

ver. 1

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

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1 Introduction

(1) Why restore the river environment?

Civilizations have been developed along rivers since early times, and this is true even today. Rivers confer benefits on human beings in various forms. Namely, rivers not only contribute to our socioeconomic activities but they also exist as a critical component in creating landscape, nature, and culture. At the same time, rivers provide valuable spaces for nurturing various forms of life.

As there is the proverb that "the man who governs the river governs the country," we, human beings, have obtained water and food from rivers while controlling streamflows to protect our life from floods. We have also actively used rivers to secure water for production and for drinking as well as transportation by ship and energy utilization.

As a result, the natural river environment and landscape have been greatly damaged in return. People have forgotten the true nature of rivers, feeling less attachment to them, and our economic benefit from rivers may be lost in the future. They say that the world's four greatest civilizations flourishing along rivers were destroyed by deforestation and loss and destruction of nature caused by limitless human activities.

In modern society, too, nature is destroyed by industrial growth and land development. If the anthropogenic impact on the natural environment increases, the diverseness of life will decrease as a result.



Children playing innocently in the river

For example, we can obtain clean water just by turning on a faucet and we can keep the washroom clean by washing it with water. However, we are less aware of where the tap water comes from and where the sewage discharged from the kitchen or bathroom goes to. As symbolized by urbanization, the load of human activities excessively impacts on the nature of the river basin and today, it is extremely important to improve the space for river, water quality, water amenities, and natural restoration to rehabilitate rivers and basins.

For this purpose, it is important to reduce the various burdens on rivers. However, such activities are limited. Consequently, we should draw out the regenerating power of the river provided by nature. We should also think of a sustainable river restoration approaches. Moreover, those who are concerned should cooperate with each other to cope with these problems for the benefit of the entire globe.

For the human race to survive for a long time on earth, our entire activities should be changed to be cyclical and coexistent with nature as soon as possible to reduce the load on rivers. Rivers are just like the blood vessels of the human body, figuratively speaking. Blood vessels and blood are absolutely essential for maintenance of human life. The inherent power of the river is exactly the same for Earth. Therefore, aiming at "river restoration" to make use of the power inherent in rivers is an important viewpoint for us to live.

(2) Aim and purpose of the guideline

This guideline is to introduce principles and implementation approaches indispensable for restoring desirable river environments in Asia, raise the interest of audience in a river nearby, create an opportunity toward new activities for river restoration, and also support current river restoration projects.

(3) Target audience

This guideline targets all people who want to bring rivers and waterfronts back into a healthy form and pass on rich river environments to the following generations.

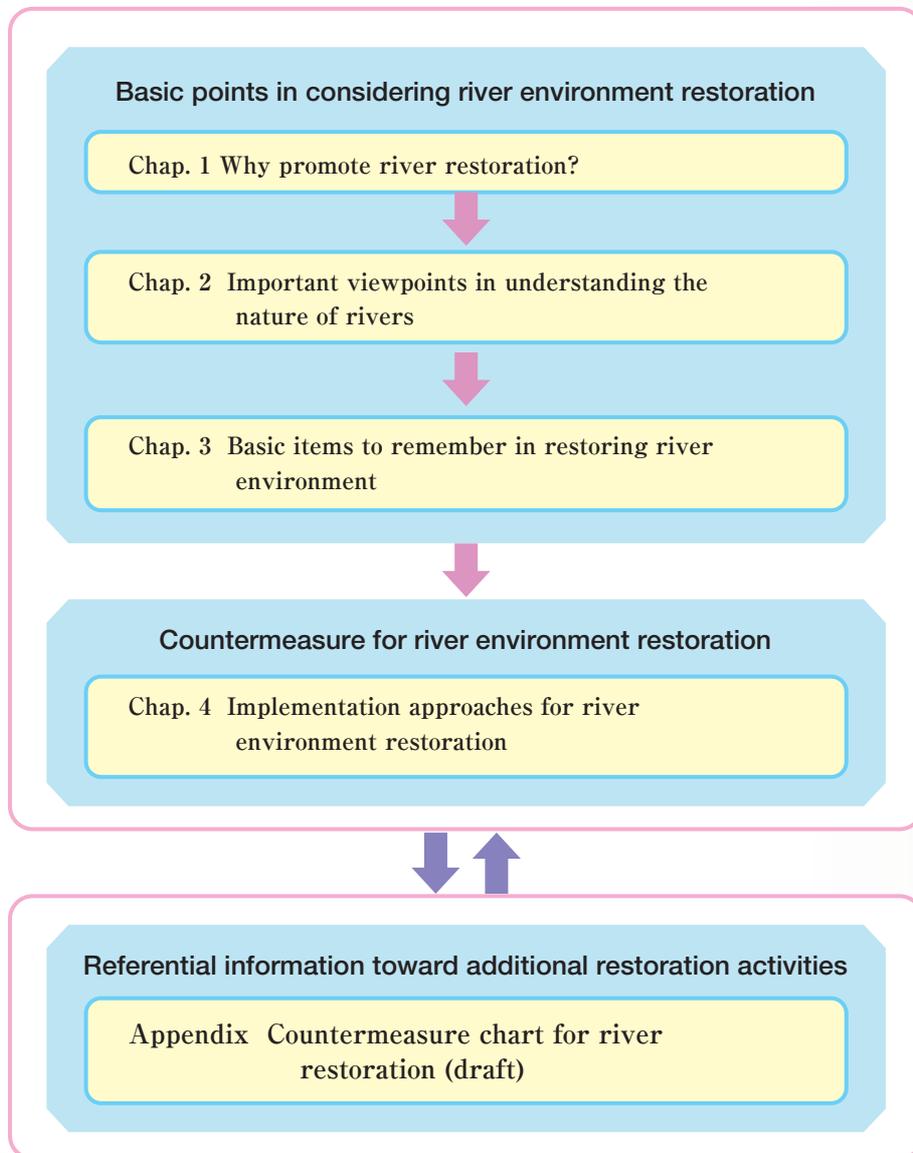
(4) Overview of guideline

In the nature restoration session of the 4th World Water Forum (held in Mar. 2006 in Mexico), two proposals were made in connection with establishing an Asian information network related to river restoration and the preparation of an Asian river restoration guideline toward improvement of river restoration technology. In response to these proposals, the "Asian River Restoration Network (ARRN)" was established by Chinese, Korean and Japanese agencies jointly concerned in November of the same year.

In the ARRN, preparation of a technical guideline for river restoration was positioned as one of the primary objectives of the network activities, and Chinese, Korean and Japanese specialists are working toward establishing the technical guideline that can contribute to creating healthy river environments in Asia through discussions.

In this guideline, basic ideas and implementation approaches for river restoration is explained in a comprehensible form so that even non-specialists who are interested in improvement of the river environment can understand them easily as a primer to the "River restoration technical guideline" aimed at by the ARRN in the future.

ARRN members will continuously discuss establishment of a practical guideline for Asia targeting the individual technologies shown in Appendix of this guideline in the future.



Contents of this guideline

2 Important viewpoints in understanding the nature of rivers

(1) Being familiar with the natural, historical and cultural transition of rivers

Since ancient times, rivers have brought great benefits to us such as water for drinking, food, amenity, and healing. At the same time, rivers have sometimes caused damage through floods and droughts. The history of the relationship between human beings and rivers is diverse, and rivers show how nature operates from past to present as well as the consequences of human beings' activities regarding rivers over a period of time.

To consider the future of rivers, it is of utmost importance to understand their natural, historical and cultural transition. This leads to a heightening of people's awareness to take good care of rivers as something familiar and to pass on a rich river environment to the following generations.



Old lively Sumida River, Japan (around 1800)



Trash-filled Sumida River, Japan (around 1960)

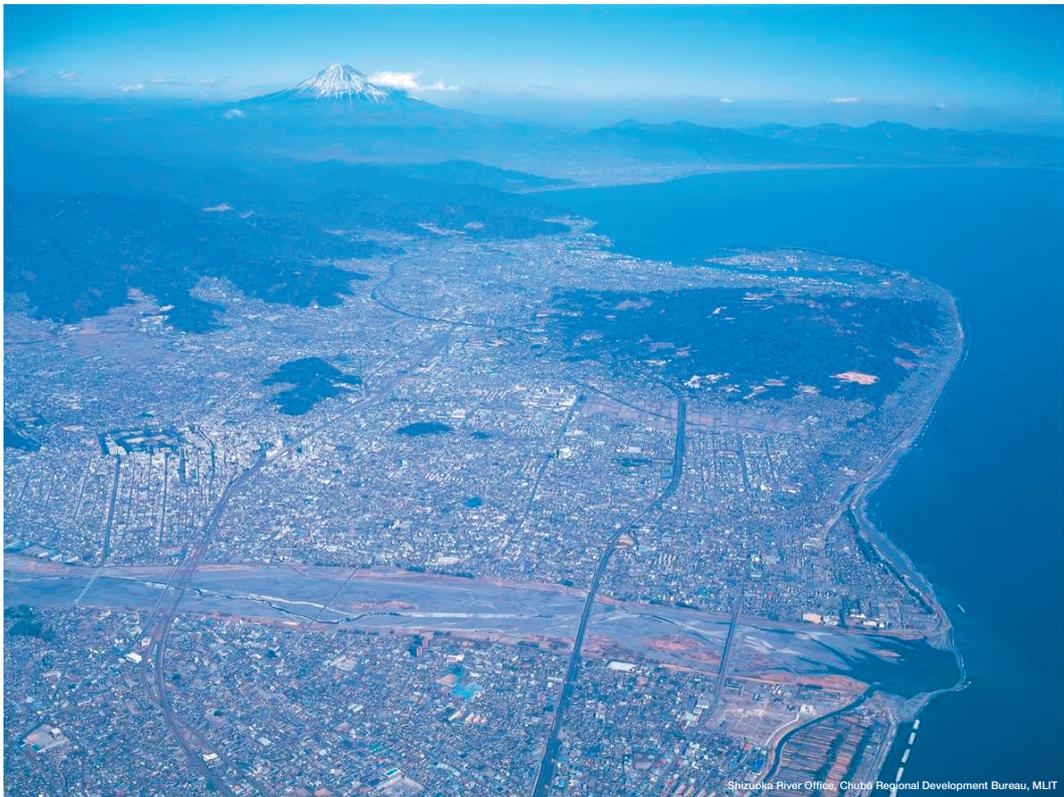


Sumida River with its life recovered, Japan (today)

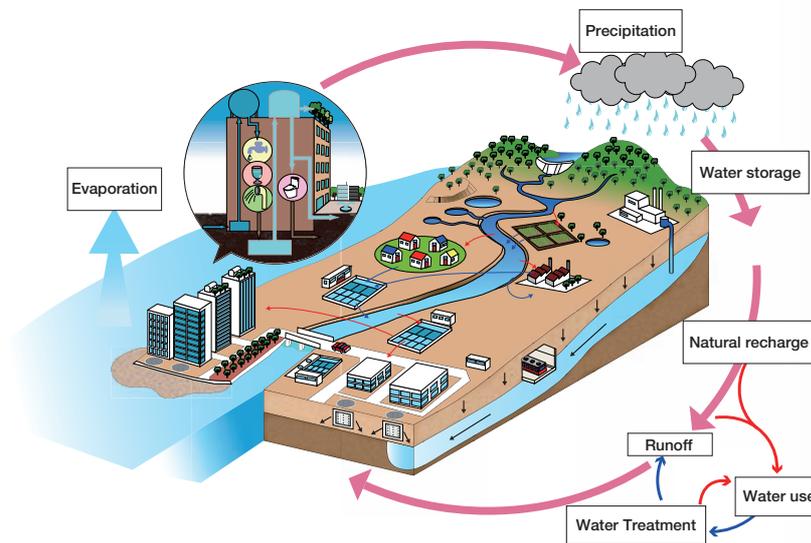
(2) Perceiving the river as a basin

The water of a river we see circulates in a "basin." The river moves substances on Earth such as water, sediment, nutrient salts, and living organisms. The characteristics of aspects of a river (flood, drought, water quality, living organisms, landscape, nature, and culture) in addition to climate, size, shape, and land utilization of the "basin" show that the state of the river results from and is affected by the way of living and the various social activities of the people living there for a long time.

When considering river restoration, it is very important to grasp the condition of the river, not only by looking at the streamflow or inside the river surrounded by levees or revetments, but also by considering the river continuity including upstream/downstream and land area as a horizontal phase of a "basin."



Abe River basin seen from the air, Japan



Considering the river as a basin

Water Resources in Japan 2004,
Water Resources Department,
Land and Water Bureau, MLIT

(3) Understanding dynamism of rivers

The streamflow of a river changes every day. It is calm in its normal state, but the width of the water surface sometimes becomes extremely small and at other times, the flow is even disrupted due to water shortage. In the meantime, once a river is swollen, the streamflow will cut away the river bed and riverbanks and carry away riverside living organisms. Sediment flowing from upstream heaps up, and the form of the river may change. In this way, rivers change at various time points naturally or artificially to its present form. Human beings and organisms in a river adapt themselves to the nature of the river and how it operates in order to live. When thinking of the river environment, it is important to understand the characteristics of the streamflow of the river.



Toyohira River in its normal state, Japan



Toyohira River in a flood, Japan



Former meandering Teshio River, Japan.



(4) Grasping the role of rivers and stakeholders

We have sought a broad range of roles of rivers such as securing water resources for agriculture and industry, using the water surface and the riverfront for transportation by ship, recreation, and healing and conducting fishery work to secure food. In addition, we have used rivers not only to obtain water but also to dispose of used water. Meanwhile, rivers are a place for various living organisms to live.

To find the desirable state of a river, it is important to grasp the lifestyles of the local people concerned in addition to the role of the river.



Weir for water intake



Tower for water intake



Sightseeing boat



Use of the water surface for canoeing



Playing in the river



Multipurpose use of river terrace



Fishery work



Water discharge to a river in the rain



Fish living in the river

3 Basic items to remember in restoring a river environment

(1) Setting multi-objectives of river restoration by considering river history and culture

To set the multi-purposes of river restoration including flood control, ecological recovery as well as aesthetics and amusement etc., it is important to consider the history of the river and the culture surrounding the river created in consequence.

Moreover, it is important to concretely clarify what is to be restored after understanding the natural environment as well as the social environment showing how people have dealt with the river.

Korea

Cheonggyecheon River



Crowd on the riverfront (around 1960)



River covered by an expressway (around 2000)



Restored river (today)

China

Zhuanhe River



Water edge, which was rich in nature (age unknown)



Mostly reclaimed water's edge (age unknown)



Restored water's edge (today)

Japan

Nihonbashi River



Crowd on the riverfront (Edo period)



River under an expressway (today)



Image of blue sky recovered (future)



(2) Planning river restoration from the viewpoint of the basin

In planning to restore a river or part of a river, it is important to consider it from the viewpoint of the whole basin (rather than considering it as a point or a line). Namely, we should consider the connection between phases such as water circulation, movement of sediment and living organisms upstream or downstream or horizontally to the land, as well as local people's activities centered around the river.



River restoration from the viewpoint of the basin

(3) Considering river restoration based on dynamism of rivers

For river restoration, it is important to respect to a maximum the natural and inherent activities of the river such as change of streamflow and river course. If a river is rehabilitated in excess its force, on the other hand, new problems may sometimes arise.



Trial to restore the meander by using the old river (Shibetsu River, Japan)



Trial to restore a gravelly river-bed by using dynamism of streamflow (Kinu River, Japan)



(4) Proceeding with river restoration in cooperation with stakeholders

To proceed with a river environment restoration project smoothly and continuously, it is important for the local people related to the river (community residents, water users, fishermen, administrative agencies, etc.) to cooperate closely from the first stage of formulating a restoration plan and to find restoration approaches that would be accepted in the surrounding region.



Field study with the local residents and stakeholders



Meeting with the local people concerned

(5) Considering a combination of river conservation and restoration

To use a river as a place for our various activities while conserving its rich nature, it is important to consider a combination of river conservation and restoration suitable to each region.



Studying a combination of river conservation and restoration using a model

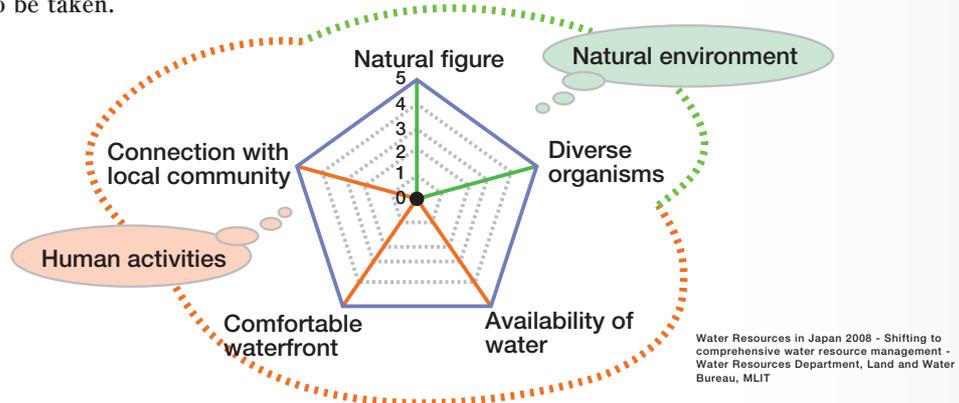


Example of one riverside widened with the mountain side conserved (Yamaya River, Japan)

4 Implementation approaches for river environment restoration

(1) Outline of approaches for river environment restoration

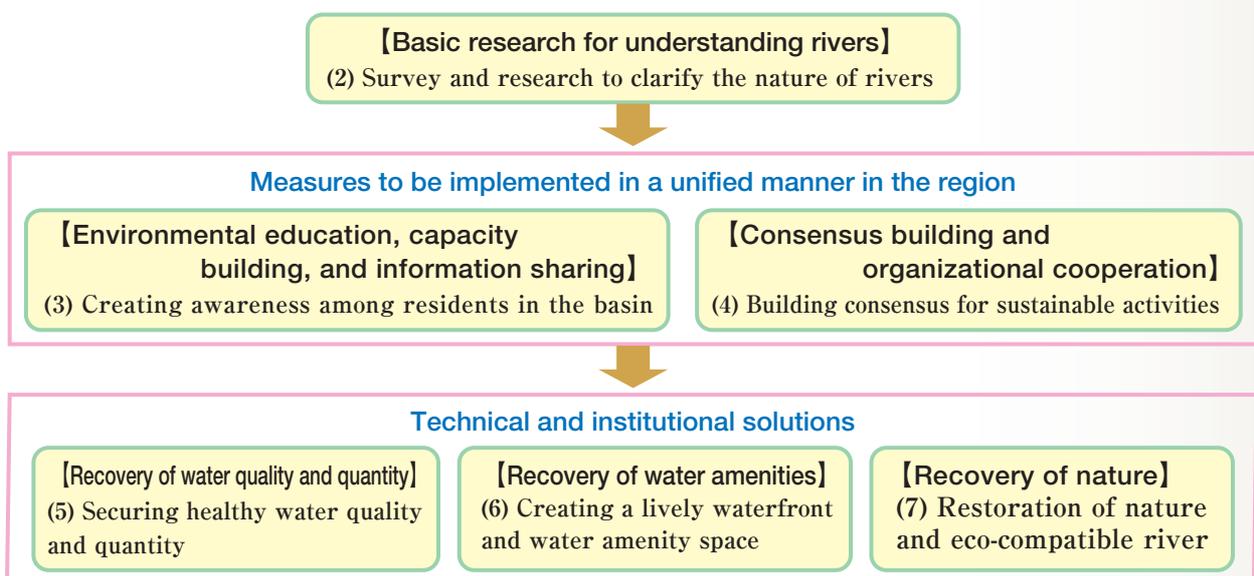
Approaches for river restoration differ depending on the current river condition and the future target river condition. The situation may also be different depending on what is to be restored in the particular river. Therefore, it is important for stakeholders to clarify the target of restoration and decide the order of precedence of measures to be taken.



An example of a river environment evaluation axis

In this guideline, a sequence of measures to restore a healthy river environment is introduced, starting with activities that we can undertake. Cooperation with the administrative agency controlling the river is then described, which is indispensable for activities for the entire basins. Cooperation with specialists such as engineers and researchers is also described, which is necessary for solving high-level technological issues.

We hope that audience can find suitable approaches for river restoration in this chapter after taking into consideration the "Important viewpoints in understanding the nature of rivers", "Basic items to remember when restoring the river environment", and "circumstances of each river" shown in the first half of this guideline.



Flow of scheme in this chapter

* (2) - (7) correspond to the paragraphs of this chapter.

(2) Survey and research to clarify the nature of rivers

(a) Collection of basic information for understanding basins and rivers

What we should do preferentially to restore the river environment is to research the actual condition of the river including its social and natural environment. Concretely, information on the history and cultural social environment showing how the river and people related should be collected through local people and documents.

It is also necessary to understand the natural environment surrounding the river such as the quantity of precipitation in the whole basin, subsequent change in flow volume and water level of the river, geomorphic character, water quality, and organisms living in the river through field study or by using the results of surveys conducted in the past.

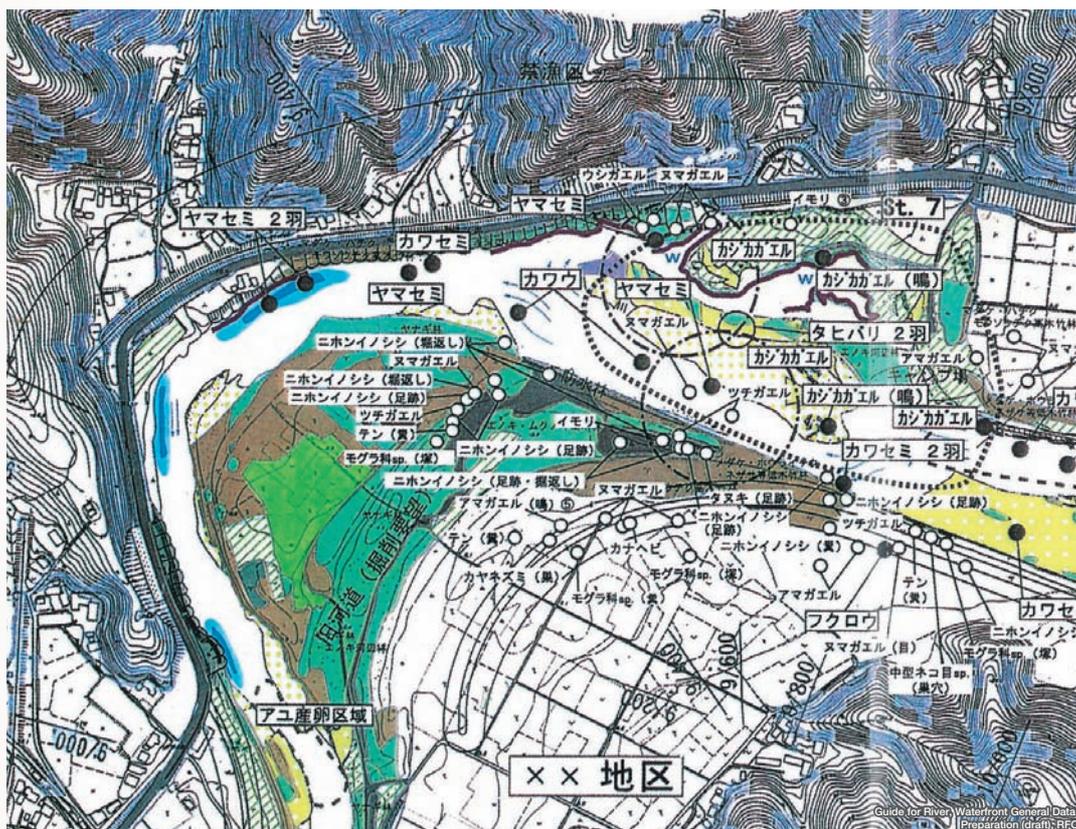
Some of these basic researches can be conducted by us but for others, we should depend on specialists. In any case, however, obtaining information from these researches is the first step towards restoring the river environment.



Water quality survey



Listening to the history of a river



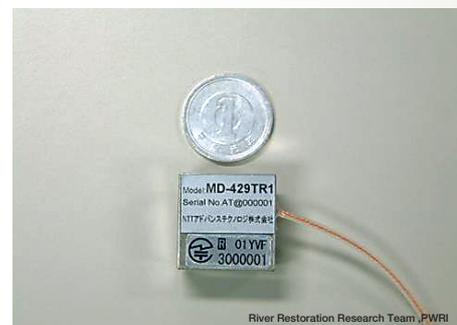
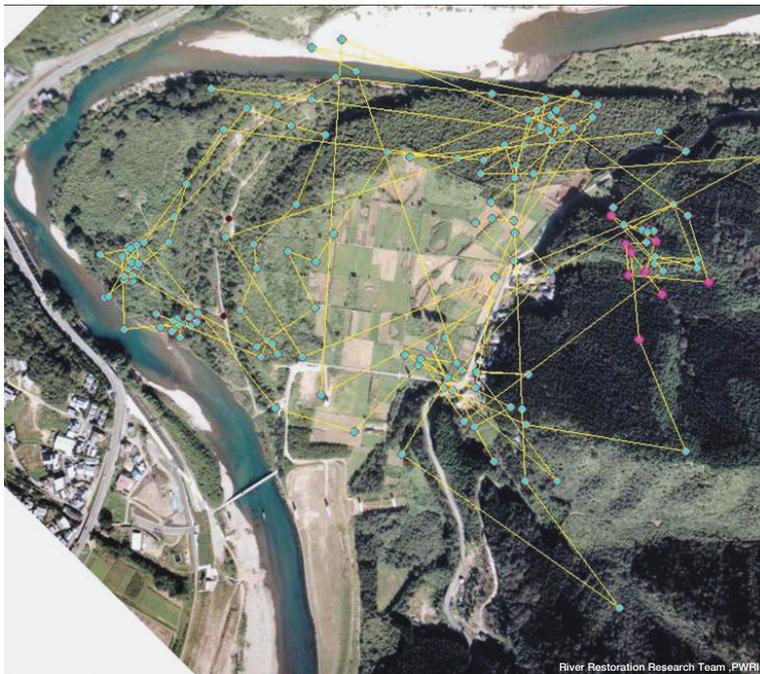
Example of a map showing organism study results (river environment information map)

(b) Studies and researches to obtain new knowledge

There are many items that have not been clarified such as the effect of human activities upon the river environment. To find the desirable river condition in the future, it is important to conduct academic researches and surveys in addition to conventional basic researches and to accumulate new scientific knowledge.



Experimental river provided for new researches and scene of survey



Behavior survey using a transmitter
(upper right: Transmitter mounted, lower right: Transmitter)

(3) Creating awareness among residents in the basin

(a) Environmental education and capacity building

An important point in addition to basic research for river restoration is to find out what approaches we can take on a regular basis, transmit such approaches throughout the region as part of environmental education, and preserve it through the generations.

To restore a once-destroyed river environment, there are many actions to be taken together with the government such as adoption of new laws and a water clarification system. However, there are many case examples reported in which the healthy form of a once-contaminated river has been restored as a result of change in residents' use of daily water and increase in their concerns about the river.



Learning about the river from the headstream



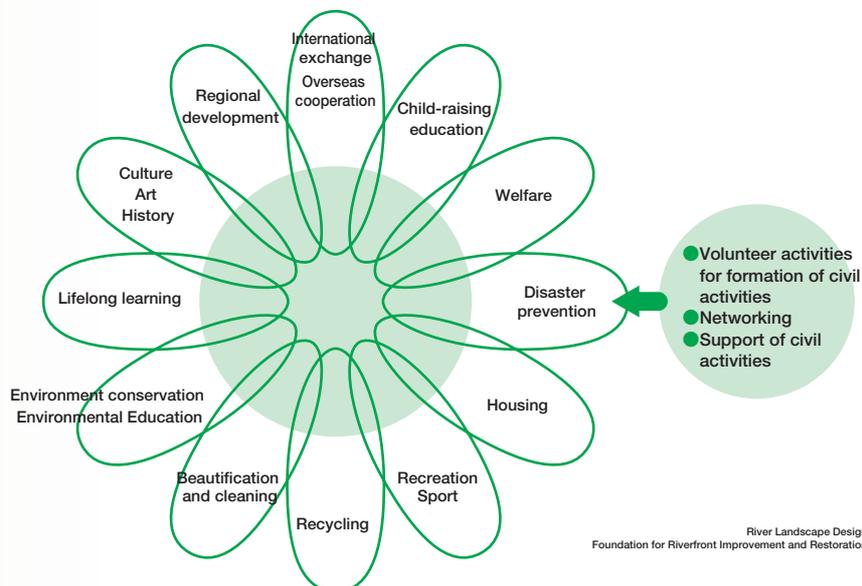
Trying a simple water quality test



Learning about traditional river construction methods



River cleaning activity



Example of various civil activities related to rivers

River Landscape Design
Foundation for Riverfront Improvement and Restoration

(b) Information-sharing

It is important to provide local residents with various river-related information and share the current river environment and activities toward river restoration among the local people concerned. Such an approach can strengthen the sense of community among the residents in the watershed area and contribute to increasing the number of supporters of river restoration activities.

Outside the watershed area, too, there are organizations that act toward improving river environment restoration. It is also important to share information about cases of success or failure with them and reflect such information in river restoration activities.



Holding a seminar



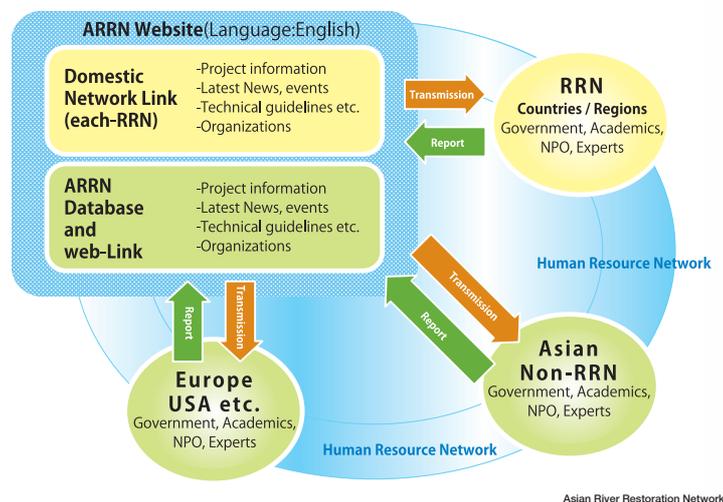
Holding a council meeting



Display of panels to describe rivers



Books, pamphlets, and magazines on river restoration

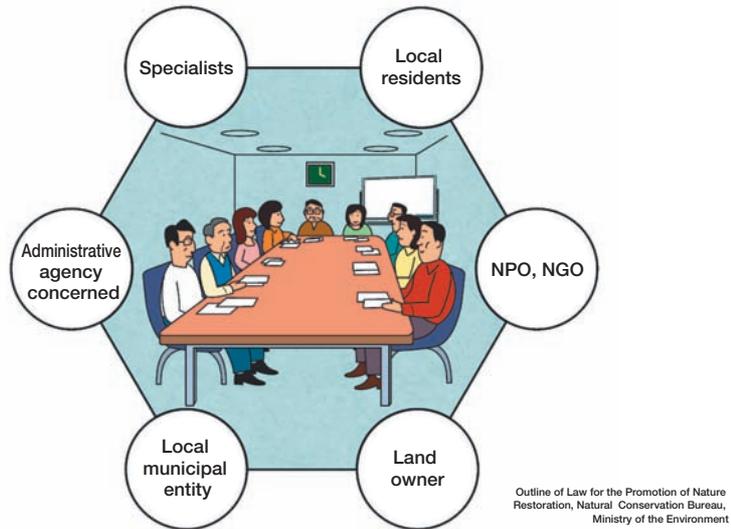


Approach to establishing an international network for sharing information on river restoration

(4) Building consensus for sustainable activities

To continue the river restoration approaches, it is essential to establish a framework where local people related to the river act cooperatively by sharing economical and spiritual benefits and values brought by river restoration.

It is also necessary in some cases to lobby the administrative agencies concerned toward introduction of new legal / institutional frameworks or easing of regulations to promote river restoration activities efficiently and smoothly.



Building consensus among stakeholders



Restoration of freshwater clams, which contribute to the regional economy and water quality improvement (Lake Shinji, Japan)



Popular soup using local freshwater clams



Vitalization of the region by regenerating storks (Maruyama River, Japan)



Local special products associated with the name of stork

(5) Securing healthy water quality and quantity

(a) Approaches toward water quality improvement

Keeping river water in healthy condition is an important factor towards creating a much-loved river in the region. To improve contaminated river water quality, there are two methods: one is to eliminate the source of the contaminant such as household and industrial wastewater in the whole basin, and the other is to directly remove contaminants that have already entered the river.



Once-contaminated Tama River, Japan



Tama River with water quality recovered, Japan



Water quality improvement in the whole basin by sewer system



Water quality improvement by plants

Table Examples of measures effective for improving water quality

Measures for the whole basin	Approaches to reducing household wastewater Reduction of household load by basin residents / installation of wastewater treatment tanks / construction of sewers
	Approaches to reducing industrial wastewater discharged from factories and farms Wastewater regulations / reduction of wastewater load by each office / measures against agricultural wastewater
	Other effective approaches Forest maintenance / proper land utilization control and improvement of recharging function
	Measures for the river
Installation of purification equipment (by the catalytic oxidation method, vegetation purification method, aeration, etc.) Removal of polluted mud by dredging channels Reuse of discharging water highly-purified by sewer systems	

(b) Approaches to improving quantity of flow

The quantity of flow required is different for each river. It is important not only to clarify the natural quantity of flow of the river but also to scientifically research the quantities of flow necessary for daily life, agricultural and industrial use, organisms living in the river, transportation by ship, and fishery, for which consensus of the local people should be obtained.

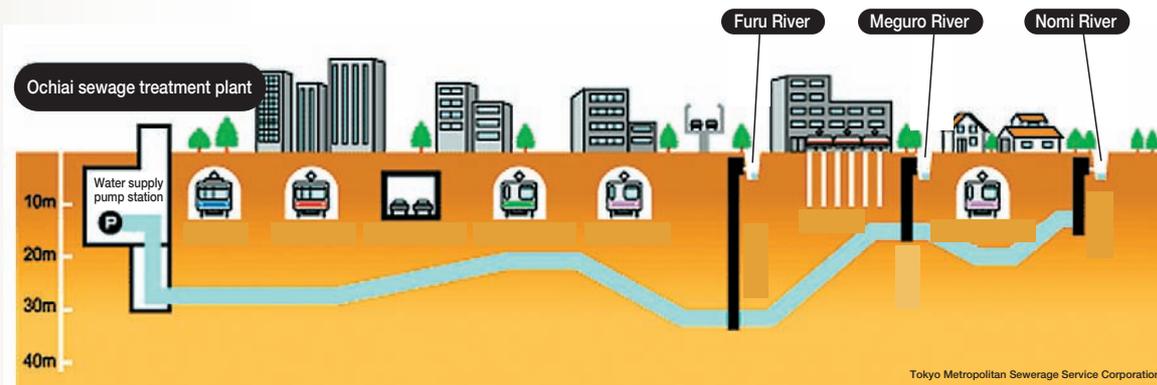
In addition, to secure a desirable quantity of flow, it should be adjusted among water users or by water utilization facilities artificially, or sewage-treated water should be reused.



Improvement of quantity of flow by releasing water at a dam



Babbling stream using treated water



Example of reuse of sewage-treated water

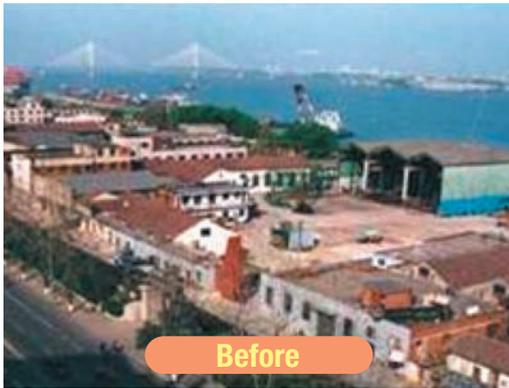
Table Example of measures for improving the quantity of flow

Measures for securing new water sources	Flushing discharge from a dam Use of sewage-treated water Water transmission from other basins
Measures for inside the basin	Review and rationalization of each water right quantity (electricity generation, industry, and agriculture) Improvement of the recharging function of the basin (construction of water-permeable paving and rainwater storage)

(6) Creating a lively waterfront and water amenity space

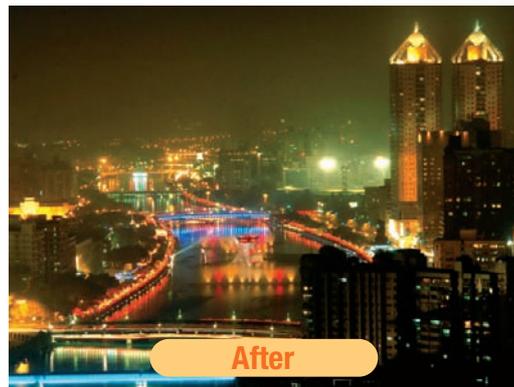
(a) Creating a waterfront space unified in the region

An important river restoration measure is to create a lively waterfront space where local people and tourists gather while respecting to the maximum the relationship between the natural environment of the river and surrounding regions. In all places in Asia, various approaches to improving water amenities have been taken, and by studying these approaches, we should identify and implement a method to improve the attractiveness of the waterfront area suitable to the region.



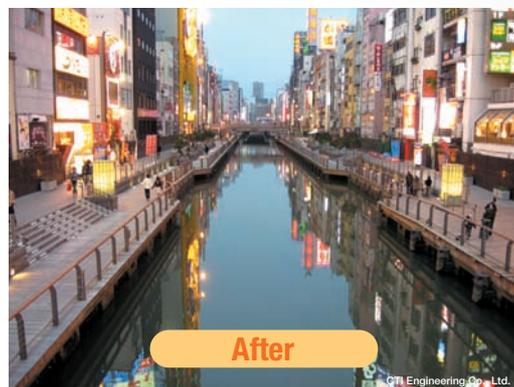
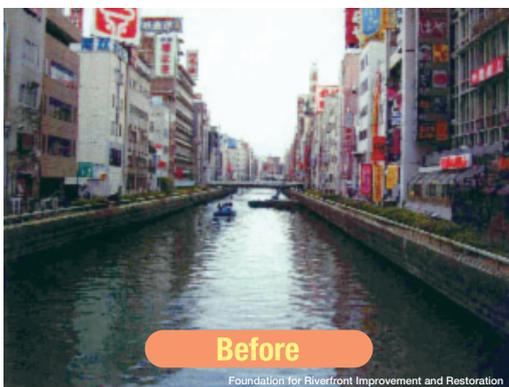
Landscaping of Yangtze river waterfront (Wuhan, China)

2nd International Forum on Waterfront and Watershed Restoration, RFC



Landscaping of Love River waterfront (Kaoshiung, Chinese Taipei)

JRRN Workshop on Urban River Restoration, Love River in Kaoshiung, Chinese Taipei



Landscaping of Dotonbori River waterfront (Osaka, Japan)

Waterfront space unified in the region

(b) Water amenity activities to rediscover the attraction of the waterfront

With many rivers, there is enjoyment unique to the river space such as traditional river-related events or recreation. It is an important method to promote river restoration to increase the opportunity of local resident involvement for water amenity activities.

By raising the interest of local residents in the waterfront environment through such opportunities, synergistic effects of further improvement of the waterfront space and regional economic revitalization can be expected.



**People enjoying the waterfront
(Anyang River, Korea)**



Cycling (Yangje River, Korea)



Canoe



**Water festival
(Chao Phraya River, Thailand)**



Traditional festival



Floating lanterns

(7) Restoration of nature and eco-compatible river

§ (a) Securing the continuity of the river

To restore the natural river environment, it is important to revive the continuity of flow from upstream to downstream as well as cross-sectional continuity between terrestrial and aquatic areas.

By providing dams and weirs with fishways and slit-type check dams to secure the continuity of the river in the vertical and lateral directions, movement of not only organisms that comprise the nature of the river but also sediment and nutrient salts that are the basis of the living environment of these organisms is enabled. This will contribute to regenerating the original natural environment of the river.



Securing continuity from upstream to downstream



Securing continuity between the river and paddy fields



Hydropower dam with wash-out gate



Slit dam



Before (2001)



After (2003)

Securing river continuity (Anyang River, Korea)

4th International Forum on Waterfront and Watershed Restoration, ARRN

(b) Conserving a diversified ecosystem by using the regenerative ability of nature

To regenerate the ecosystem inherent in a river, it is important to utilize the river's regenerative ability to the maximum extent while taking the natural operation of the entire river into account. Identifying the characteristics and indexical organisms of the river ecosystem and creating an environment where the species can flourish sustainably through cooperation of stakeholders also leads to restoration of a natural river environment.

For example, an effective method of restoring the nature of a river is to create an environment that protects the species historically inherent in the region and remove alien species that are not originally living there.



Regeneration of the gravel river bed inherent in Kinu River, Japan

Organisms unique to a gravel river bed



Aster kantoensis



Eusphingonotus japonicus

Invasion of alien species



Robinia pseudoacacia



Sicyos angulatus

This countermeasure chart (draft) introduces concrete technics/policies to achieve the Chapter 4 "Implementation approaches for river environment restoration". We continue to revise this chart to complete the technical guideline for river restoration through discussions by ARRN members.

Countermeasure Chart (1/2)

4.(2)Survey and research to clarify the nature of rivers	
Phase 0 : Principle/Concept	Collection of basic information for understanding basins and rivers
	Studies and researches to obtain new knowledge
Phase 1 : Basic Approach	Collection and classification of basic information (channel shapes, growth and habitation of living things, hydrologic data, water level, and water quality, etc.)
	Survey on the nature and social properties around the basin (Grasp of unique properties according to nature and climate, living environment, industrial economy, social culture, etc.)
	Hydrologic survey (rainfall, water level, flow volume, flow velocity etc.), Water quality survey (physical / chemical water quality, biological water quality)
	Survey on waterfront utility, facilities, river landscape etc.
	Grasp of the ecosystem in river zones (physical characteristics of ecosystem dynamics, characteristics of vegetation, and characteristics of animal community, etc. in river zones)
	Grasp of the condition of water cycle system (basic survey / method for learning the past / present / future condition of water cycle system, etc.)
	Survey on sewage treatment (sewage treatment, wastewater treatment, etc.)
	Characteristic survey on hydraulics and water quality in lakes and dam reservoirs (present state of eutrophication and accompanying changes in biota / ecosystem, etc.)
	Quantitative measurement by water pollution analysis etc. and forecast (elucidation and grasp of phenomena concerning water quality, establishment of water quality analytical models, etc.)
Collection of related guideline and toolboxes on river restoration	
Phase 2 : Advanced Approach	Promotion of research and survey for obtaining new findings (setting of water quality items, elucidation of water pollution phenomena, development of prediction / evaluation techniques, study on river ecology etc.)
	Implementation of pilot projects for deeper understanding and recognition (setting of model rivers etc., implementation of pilot projects)

4.(3)Creating awareness among residents in the basin	
Phase 0 : Principle/Concept	Environmental education and capacity building
	Information-sharing
Phase 1 : Basic Approach	Establishment of an information sharing system
	Public announcement and publicity activities for the effect of the project (information provision to mass media etc.)
	Public relations and awareness raise on river restoration (brochure, newsletter, books etc.)
	Information dispatch (river condition, water quality, water level safe information etc.)
Phase 2 : Advanced Approach	Environment education
	Program development of environment education and personnel training
Phase 2 : Advanced Approach	Establishment and publication of database on rivers, establishment of support center

4.(4)Building consensus for sustainable activities	
Phase 0 : Principle/Concept	Building consensus and legal/institutional scheme
	Co-ordination with stakeholders (cooperation and adjustment with various plans)
Phase 1 : Basic Approach	Local commitment (basic policy, cooperation between promoting bodies, promotion system, assessment)
	Application of PDCA cycle
	Installation or reconstruction of legal and institutional framework
	Economic evaluation of environmental value (CVM etc.)
	Training of facilitator for helping consensus formation
Phase 2 : Advanced Approach	Others (installation of public-involvement system, town meeting)
	Establishment of co-research/technological development organization by public sector and private sector combination
	Installation of basin management system (IWRM etc.)

Contents included in this reference guideline (ver.1)

4.(5)Securing healthy water quality and quantity	
Phase 0 : Principle/Concept	Approaches toward Water quality improvement
	Approach to improving quantity of flow
Phase 1 : Planning/Design	Setting of environmental standards for water quality (health items, living environment items, etc.)
	Setting of consolidation object of water quality (appropriate goals according to the purpose of water use, causes of contamination, etc.)
	Legislation concerning wastewater control (factory Law, agricultural chemicals regulation law, water pollution control law, environmental pollution prevention act, etc.)
	Comprehensive measures concerning water pollution (water quality conservation measures, lake water quality conservation measures, groundwater contamination measures, drinking water source measures, etc.)
	Formulation of sewerage plan, improvement plan / design for treatment facilities etc. (sewage treatment, sludge disposal, rainwater drainage plan, facility plan, water treatment facility, sludge treatment facility, etc.)
	Setting of required flow quantity (environmental flow etc.)
	Consideration of the effect of measures, grasp of project cost (calculation of construction cost and maintenance expenses, etc.)
	Project implementation according to priority (determination the urgency of project and implementation of the project according to the urgency, etc.)
	Adaptive / step-by-step implementation of project (adaptive management that performs a project step by step with feedback to the plan according to situations)
	Phase 2 : Construction/ Maintenance
Construction method for sewerage treatment facilities etc. and device considered for the site (construction of piping facilities, pumping station facilities, water treatment facilities, sludge treatment facilities, etc.)	
Construction method considering the surrounding environment and device considered for the site (construction with less impact on the surrounding environment)	
Implementation of continuous monitoring (water quality control [rivers, sewage facilities, etc.], arrangement of the river water automatic monitoring system, etc.)	
Implementation of follow-up and assessment (environmental standards achievement ratios and proper assessment of the effect of policies)	
Improvement of the river register and implementation of facility maintenance (register improvement, facility maintenance, etc.)	
Improvement of the sewage register and implementation of facility maintenance (register improvement, facility maintenance, etc.)	
Formulation of monitoring method and implementation of monitoring (implementation method, system establishment, etc. for monitoring pollutant sources)	

4.(6)Creating a lively waterfront and water amenity space	
Phase 0 : Principle/Concept	Creating a waterfront unified in the region
	Water amenity activities to rediscover the attraction of the waterfront
Phase 1 : Planning/Design	Formulation of water affinity improvement plans (development of water amenity facilities such as water park, amenity-oriented revetment, policy to use for recreation)
	Formulation of river landscape plans (development of good riverscape)
	Formulation of policy to utilize the environment, disaster prevention, and space functions provided by rivers.
	Formulation of a comprehensive improvement policy for town planning with river utilization (urban restructuring with river utilization)
	Planning recreation activities related to history and culture
	Plan harmonizing flood control plan with environmental measures (environmental measures in consideration of flood control plan)
	Consideration of the effect of measures, grasp of project cost (calculation of construction cost and maintenance expenses, etc.)
	Project implementation according to priority (determination the urgency of project and implementation of the project according to the urgency, etc.)
	Adaptive / step-by-step implementation of project (adaptive management that performs a project step by step with feedback to the plan according to situations)
	Phase 2 : Construction/ Maintenance
Construction method considering the surrounding environment and device considered for the site (construction with less impact on the surrounding environment)	
Implementation of continuous monitoring (monitoring for conservation of river landscape etc.)	
Implementation of follow-up and assessment (impact evaluation and minimization of harmful impact)	
Setting and implementation of maintenance (formulation of a maintenance plan etc.)	

4.(7)Restoration of nature and eco-compatible river	
Phase 0 : Principle/Concept	Securing the continuity of the river
	Conserving a diversified ecosystem by using the regenerative ability of nature
Phase 1 : Planning/Design	Setting of the environment to be preserved and measures (growth areas (riffles and pools / revetment), spawning ground, fish pass)
	Formulation of a nature-friendly river work project (measures for canceling problematic river works, and measures for raising the entire level of river works)
	Formulation of a nature restoration project plan (goal setting, draft plan formulation / forecast, analysis, etc.)
	Formulation of measures against alien species (measures / control on influence by invasive species)
	Formulation of a water cycle plan (planning for the entire basin from the upper to down streams taken in consideration of the dynamic property of flow regime, comprehensive sediment control)
	Plan harmonizing flood control plan with environmental policy (particularly, urban river improvement plan, maintenance of flood control function, conservation of biodiversity, etc.)
	Consideration of the effect of measures, grasp of project cost (calculation of construction cost and maintenance expenses, etc.)
	Project implementation according to priority (determination the urgency of project and implementation of the project according to the urgency, etc.)
	Adaptive / step-by-step implementation of project (adaptive management that performs a project step by step with feedback to the plan according to situations)
	Phase 2 : Construction/ Maintenance
Construction method considering the surrounding environment and device considered for the site (construction with less impact on the surrounding environment)	
Implementation of continuous monitoring (monitoring for conservation concerning ecosystem, water cycle, etc.)	
Implementation of follow-up and assessment (impact evaluation and minimization of harmful impact)	
Setting and implementation of maintenance (formulation of maintenance plan and basin-based management, measures and management focused on ecosystem and natural resources, etc.)	

: Cover contents of this reference guideline (ver.1)

Epilog – For promotion of further river environment restoration in Asia –

We issued this guideline in the hope that it will contribute to motivating a new movement to look at issues related to nearby rivers and watershed areas and restore them to be in healthy condition.

This guideline introduces the basic idea of river restoration in plain words as a primer to the "river restoration technical guideline in Asia" which the ARRN aims to establish, but it does not cover all the necessary points in considering river environment restoration issues.

We will complete the practical technical guideline for river restoration through discussions by ARRN members, which can satisfy citizens tackling river environment improvement, engineers working for government or companies, and researchers supporting them academically.

The ARRN will make continuous efforts not only to publish the guideline but also to provide opportunities to share useful information and exchange people related to river restoration. For this purpose, your continued support and cooperation would be appreciated. The outline of the ARRN is available at the following website, and if you send your comments about this guideline to the ARRN secretariat at the following e-mail address, it would also be appreciated.

Website <http://www.a-rr.net/>

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List of photo suppliers

Ishikarigawa Development and Construction Department, Hokkaido Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

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Keihin River Office, Kanto Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Shizuoka River Office, Chubu Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Toyouka River and National Highway Office, Kinki Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

National Diet Library

Bureau of Environment, Tokyo Metropolitan Government

Bureau of Construction, Tokyo Metropolitan Government

Tokyo Metropolitan Sewerage Service Corporation

River Restoration Team, Public Works Research Institute

Aqua Restoration Research Center, Public Works Research Institute

Japan National Tourist Organization (JNTO)

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Beijing Institute of Water

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Guide for River, Waterfront General Data Preparation (draft), Foundation for Riverfront Improvement and Restoration

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Lecture material for "The 2nd International Forum on Waterfront and Watershed Restoration" held by Foundation for Riverfront Improvement

and Restoration

Lecture material for "The 4th International Forum on Waterfront and Watershed Restoration" held by ARRN

Lecture material for "Workshop on Urban River Restoration, Love River in Kaohsiung, Chinese Taipei" co-held by JRRN

Lecture material for "The 2nd JRRN Mini-Seminar on River Environment" held by JRRN

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