companies joined in voluntarily.
- Various measures were taken to improve water quality. For example, a sewage system was improved and a water purification system was installed in the basin. The river was improved up to a close-to-nature river.
- The Yangjae Stream has various waterfront facilities. (Swimming areas and rice farming experience place).

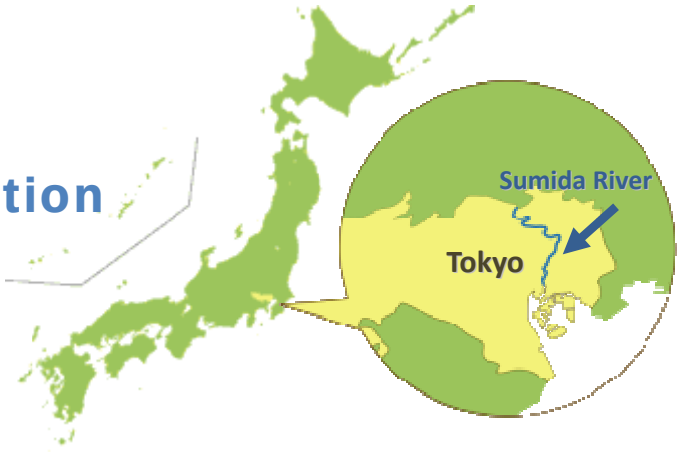
Current situation and future prospects of river restoration

- Today, this area boasts 10,000 visitors daily who come to see its changes and experience a refreshing green oasis within suffocating black smog and mob of the city. And various cultural events are held in waterfront such as film festivals and musical concerts.
- The BOD of the Yangjae Stream reached 2mg/l. This is an environmentally friendly area that is home to 36 different kinds of birds and about 22 types of fish and marine life.
- Gangnam-gu (District) office offered a new method of purification to improve river environments.

- River Management Division Gangnam-gu office
- Reference Materials/Site
  (English) →http://english.gangnam.go.kr/
  (Korean) →http://www.gangnam.go.kr/

Sumida River

River Length:23500m　Area:690.3km^2



Background of river restoration

- In the Edo period (1603-1868), as the city developed, a waterfront was developed in the Sumida River and many people gathered for boating and fireworks.
- In the 20th century, due to an increase in population and plants along the river, the water quality deteriorated. In particular, in the period of high economic growth (1950 to 1960s), BOD reached 40mg/l, the deterioration of the river environment reached a peak, and a bad smell drifted into surrounding areas.
- Around the same period, levees were constructed to protect the capital city from tidal waves. Because linear levees separated local residents from the waterfront, the landscape that had long been loved by people and the bustle of the waterfront were lost.

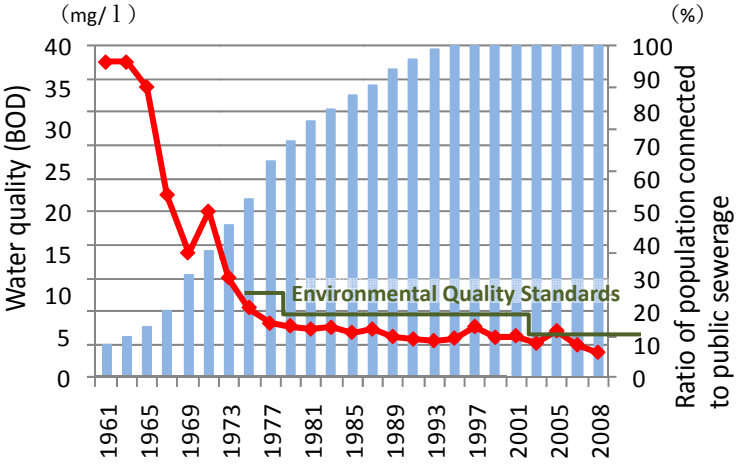
(Source: Tokyo Metropolitan Gov.)

Around 1967

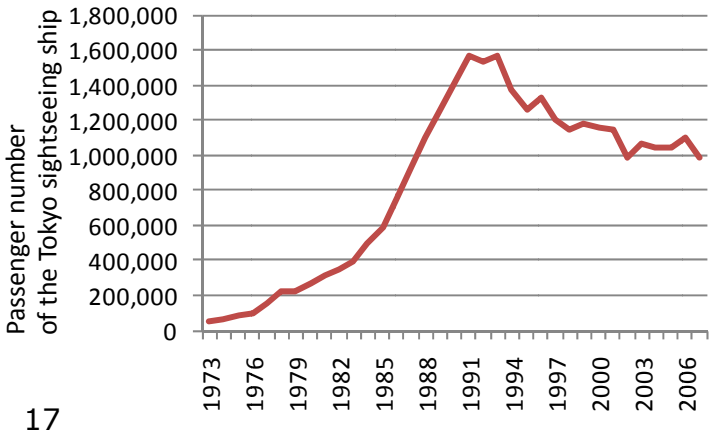
linear levees

Efforts for river restoration

- Various measures were taken to improve water quality. For example, a sewage system was reconstructed in the basin (diffusion rate increased from 10% in 1961 to 100% in 1995); regulations on plant effluent were tightened; and water was drawn from the Tone River to purify river water.
- Gently sloping levees and high standard levees were constructed as substitutes for linear levees to increase durability. At the same time, river edge terraces (promenades) were improved and levees were forested to improve water amenities.



Gently sloping levees



KEYWORDS

Water quality improvement, Restoration/improvement of waterfront area (River walk)

Current situation and future prospects of river restoration

- In 1978, the BOD of the Sumida River reached 7.4mg/l, and it has remained stable to meet environmental standards since then. With the improvement of the sewage system and activities of citizens' groups, water quality was significantly improved. This led to the recovery of fish, aquatic birds, and aquatic plants along the shore.
- As the bad smell was gone and water amenity space was improved, the waterfront of the Sumida River attracted many people again. Fireworks and boat races, which had been suspended for a while, have now been restored. The river has become popular among tourists from inside and outside the region with more sightseeing boat services offered.
- The Tokyo Metropolitan Government plans more improvement, positioning increased attractiveness of waterfront areas including the Sumida River as an important pillar of its future urban strategies.

The present sumida river（2010）

The present sumida river （2009）

boat races

■ River Management Division　Tokyo Metropolitan Gorvenment

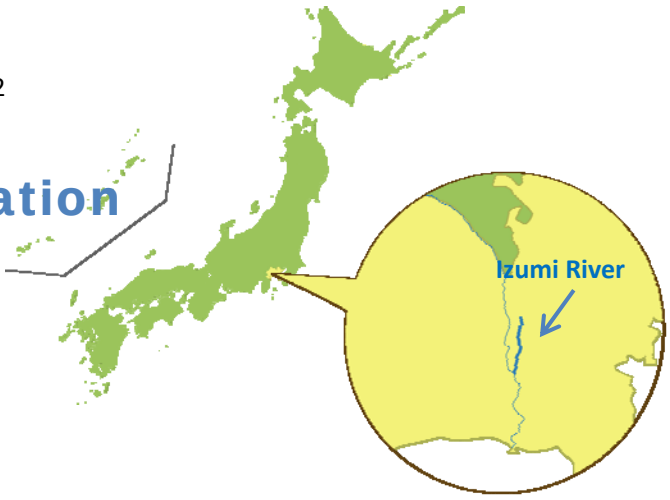
■ Reference Materials/Site

(English)→http://www.a-rr.net/jp/en/waterside/domestic/07community_and_urban_river_re/570.html

(Japanese)→ http://www.a-rr.net/jp/waterside/domestic/index.html

Izumi River

River Length : 11,500m　Area:11.5km^2



Background of river restoration

- The Izumi River is a small river, flowing low ground in the bottom of a ravine lying between a plateau in the west side of Yokohama City. The headwaters spring from the cliff line of the ravine door.

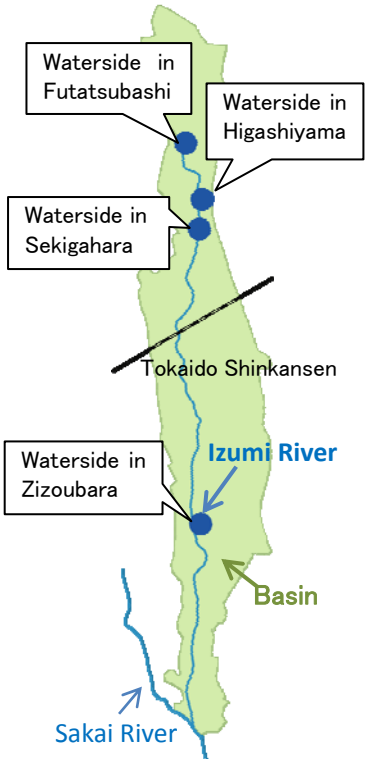
- The urbanization of the basin has advanced rapidly near the center of Yokohama though farmlands and slope woods still remain in the middle and lower basin. In the 1970s, the river had been immediately flood with just a little rain. Therefore, the shore was covered by steel sheet piles. The riverbed was also dug deeply, and then it made residents hard to approach the riverside. The water quality of the river had been deteriorating and exactly “Sewage River”.

Efforts for river restoration

- In Yokohama City, the study of "Izumi River environmental improvement basic plan" was started in 1987. Through workshops and other activities by elementary students in the basin, an integral improvement plan to make effective use of nearby river, involving park maintenance, green space conservation and other projects, were developed.
- Afterwards, the plan, "Home river construction project”, received approval from the Ministry of Land, Infrastructure and Transport Tourism in 1991, so the implementation of the plan has started. Basic improvements such as "Waterside in Zizoubara" in1994, "Waterside in Higashiyama" in 1996, "Waterside in Sekigahara" in 1997 and "Waterside in Futatsubashi” in 1998 were carried out.
- For instance, widening the river and reconstructing the flow path and waterside were implemented in "Waterside in Sekigahara" so as to be familiar with surrounding landscape. Besides, an integral improvement, which is associated woods in slopes on the left bank side with the whole river space, was carried on. And so a green rich and popular space with residents was created.

Before maintenance
(Waterside in Higashiyama)

After maintenance
(Waterside in Higashiyama)



Izumi river basin and
its basic improvements

KEYWORDS

Integral improvement with city planning, multi-natural river-making, and the citizens' participation

Current situation and future prospects of river restoration

- Improved waterside is giving a lively public space for residents in their daily life, as children are fishing crayfish and plying with water and people are enjoying walking along riverside.

- The Izumi River basin has eight waterside protection associations. Local residents are regularly participated in cleaning the river. Through these activities, more people get feeling closer to and interested in river, which make the riverside more community-based space.

- In 1996, some fish (Carassius and loach) were recognized for the first time in the river. According to the monitoring survey (2005-2006), 18 fish species were found in the Izumi River. It is expected that the number of fish species are increasing and those phase are being varied. It is assumed that these changes are related to the improved water quality, which is realized by the implementation of improving environmental-friendly river path and the increase of sewerage coverage (BOD: more than10mg / l until1993 □ below 5mg / l since 1996) .

- The spatial designs for improving "waterside in Higashiyama" and "waterside in Sekigahara" received "Civil Society Award for Best Design Award" in 2005.

- "Izumi River Valley water cycle reproduction Action Plan", was established in 2002. In this plan, policies for recovering water to the 1950s quantity and quality and restoring clarified spring water are being promoted.

Current landscapes near the waterside in Higashiyama

■ River Management Division　Yokohama City

■ Reference Materials/Site

(English)→http://www.a-rr.net/jp/en/waterside/domestic/07community_and_urban_river_re/1075.html

(Japanese)→http://www.a-rr.net/jp/waterside/domestic/04/881.html

Kushiro River

River Length：154,000m　Area: 2,510km^2

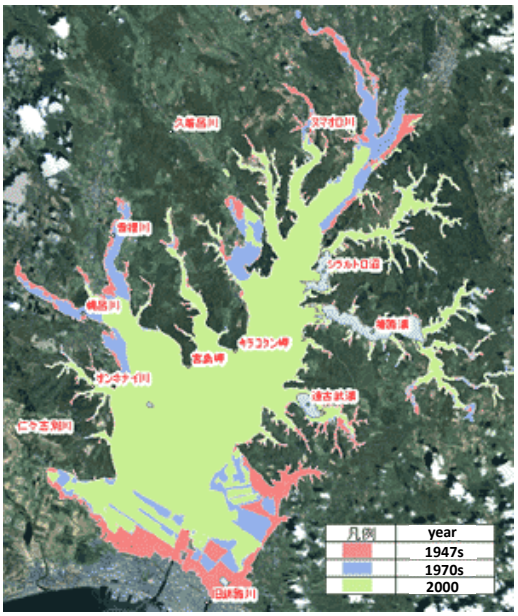
Background of river restoration

●Kushiro wetland situated at the lower river basin of Kushiro River, covering 20,000 ha, is the largest wetland in Japan. It has become a valuable habitat of plants and animals. In 1980 it has been registered as Japan's first Ramsar Site wetland.

●After a great flood caused serious damages in 1920, the Kushiro River flood control project was began with an implementation of straitening the river line. As the valley has been developed in parallel with the project, some wetlands have turned into farmlands or urban areas and surrounding forests has been cut off.

●These land-use changes and river renovation caused a decrease in the inflow of landslide and groundwater, and a reduction in wetland, and accelerated dryness. The wetland reduced by around 20% in the past 50 years, which has been a significant impact on wetland ecosystems and landscapes.

Kushiro urban areas in the lower Kushiro wetland

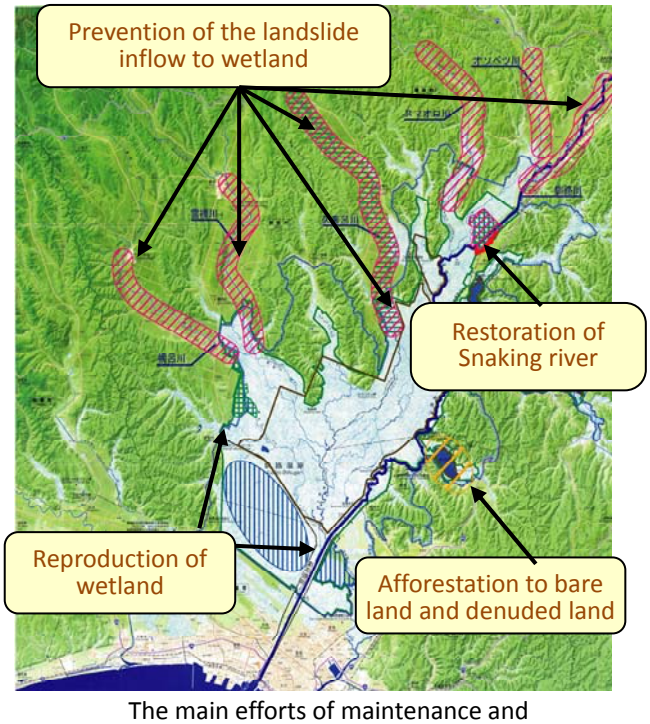


Changes of wetland area from 1947 to 2000's (Ministry of Environment)

Efforts for river restoration

●The Ministry of Land, Infrastructure, Transport and Tourism set up the study committee in 1999, and carried out the environmental preservation of the Kushiro River. Followed by the enactment of the Nature Restoration promotion Act, in 2003 "Kushiro wetland natural restoration conference" was established by the union of the Ministry of Land, Infrastructure and Transport Tourism, the Ministry of Environment, the Ministry of Agriculture, Forestry and Fisheries, the local residents, NPO, the local organization and the people from academic background, therefore Kushiro river natural restoration project was moved into implementation.

●This nature restoration project is targeting the previous wetland environment, which was before registered as Ramsar site and started rapid deterioration. In order to prevent landslide inflow to the wetlands, wide-ranging efforts over the entire wetland, i.e. restoration of the snaking river, afforesting the bare land and denuded land, and maintenance and restoration of the wetland, has been conducted.



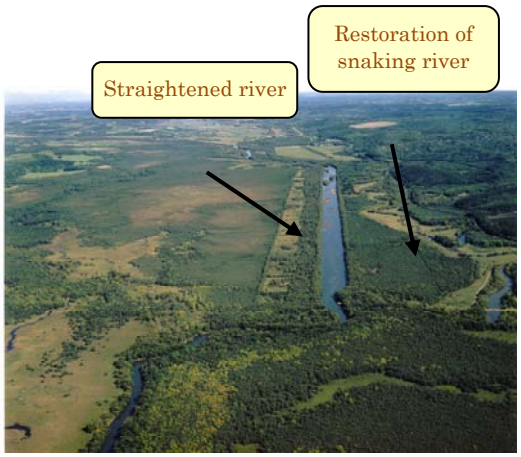
The main efforts of maintenance and reproduction of Kushiro wetland

KEYWORDS
natural reproduction conference, protection and rebirth of marshland, and restorations of meandering stream

Current situation and future prospects of river restoration

●The nature restoration project of Kushiro wetland is targeting "Qualitative, quantitative recovery of the wetland ecosystem", "Restoration of the circulation that maintains the wetland ecosystem", and "promoting sustainablly wetland-related socoiety" for the entire valley. It is considered that relevant administrative agencies, local governments, experts, local residents and landowners and citizen groups such as NPO etc, that compose the natural restoration conference, play their roles and promote diverse nature restoration.

●It is assumed to check the implementation of these measures every five years, and review them and evaluation methods based on the progress every ten years.



Snaking river restorations for straightened river (currently underway)

object	approach	methods
Qyalitative, quantitative recovery of the wetland ecosystem	Protection and restoration of wetland ecosystem, habitat of rare species	Protection of healthy wetland Protection and restoration of habitat of rare species in wetland Protection and restoration of habitat of rare species in lake Recovery and restoration of pristine wilderness area Development of management approach of nonnative species
	Protection and restration of river management	Protection of rivers with healty envitonment Recovery and restoration of existing river dynamizm Protection and restoration of various environment, i.e. riparian forest Protection and restoration of longitudinal continuity of river
Restoration of the circulation that maintains the wetland ecosystem	Protection and restoration of forests in the hilly side area side of rivers	Protection of forests with healty function Recovery and resetoration of forest in bare area Recovery, protection and renovation of forest ecosystem in treeless and afforestation area Awareness and renovation of
	Reovery of water sycle and physical cycle	Understanding water and physical cycle mechanism in the basin of Kushiro River Protection and recovery of water quality of inflow
	Controlling sediment inflow to wetland, river and lake	Understanding sediment production, sediment transpotation, and sedimentation mechanism Controlling outflow at sediment source Alleviating sediment inflow to wetland
Promoting sustatinablly wetland-related society	Promotion of continued utilization and environmental education	Enhansing environmental eduation and networking transmission of information and promotion of resident participation in nature restration project Developing guidelines and rules on utilization of wetland Study a way of sustainable development of local industry Protection of beautiful landscape

●The Kushiro River and the Kushiro wetland are eminent sightseeing spots of Japan, where a lot of tourists visit for canoe and nature observation, besides known as a nesting site of Japanese crane that is a special national natural treasure in Japan. Because the nature restoration project of Kushiro wetland is one of the pioneering cases in Japan, further promotion is expected to achieve its objectives.

Japanese crane

Kushiro wetland

Canoe

(Photo：Kushiro Development and Construction Department)

■ River Management Division　Ministry of Land, Infrastructure, Transport and Tourism (Hokkaido Regional Development Bureau)

■ Reference Materials/Site

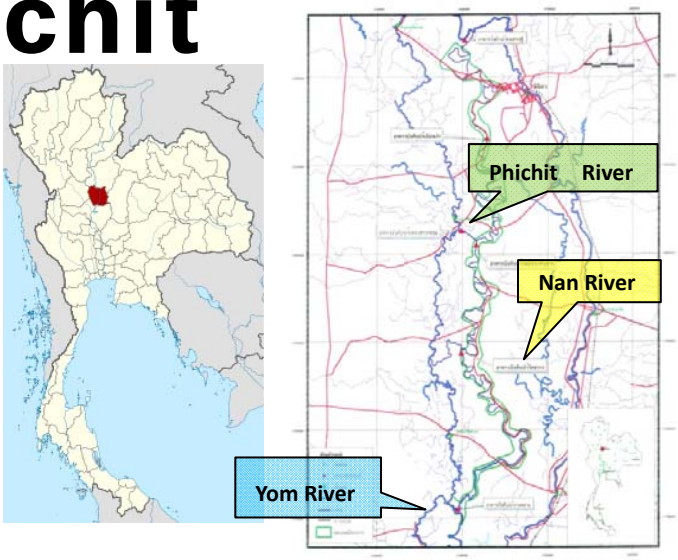
(English)→http://www.a-rr.net/jp/en/waterside/domestic/restoration_project/567.html

(Japanese)→http://www.ks.hkd.mlit.go.jp/kasen/kushiro_wetland/index.html

Mae Nam Phichit

(Phichit River)

Origin: Nan River Outlet: Yom River
River Length: 127 Km.
Catchment's area: 91.10 Km^2.
Average Annual Rainfall: 1,225.70 mm.
Average runoff: 20.61 m3/s



In sub-basin of Upper Chao phraya River, Phichit Province ,THAILAND

General Information

Mae Nam Phichit (Phichit River), in fact old Nan river, in the past was shallow with some part dried out due to the way changing of Nan river, eventually turn into dead river.

The Phichit river passes and separates from Nan river through various communities in Phichit province and flows to meet Yom River at Bang-Klan sub-district in Pho-Talae district. It has been various names according to the places that the river passing.

Background of the river

Phichit is the name of a province of Thailand, located in the north of the country. The rivers Nan and Yom flow through the Phichit province, before they join shortly to the Chao Phraya river is formed. The Origin of Mae Nam phichit is Nan rivers at Dong Settee village and flows to Yom river at Bang Klan temple. Total length is 127 Km. The province mainly consists of low fertile river plains, making rice and lotus the main crops.

Problem occurred in Phichit river

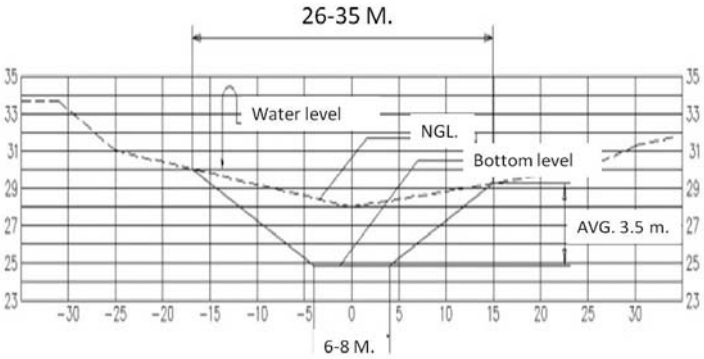
The Phichit river is shallow due to accumulated sediment bring to the problems of water shortage in dry season and flood in rainy season adding with water pollution by waste water released to the river from the community near the river. So that the Phichit river need to be dredged and rehabilitation.

Phichit river before restoration

Objectives

One of the mandates of the Department of Water Resources (DWR) is water resources management, development, conservation and rehabilitation which aim to systemize water resources management in the river basins. To conserve and rehabilitate water resources in Phichit river, DWR have the plan on conservation, development and rehabilitation of Phichit river the activities is follow:

- Improvement and rehabilitation of Phichit river by dredging existing shallow river due to accumulated sediment. More water can be stored, drainage is faster, that contributes to better ecosystem.
- Construction of control structures in the river in order to increase storage capacity of natural water and make utmost benefit from the control structures.

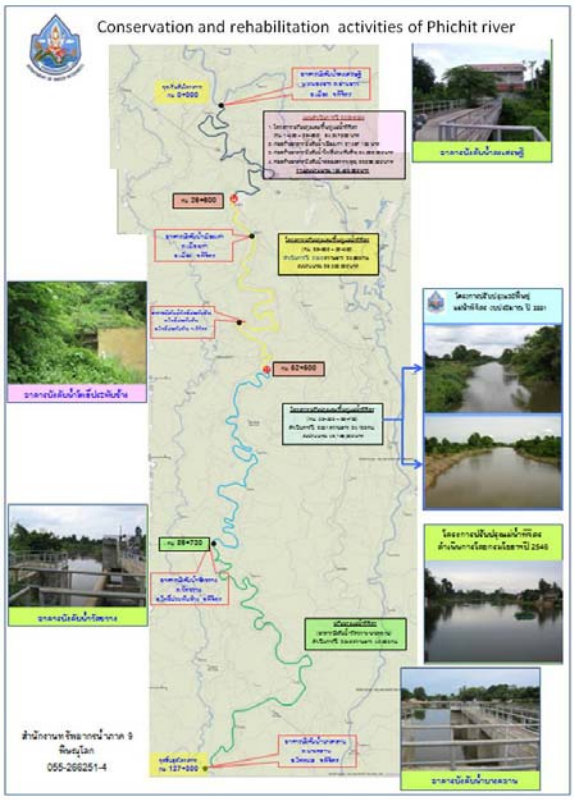


X-section of dredging

Summary of implementation

To improve and rehabilitate of Phichit river, DWR has been allocated the budgets are as follow :

- In the fiscal year 2003, 2008, Phichit river project previous stage and stage I : To excavate and channel improvement of Phichit river for 75 km. and Bang Klan , Wat Kwang and Dong Settee control structures at the amount of 232 million baht.
- In the fiscal year 2009, Phichit river project stage II : To excavate and channel improvement of Phichit river for 22 km. at the amount of 34 million baht.
- In the fiscal year 2010, Phichit river project stage III : To excavate and channel improvement of Phichit river for 27 km. at the amount of 60 million baht.



In the next fiscal year

DWR have the plan to implement Phichit river are as follow:

- In the fiscal year 2011, Construction of 3 control structures in Phichit river (Meang Kaow, Po Pratubchang and Suppakhun control structures) about 70 million baht.
- In the fiscal year 2012, Construction of pumping station and facilities at Dong Settee about 25 million baht. Equipped with remote control system about 20 million baht.

Expected benefits

Phichit river has been improved and rehabilitated to have more efficient storage capacity and benefit gained from the project are as follow:

- to solve the problem of water shortage for domestic use by increase water capacity in the river
- water for agricultural use (benefit area is 43,700 Rai or 7,000 ha)
- flood reduction (The storage capacity after channel improvement is 153,350 m3)
- the ecosystem of the river revitalized
- the better of people living condition and increasing participation of people in water resources management
- tourism and recreations


Phichit river after restoration

River Skerne

River Length ：4,000km Area：255km^2

Background of river restoration

●The River Skerne is located in the town of Darlington, flowing through urban parkland surrounded by housing and industry.

●Over the past 200 years it has undergone straightening and deepening for flood control and drainage. Much of the floodplain has been raised high above the river by industrial waste tipping.

●Housing development, gas and sewer pipes and electricity cables, further limited restoration opportunities as is typical of urban rivers elsewhere.

●The River Skerne Restoration Project was promoted as a part of the EU-LIFE demonstration project since 1994. This aimed desseminate information about river restoration methods as an integral part of sustainable water management and to promote further river restoration initiatives.

Efforts for river restoration

● The Restoration Project objected restration of 2km of the river in terms of physial features, flood management, habitat diversity, water quality, landscape and access for the community.

●The physical restoration of river features was achieved, where constraints allowed, by: re-meandering the course where space permitted; cutting a new channel and filling the old; re-profiling the river bank to more natural shapes.

●Where the straight course was retained it was enhanced by riffles and in-stream flow deflectors, forcing the water to change direction, forming pools and shallows. The banks were re-profiled to a gentler, safer angle and waterside planting used to create ledges.

●To restore the ecological value of the river, the project was carried on by improving the sewer systems and riverside outfalls, creating shallow wetlands on the lowered floodplain, and introducing different river features to encourage natural processes and create new habitats.

●Local community involvement and understanding was implemeted to make the river accessible, attractive and interesting to the people of Darlington, by community input in design, planning planting and education, providing new footpaths, footbridge and access to the rivers edge, landscaping to create a pleasant ‘greener’ environment.

River Skerne prior to restoration works
(The River Restoration Centre)

KEYWORDS
Meanders and Deflectors, Footpaths and Access, Sewers and Outfalls, Backwaters, and Public Involvement in Landscaping and Planting

Early results in the river function

●Improved function of the River Skerne by the project are listed in the table below,

River function	Results
Flooding	Shallow flooding of the planted grassland removes silts from the river. Waders feed in the pools.
Habitat	The riffle and deflectors have created pools and shoals resembling a more natural River Skerne.
Wildlife	Previously absent or uncommon, swans, fish, dragonflies and the protected water vole have been recorded.
Water quality	The quality of surface water entering the river has been improved, whilst visually, the removal of outfalls has had an immediate effect.
Planting	Trees, shrubs, plants and bulbs enhance the informal park. Riverside flowers add colour and life.
Landscape and recreation	Visually much more attractive. New paths and a new footbridge complete the theme of 'bringing the countryside into town'.
Education	Universities/colleges have shown great interest and local schools have helped with planting and monitoring.

Constructed footpath (The River Restoration Centre)

Riffles where re-meandering was not possible
(The River Restoration Centre)

Willow mattress revetment under construction, 1995
(The River Restoration Centre)

Created Backwaters and Wetlands (The River Restoration Centre)

Benefits and Monitoring

●An independent survey after the complition of the project showed that local residents mostly agreed with the achievement of the projects' objectives; increase in wildlife and habitat, improved landscape quality, improved recreation, reduced risk of flooding and good value for money.
●Overall 82% of the local community approved of the River kerne Project just one year after the majority of work had been completed. Even after two years passed, the River Skerne is still attracting much attention, receiving several awards such as Royal Institute of Chartered Surveyors Award in the Regeneration category and Civic Trust Special Award for Landscape.
●A comprehensive monitoring programme has been running since the start of the project and will continue for at least four more years.

Reference Materials/Site

The River Restoration Centre
(English)→http://www.therrc.co.uk/

Kissimmee River

River Length : 216,000m Area : 7,700km^2

Background of river restoration

- The Kissimmee River once meandered for 103 miles through central Florida. Its floodplain, reaching up to two miles wide, was inundated for long periods by heavy seasonal rains. Wetland plants, wading birds and fish thrived there.
- Between 1962 and 1971, as part of the Central and South Florida Project, the river was channelized and two-thirds of the historical floodplain was drained. Excavation of the canal and placement of the spoil material destroyed one-third of the river channel.
- The canal achieved sognificant flood reduction benefits, however the channelization also harmed the river-floodplain ecosystem such as wintering waterfowl, wading bird and game fish populations.
- Environmental restoration project began in 1999 – a 50-50 partnership with the South Florida Water Management District and the U.S. Army Corps of Engineers – is currently projected to be complete by 2014.

New meandering Kissimmee River
(ORLANDO SENTINEL / December 22, 2009)

Efforts for river restoration

- The Restoration project is intended to restore over 40 square miles of river and floodplain ecosystem including 43 miles of meandering river channel and 27,000 acres of wetlands.
- In the upper basin, restoration efforts consists of improvements to two canals, changes in managing water levels in Lakes Kissimmee, Hatchineha, and Cypress, as well as the acquisition of land.
- In the lower basin, approximately 22 miles of the Canal will be backfilled. Also excavating nearly nine miles of river channel, and removing two water control structures and locks.
- The project developed a comprehensive evaluation programme named 'Kissimmee River Restoration Evaluation Programme'. It takes performance measures to predict ecological changes that are expected to result from the project, including changes in hydrology, water quality, and major biological communities such as plants, invertebrates, fish, and birds.

Kissimmee River Restoration Project
(C-37 Canal Widening Public Meeting (November 19, 2009), US Army Corps of Engineers)

KEYWORDS
Meanders, Restoration Evaluation Programme, and Balancing Flood Control, Water Supply and Environmental Restoration

Progress of the Restoration project

● In the lower Kissimmee River Basin, Phase one construction was completed in 2001 and phase two was completed in 2009, restoring continuous water flow to 19 miles of the Kissimmee River. The third phase is now underway and includes backfilling and restoring flow to eight miles of the river.

● About 98 percent of lands needed to complete Kissimmee River Restoration have been acquired – a total of 102,061 acres.

Table. Restoration Project Schedule (krr_krrep_factstour_sheet, South Florida Water Management District)

Construction Sequence	Name of Phase	Timeline	Backfilled Canal	River Channel Recarved	River Channel to Receive Reestablished Flow	Total area (acres)	Wetland Gained (acres)
1	Phase I	Jun '99 – Feb '01	8 miles	1 mile	14 miles	9,506	5,792
2	Phase IVA	Jun '06 – Sep '07	2 miles	1 mile	4 miles	1,352	512
3	Phase IVB	Jun '08 – Dec '09	4 miles	4 miles	6 miles	4,183	1,406
4	Phase II/III	Apr '12 – Oct '14	9 miles	4 miles	16 miles	9,921	4,688

Environmental impacts and Future prospects

●The comprehensive continued monitoring documented promising increases in dissolved oxygen levels, reductions in river channel floating plant cover and accumulated sediments on the river bottom, recovery of wetlands, and increased populations of waterfowl, wading birds, and bass and other sunfishes.

Largemouth bass and sunfish increased from 38 to 68% of the fish community

(The future of Kissimmee River, South Florida Water Management District)

Again a mecca for boaters and anglers as the ecosystem restored

(The future of Kissimmee River, South Florida Water Management District)

New habitat is created by the Restoration (The future of Kissimmee River, South Florida Water)Management District)

Reference Materials/Site

South Florida Water Management District, US Army Corps of Engineers
(English)→http://www.sfwmd.gov/, http://www.saj.usace.army.mil/

About ARRN

Objectives

ARRN aims to contribute to the creation of rich Asian water environment for the following two purposes as a non political organization.

- To establish a mechanism to exchange and share case studies, information, technologies, and experiences related to river/waterfront restoration in the world and in the Asian countries, with engineers, researchers, ecologists, government officials and citizens through events and websites.
- To establish a river/watershed restoration guideline that can be utilized in the Asian monsoon area with similar social and natural environment, and improve knowledge and skills of network participants.

Korea

China

Japan

Activities

ARRN carries out following activities to achieve the above-mentioned objectives.

- Holds international forums and workshops with agendum of river/watershed
- Publicize information related to waterfront restoration through websites and news letters
- Prepares and distributes guidelines related to river/watershed restoration
- Assists plans to dispatch lecturers and experts, and site tours among networks in counties and regions
- Carries out activities of survey/researches, publication, public relations related to river environment

Reference Guideline for Restoration by Eco-Compatible Approach in River Basin ver.1 ***Separate Volume***

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Japan River Restoration Network (JRRN)

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