

Lecture 1

Case of JAPAN I

—Comprehensive Water-Resource Issues of
Island Communities—

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OVERVIEW: WATER RESOURCE ISSUES OF ISLAND COMMUNITIES – CASE STUDY FOR SUSTAINABLE DEVELOPMENT IN OKINAWA PREFECTURE

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1. INTRODUCTORY REMARKS

As the era in which we confront the issues of water (resources), the 21st Century is, in other words, also the time for us to develop our know-how in the Sustainable Development of global environmental resources. However, in contrast to other non-renewable resources, the processes of water recycling and re-use all too often severely lack proper risk management principles. As evident in the many recent water-related emergencies (floods, droughts, etc.) resulting from global warming and other causes, it is imperative for us to act now to deal with the issues (including impacts on food production et al) threatening Man's very survival.

While these issues are of grave import on the continents, they are and have been of perennial concern in island communities. Today, I will introduce an example of integrated development and usage of island water resources through a case study of Okinawa Prefecture.

The (supply & demand plans and project) development of Okinawa Prefecture's water resources has come through three consecutive (10-year) development and promotion plans. While these have contributed greatly to underlying basic infrastructure and industrial development, the benefits are yet inadequate. As such, the new national program starting this fiscal year (2002) outlines new promotion and development measures that position energy and water resources as integral to securing foundations for economic self-sufficiency and stable social environments.

At this point, to provide an introductory understanding of conditions in Okinawa today, I will outline the strategies and water resources problems that face our island communities. (REF: PowerPoint Slide #2)

- Basic Precepts: Peace, Comfort, Vigor
- GOALS:
 - Sustainable Development for Self-Sufficiency: Open Contact with the World, Establishment as a Hub of (Asia-Pacific) Cooperation
 - Communicating Regional Aspects in tune with 21st C Trends and Currents: Participatory Planning, Responsibility vs. Choice, Stationary vs. Mobility/Interaction
 - Balancing Nature and Man's Habitats; Conservation & Preservation: Providing for the Talent and Skills Diversity to Support Sustainable Development
 - Developing Stable Logistics/Transport, IT, Energy and Water Resource Capabilities to Support Social Infrastructure and the Economy.

Next, I would like to consider the issues of water and water resources within the

context of Okinawa's natural environment, that of an island prefecture at the southernmost end of the Japanese Archipelago, as a lead-in to the potential for geotechnology solutions.

- Unique Characteristics of the Southwest Islands (Ryukyu Archipelago): 4 Controlling Factors (Climate, oceanic properties, and geophysical factors)
- Natural Disasters, Environmental & Pollution Strategies: Issues and Countermeasures
 - Long Term Water Supply Strategies for Okinawa Prefecture:
 - Fundamental Concepts and the Evolution of Water Conservation
 - Water Supply Strategies and Policies of Resource Development
 - Rethinking Water Usage/Supply Systems
 - Drought Controls and Measures Taken at Source (Water sources are recharged by the forest! Community Support Essential!)
 - Okinawa's Strategies as an Archipelago with Remote Islands: Case Studies of Diverse Water Resource Usage
 - Building Dams on Small, Remote Islands, Underground Dams for Agricultural and Residential Water
 - Alternate water sources:
 - Springs, Small Scale Waterworks, Rainwater, Wells, Groundwater
 - Redevelopment and Use of Idle Water Sources; Development of Seawater Desalination Plants
 - Recycling and Treating Sewage and Wastewater

2. REGIONAL STRATEGIES FOR THE OKINAWA ISLAND GROUP

Okinawa's strategies for economic self-sufficiency in the 21st Century are based on interaction and interaction with those parts of the Asia-Pacific region within a 3,000-kilometer radius of these islands. (REF: Power Point 3)

The national government followed the 1st Okinawa Promotion and Development Plan (1972-1981) and the 2nd Okinawa Promotion and Development Plan (1982-1991), with a 3rd Okinawa Promotion and Development Plan (1992-2001). A comprehensive review of these plans was compiled (May, 2002) which summarized Okinawa's current level of development and its remaining issues, as well as its potentials. These findings were incorporated into the new development program for Okinawa.

Presented here (Figure 1) for reference are the guiding policies of the promotion and development programs as well as Okinawa Prefecture's environmental management program as examples of the methods of pursuing sustainable development in island environments. Also, to introduce the concepts underlying Okinawa's future plans, here are: a) Okinawa's socio-economic issues and conditions, the trends of the day, Okinawa's unique aspects, and the perspectives on which Okinawa's vision of the future is based; b) in pursuit of development, providing the fundamentals that allow sustainable development, such as a vigorous industrial base, greater exchange and cooperation with the Asia Pacific region, balance between the natural environment and Man's habitats, a healthy, orderly society, the nurture of diverse talents and skills, and invigoration of the remote and isolated areas, and, c) adopting development and promotion measures for each island region; developing support systems and taking special action to advance these development and promotion measures; giving full play to Okinawa's characteristics; overcoming disadvantages; requesting the National Government provide special support measures for improvement of military base issues

and other problems. In this light, in July of 2002, the Cabinet Office promulgated the Okinawa Development and Promotion Plan with its four sections of: (1) General Remarks, (2) Basic Direction for Development and Promotion, (3) Development and Promotion Measures, and (4) Development and Promotion Measures by Region.

3. UNIQUE ASPECTS OF OKINAWA'S NATURAL ENVIRONMENT

Among the island communities of the Asia-Pacific, the Southwest Islands, a.k.a. the Ryukyu Archipelago, have a unique position in terms of island studies perspectives. I have summarized below, some of the unique environmental aspects, and methods and technologies of community development.

The four facets having with the greatest impact on natural conditions in the Ryukyu Archipelago are:

- 1) latitude (sub-tropical);
- 2) aberrant weather patterns (typhoons, tropical depressions);
- 3) ocean currents (the Black Current, warm water flows); and
- 4) the Chinese mainland (the Eurasia continent).

The world has numerous island communities, each with its own unique aspects. Okinawa is notable for characteristics unique from other areas of Southeast Asia, or the island nations of the South Pacific. (REF: Power Point 4)

Okinawa Prefecture consists of some 160 small islands (40 of which are inhabited) scattered across a broad expanse of the East China Sea and the Pacific Ocean. They reach 1,000 kilometers east to west, 400 north to south.

The ancient connection between the Ryukyu Archipelago and the continent is evident not only in the geology and landscape, but in anthropological, ethnic and biological aspects. (Figure 2) (REF: Power Point 5)

The mission of civil engineers is securing happiness and the greater good of mankind. This can only be achieved through deep understanding of, and dialogue with, nature. Project implementation, from planning to maintenance, must be based on comprehensive understanding and evaluation of natural phenomena, while always focusing on safety, disaster prevention, health and security. At the same time, continual progress is essential to conservation of land and the natural environment, and protection of our living environment.

At this point, for reference, I will explain the phenomenon of natural disasters. First, the principle guiding disaster prevention is full consideration of the interaction between natural phenomena and human activities: how they interact determines the potential for disasters. I will clarify how knowing the (both direct and indirect) causes of aberrant weather patterns, et al, is useful in evaluating disaster prevention and recovery methods. Additionally, the potential to avert disaster is determined by the involvement of the ordinary citizen, government authorities, and disaster control experts. When the various natural forces are input into a black box of local factors, we see that various types and scopes of disasters appear as the output. (Figures 3 - 4)

Next, as an example of the regional advantages and disadvantages to Okinawa Prefecture, I will introduce the movements of last month's Typhoon No. 16. In a typical year with the usual typhoon paths, the Ryukyu Archipelago is in the midst of the Typhoon Corridor. Around June, typhoons move off the north coast of Taiwan, before heading for the Chinese mainland. Later months are marked by a more easterly path which leads northward to Kyushu, Shikoku and the main island of Honshu, while come October, the path starts far east of the Ryukyus and moves due north. In recent years,

these usual paths have given way to irregular pathways (Figure 5), reportedly due to changes in the global environment (changes in the ocean current patterns). These bring droughts or other natural disasters to Okinawa Prefecture. These disasters include heavy rainfalls (Note: water resources – the rains also have the benefit of bringing water) for which prediction and countermeasures are a problem of growing difficulty. Okinawa Prefecture has overcome its cruel destiny replete with natural disasters (heavy rain or low rainfall/water rationing) that are brought about by its island environment. It takes advantage of its geographical location, as well as its history of friendship and exchange with the southern reaches and the world, to achieve self-sustained development (international exchange; technology transfer to other subtropical island regions).

Incidentally, Typhoon 16 was a strong typhoon, remained stationary for an extended period, and marked historic highs for wind velocities and total precipitation. (REF: Power Point 7)

4. RELATIONSHIP OF GLOBAL ENVIRONMENTAL ISSUES WITH GEOTECHNOLOGY

First, to provide an awareness of environmental science and environmental engineering, I will present the (1987) proposals of the Science Council of Japan on the relationship of Environmental Science, a comprehensive interdisciplinary field of study, and Environmental Engineering, a practical science. (Figure 6)

Next, let us look at two systems to serve as references in considering global environmental issues (Figure 7 & 8). The first figure categorizes environmental problems into those of natural causes and human causes. The second figure looks at global environmental issues as a problem for geotechnology.

Next, I will briefly go over the role of geotechnical engineering in island environments. In 1981, Sembenelli and Ueshita defined Geotechnical Engineering as a prospective, comprehensive and interdisciplinary approach to environmental issues as opposed to the conventional Soil Mechanics/Soil Engineering which are academic, technical and symptomatic approaches (Figure 9). Environmental geotechnical engineering sessions were early recognized in international conferences. The discipline covers the atmosphere, hydrosphere, geosphere, biosphere, and the microbiosphere, as summarized in the diagram (REF: Power Point 8 9). In April 2000, the Science Council of Japan Specialized Field Liaison Committee suggested Geotechnical and Geoenvironmental Engineering as a new field of study that incorporates a broader scope of phenomena to meet the needs of the 21st Century. Based on this trend, I have proposed and promoted the application of Insular Environmental Geotechnical Engineering that links civil engineering, environmental engineering, and geotechnical engineering with island studies. (REF: Power Point 10-12)

5. AN OVERVIEW OF WATER RESOURCE ISSUES IN OKINAWA

- Concept of the Hydrological Cycle in an Island Environment, and Water Uses in Hawaii and Okinawa

Water resource is one of the most important natural resource of a nation. In Okinawa, the lack of water resources has impeded industrial growth. Since the postwar U.S. military plan in 1962, there has been over 30 water supply and demand

studies and plans for Okinawa. The island's water issues must be understood in connection with the island community, meteorology, hydrology, and geology. It is also important to understand the relationship between water volume, quality, and flow, as well as the north-south conflict between the water sources versus the (urban) water consumers in Okinawa. (Figure 10)

I have joined with others in bilateral water issues and resource studies conducted between Hawaii and Okinawa. The findings have been published in "Island Regions' Water Resource Issues and Prospects", covering the differences between Hawaii's natural underground dams and Okinawa's surface dams and manmade underground dams, as well as water sources, volume and quality (REF: Power Point Slides 13-16).

Next, I will discuss systems of water usage and water resource development vis-à-vis consumption, in Okinawa Prefecture. I will outline this using a figure to show the water resource development projects under the 3rd Okinawa Development and Promotion Plan as well as the Long Term Water Supply Draft Proposal (2002-2003). (REF: Power Point slides 19-26) Figure 11 shows how water demand for daily use is projected; Figure 12 summarizes the rivers and surface water tapping facilities in Okinawa, and Figure 13 details the Water Source Fund projects and the submarine water transmission pipes.

The following recommendations are made on Okinawa Prefecture's long-term water supply and demand plan:

- (1) Develop water resources such as rivers, dams, groundwater, and seawater desalination
- (2) Diversify water sources (rainwater, recycled water) that can be diverted among different uses
- (3) Promote a water-conservation conscious society; streamline water use
- (4) Measures at the water source, including the Water Source Fund and various forms of exchange and cooperation between the water source areas and consumption areas.

In addition, there is a requirement for follow-ups to the plan. (The national dams in northern Okinawa offer a good example of follow-up in development, use and management.)

6. APPENDIX

I will introduce the diverse water sources and water resource development and usages via pictures and charts. (REF: Power Point Slides 27-38)

- Small scale dams for small islands
- Springs, wells, and small-scale waterworks: uses and sanitation issues
- Rainwater tanks in individual homes and apartment complexes: equipment, water quality issues
- Merits of seawater desalination in remote islands: abundant seawater, plant construction period, area, ease of feeding water
- Underground dams (Miyako, Itoman area, remote islands): Pollution and threat of cave-in's
- Sewage and wastewater treatment and recycling: offices, hotels, resort facilities, water used by public facilities of all types; Ecology and Amenities (The Ota Riverfront project, Aqua Park, et al); Agricultural and Industrial Water Use (Figure 14)

7. CONCLUSION

Key Words: Island Studies, Environmental Engineering, Practical Bio-engineering, disaster, disaster prevention

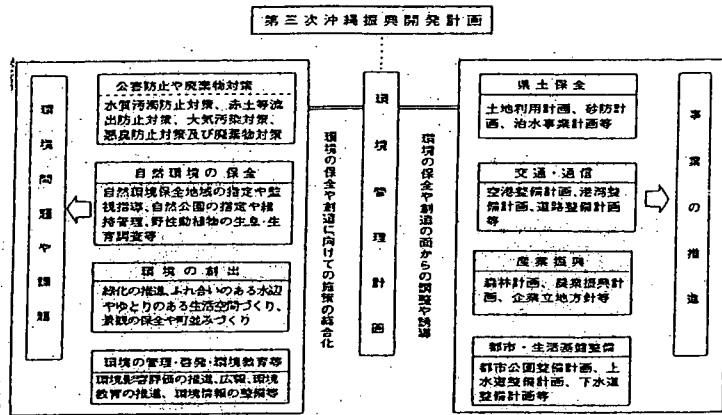
SUSTAINABLE DEVELOPMENT

Think Globally. Act Locally

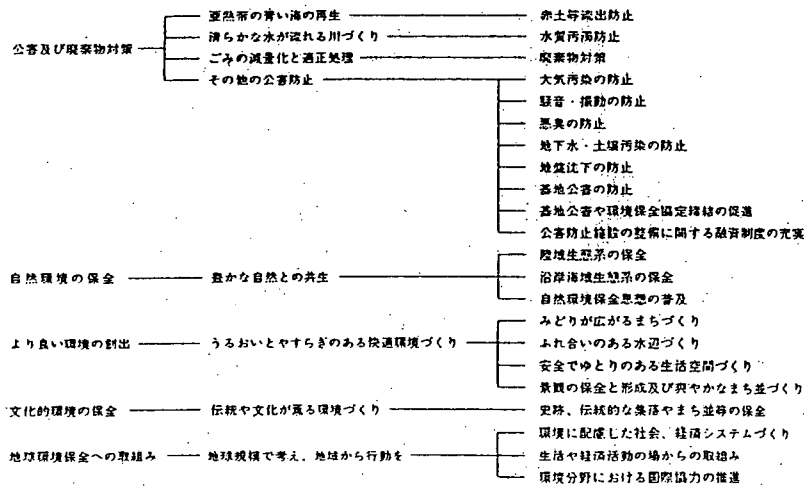
The 3R's: Reduce, Reuse, and Recycle

Create, Sustain, Renew

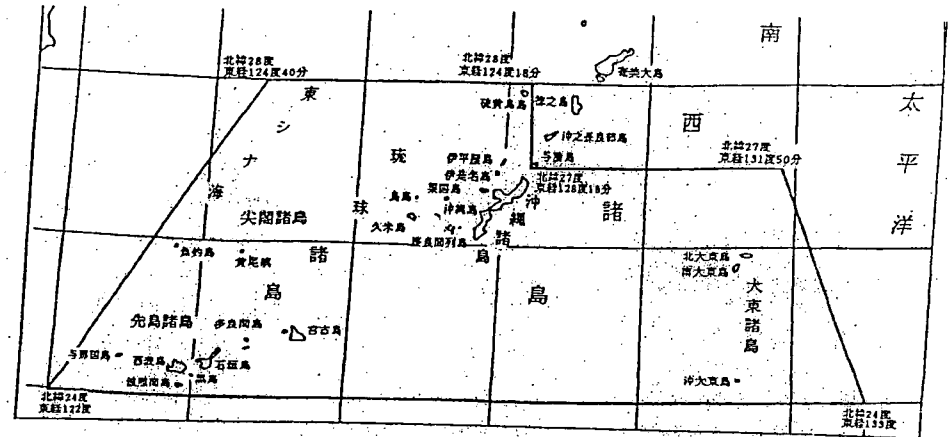
Accolades to Civil and Environmental Engineering!!, Act Locally!



環境管理計画の位置付け



施策の体系



島嶼県沖縄の圏域図

(「土地対策の概要 95」沖縄県企画開発部, 1995年による)

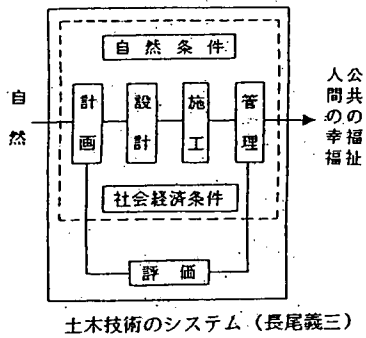
高島と低島の自然環境

	高島	低島
1. 地形的特徴 (1) 山地及び丘陵 (2) 台地 (3) 低地	山地が存在し、山地周辺には、比較的起伏の丘陵地が発達する。 海成の砂礫台地が発達する。 谷が発達し、谷地低地が見られる。	山地は存在しない。尾根が穹高性をもつ丘陵とそれを取り巻く台地が発生する。場所によっては、台地より低地に小起伏の丘陵が発生する。 琉球石灰岩から構成された石灰岩台地が発達する。 谷の発生が少なく、断片的な海岸低地が見られる。
2. 地質的特徴	a 離島 古期岩類、深成岩類が主である。 b 火山島 火山岩、噴出岩が主である。	a 陸地 古期岩類、深成岩類が主である。 b サンプラ 琉球石灰岩が主である。
3. 土壌的特徴	成帯性の赤黄色土および火山灰土壌が主である。	石灰岩土壌(テラロッサ)が主である。
4. 水文的特徴	河川水系	地下水水系

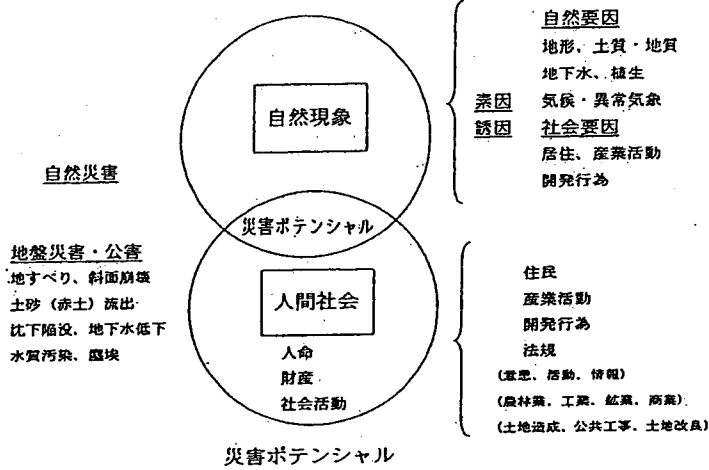
(目崎茂和:島の生態基盤——琉球列島の分類1978)

Figure 2: Geography and Geology of Okinawa Prefecture

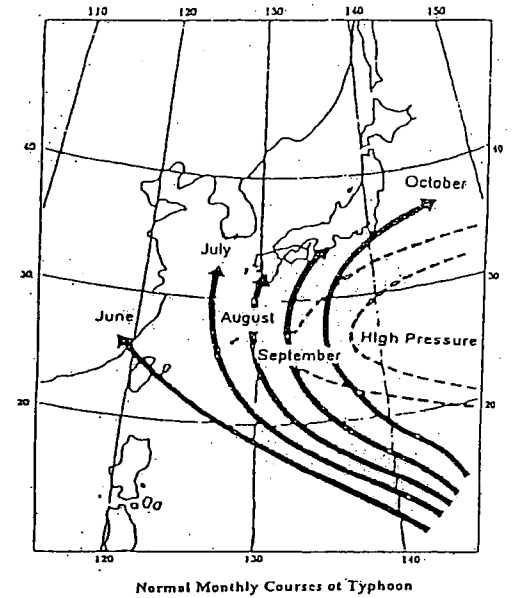
Figure 1: Environmental Management Scheme in the 3rd Development and Promotion Plan



土木技術のシステム (長尾義三)



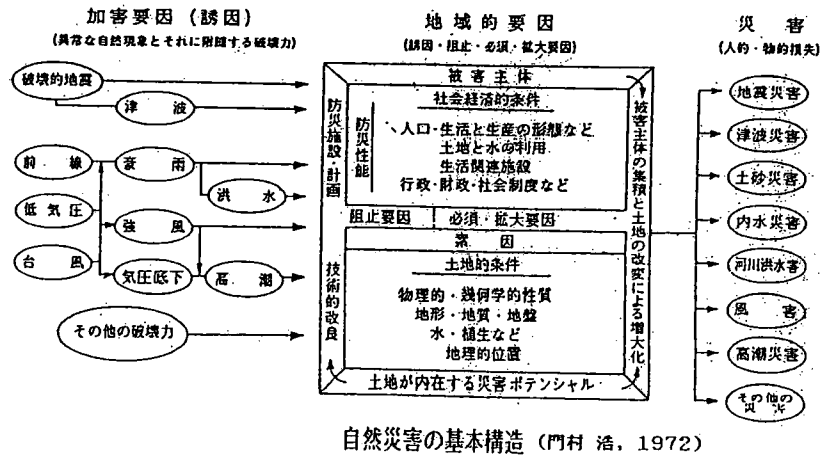
災害ポテンシャル



Normal Monthly Courses of Typhoon

環境/国土保全と災害・公害防止事業	
	施設/事業内容
自然環境	保全・回復・自然公園保護・管理、保護センター等、緑化
災害防止	治水、すべり・崩壊対策、海岸保全対策、治山対策、防災体制
公害防止	7公害対策、環境資源保全活用、管理計画、環境影響評価、赤土等流出防止対策等

Figure 3: Civil Engineering Technology: Disaster Prevention and Countering Pollution



自然災害の基本構造 (門村 浩, 1972)

Figure 4: How Natural Disasters Occur

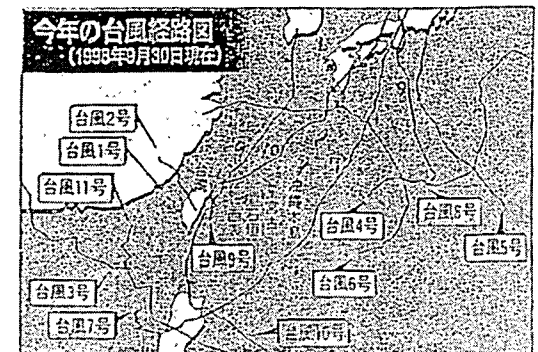
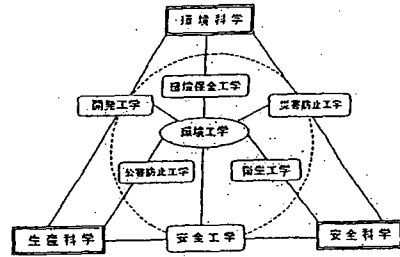


Figure 5: Typhoon Routes



(O)は広義の環境工学の領域を示す。

環境工学の位置

(『現代環境工学概論』：オーム社、1978)

Figure 6: Environmental Science and Environmental Engineering

環境悪化事象の分類 (天野, 1971) 出典『環境科学』: 技報堂

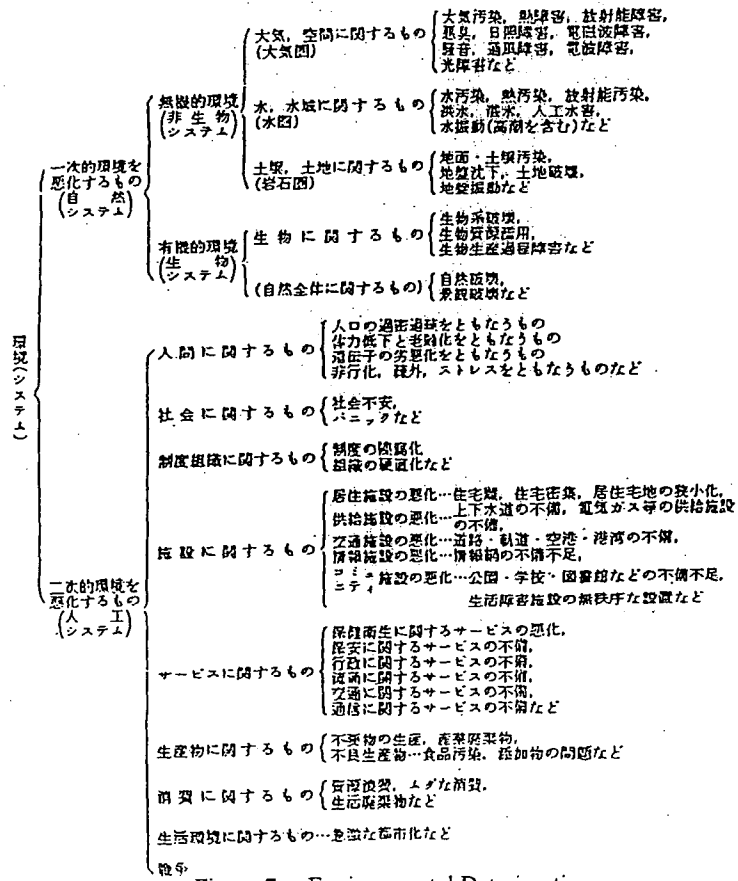


Figure 7: Environmental Deterioration

地球環境問題と地盤との関係 (地球環境悪化の構図, 石 弘之より)

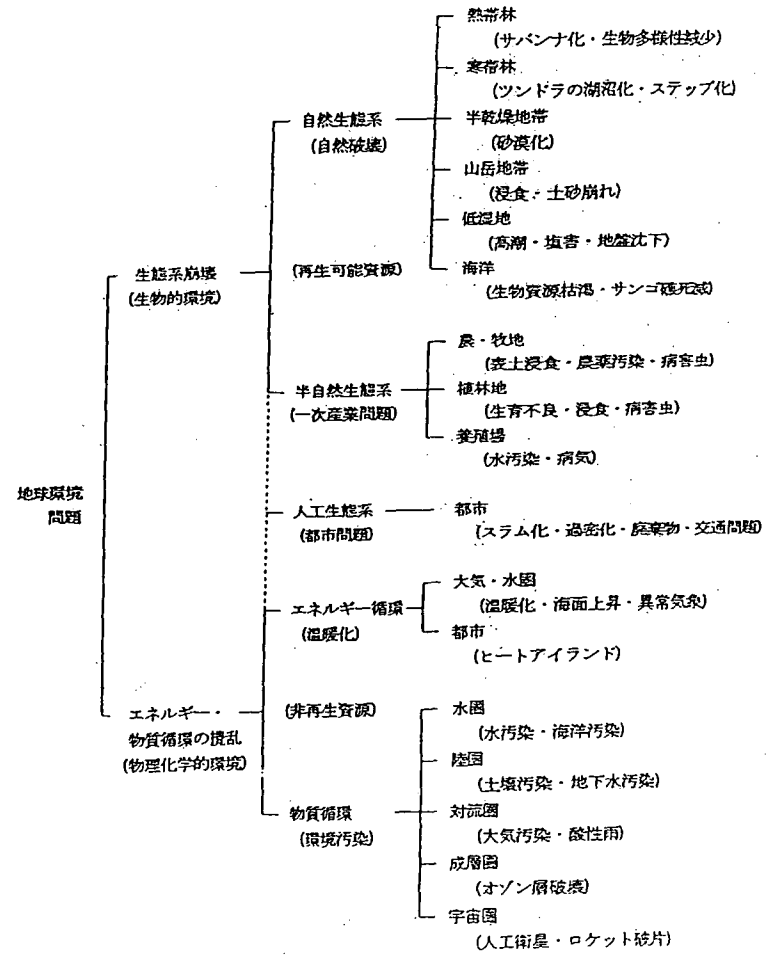
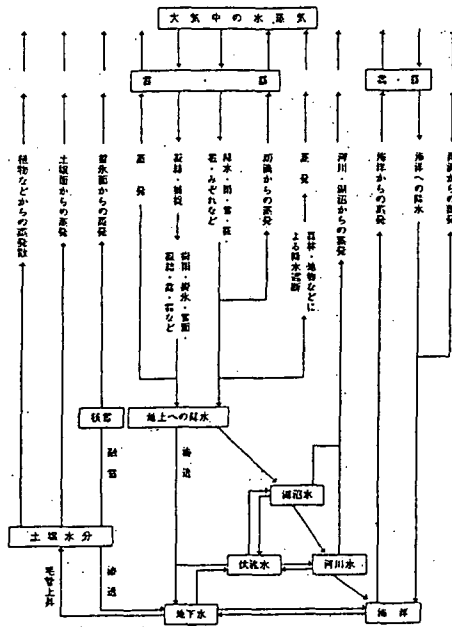


Figure 8: Global Environmental Issues

Recognition to environmental geotechnics vs. conventional geotechnical engineering (Sembenelli and Ueshita, 1981)

Conventional Geotechnical Engineering	Environmental Geotechnics
1) Solution for accidental problems/hazards	Predictable/forecasting engineering to protect environment impact
2) Limited to special cases and responsibility	Comprehensive, interdisciplinary based on soil mechanics, soil engineering rock engineering, engineering geology, groundwater engineering etc.
3) Academic, theoretical contribution	Engineering, practical contribution to regional geotechnical problems. Ultimates comprehensive responsibility
4) Contribution to local, limited field	Positive contribution to environment impact assessment and control at initial regional development project

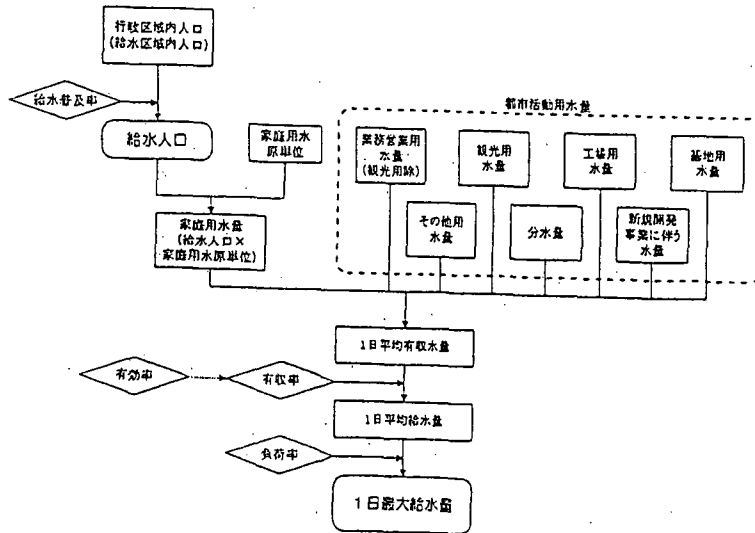
Figure 9: Soil Mechanics/Soil Engineering vs. Environmental Geotechnical Engineering



(資料) 資源調査会編『日本の資源問題』(上)

水の循環

Figure 10: The Hydrological Cycle



生活用水の予測手順

Figure 11: Flow Chart: Water Supply & Demand Planning

沖縄県の主要ダム施設一覧(平成12年度末現在)

No.	ダム名	河川名	目的	貯水池の規模(千m ³)		開発水量		事業者	備考
				総貯水容量	有効貯水容量	上水(m ³ /日)	工業(m ³ /日)		
(多目的ダム)									
1	福地ダム	福地川	FNWI	55,000	52,000	86,800	31,200	沖縄総合事務局	
2	新川ダム	新川	FNWI	1,650	1,250	13,200	4,800	沖縄総合事務局	
3	安波ダム	安波川	FNWI	18,600	17,400	55,200	19,800	沖縄総合事務局	
4	普久川ダム	普久川	FNWI	3,050	2,550	19,900	7,100	沖縄総合事務局	
5	辺野喜ダム	辺野喜川	FNWI	4,500	4,000	15,500	5,500	沖縄総合事務局	
6	湧部ダム	湧部池川	FNWI	8,200	7,800	11,500	12,000	沖縄総合事務局	(水量:m ³ /日)
7	与那川ダム	与那川	FNWI	7,100	6,900	28,800		沖縄県	
8	安波ダム	安波川	FN	510	470			沖縄県	
9	内川ダム	内川	FNWI	66	56	45		沖縄県	
10	真栄里ダム	真栄川	FNA	2,300	2,100			注1 沖縄県・沖縄総合事務局(共同事業)	
(都市用水)									
11	金武ダム	備前川	W	820	660	19,000		沖縄県企業局	
12	山崎ダム	天願川	W	1,250	1,190	7,600		沖縄県企業局	注2
13	屋敷ダム	前田川	W	83	60	325		金武町	
(かんがい用水)									
14	座原ダム	座原川	A	13,000	12,850		2,201※	沖縄総合事務局	
15	石垣ダム	宮良川	A	420	400		0.938※	沖縄総合事務局	
16	名取ダム	名取川	A	3,970	3,820		0.761※	沖縄総合事務局	
17	大瀬ダム	大瀬川	A	1,190	1,170		0.187※	沖縄県	
18	名取ダム	名取川	A	300			5.221	金武町(防衛施設庁)	(水量:m ³ /日)
19	岩瀬ダム	岩瀬川	A	423			1.936	金武町(防衛施設庁)	(水量:m ³ /日)
20	湧部ダム	湧部池川	A	267		180	2.696	辺野喜町(防衛施設庁)	(水量:m ³ /日)
21	湯川ダム	湯川	A	375	333		0.873※	辺野喜町	
22	長瀬ダム	長瀬川	A	1,600	1,430		0.223※	沖縄県	
23	石川ダム	石川	A	230	216		0.130※	沖縄県	改修中
24	砂川地下ダム	砂川	A	9,500	6,900		1.46※	沖縄総合事務局	
25	比地地下ダム	比地川	A	10,500	7,600		1.83※	沖縄総合事務局	

目的(F:洪水調節、N:洪水の正常な機能の維持、A:かんがい用水、W:水道用水)

※最大取水量

注1)1日最大 146,620m³/日

注2)山崎ダムは石川貯水調整池と合わせて46,200m³/日の開発水量

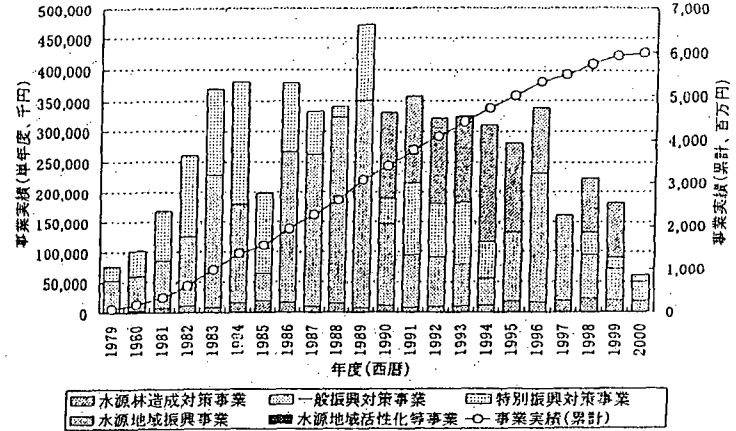
出典)沖縄県土木建築部:平成11年度土木建築部要覧、沖縄県土木建築部河川課:沖縄県のダム要覧

内閣府沖縄総合事務局北部ダム事務所:平成12年度事業概覧、
沖縄県農林水産部農地水利課:平成12年度沖縄県農業用水供給計画事業要綱報告書、
財団法人日本ダム協会:ダム年報2000

河川表流水取水施設(平成11年現在)

取水ポンプ場名	河川名		日最大取水量(m ³ /日)
	水系	河川	
1 武見	武見川水系	武見川	9,850
2 座津武	座津武川水系	座津武川	18,400
3 宇嘉	宇嘉川水系	宇嘉川	16,400
4 辺野喜	辺野喜川水系	辺野喜川	6,900
5 佐手	佐手川水系	佐手川	32,000
6 佐手前	佐手前川水系	佐手前川	8,600
7 与那	与那川水系	与那川	32,700
8 宇良	宇良川水系	宇良川	23,300
9 比地	比地川水系	比地川	14,700
10 田嘉里	田嘉里川水系	田嘉里川	19,900
11 喜如嘉	外堀田川水系	外堀田川	19,000
12 満名	満名川水系	満名川	23,300
13 西屋部	屋部川水系	西屋部川	21,600
14 大保	大保川水系	大保川	37,400
15 平南	平南川水系	平南川	31,680
16 源河	源河川水系	源河川	38,600
17 川崎	天願川水系	天願川	55,300
18 比謝川	比謝川水系	比謝川	63,900
19 長田川	比謝川水系	長田川	25,000

Figure 12: Dams and Pump Stations in Okinawa



注)2000(平成12)年度は予算値

出典)沖縄県企画開発部地域・離島課資料

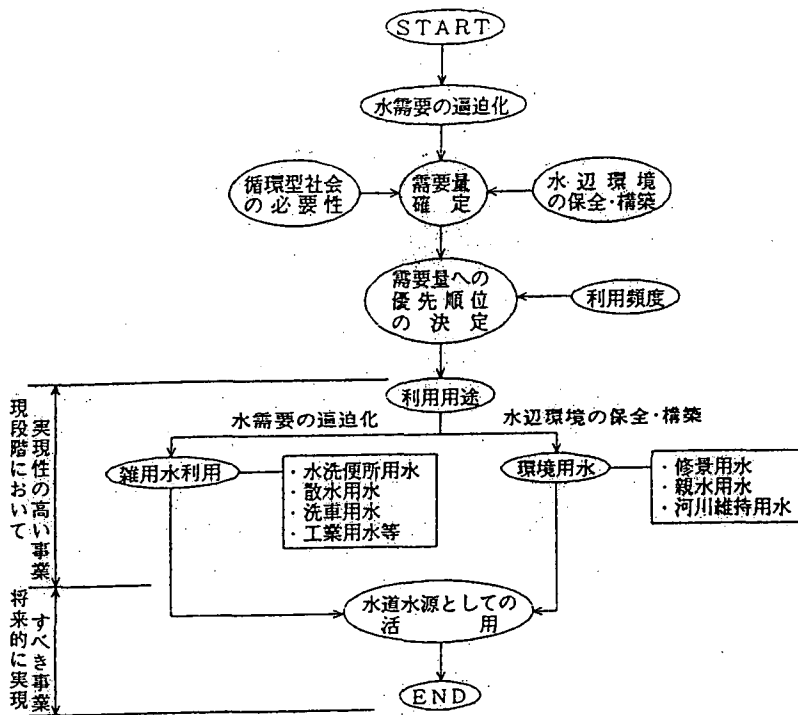
沖縄県水源基金の事業実績の推移

海底送水管の一覧

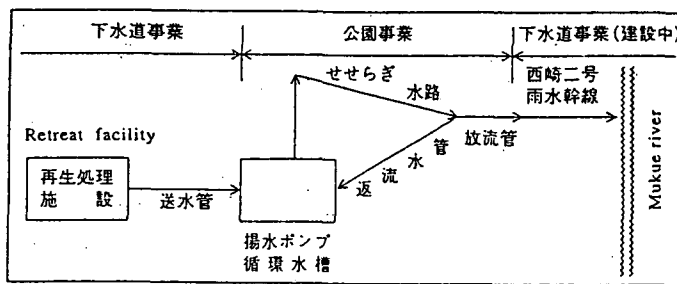
施工年度	送水管布設区間	事業主体名	施設計画		送水管総延長(m)	送水管口径(mm)
			給水人口(人)	給水量(m ³ /日)		
S46	平良市狩俣(宮古島)~池間島	宮古島(企)	2,500	420	2,903	150
S47~S49	西表島~新城島~黒島	竹富町	746	220	13,098	75~150
S47~S49	下地町前浜(宮古島)~来間島	宮古島(企)	548	206	1,601	125
S47~S49	勝連町平度屋(沖縄本島)~津堅島	勝連町	1,600	270	4,606	125
S50	奥武島~オーハ島	仲里村	117	21	555	75
S50~S51	石垣市新川(石垣島)~竹富島	竹富町	550	140	4,242	150
S50~S51	本部町備瀬(沖縄本島)~伊江島	県企業局	8,000	1,700	5,226	200
S50~S51	今帰仁村運天(沖縄本島)~古宇利島	今帰仁村	1,200	255	1,482	150
S52~S53	西表島~小浜島	竹富町	1,000	400	2,904	150
S52~S53	知念村吉富(沖縄本島)~久高島	知念村	540	140	6,550	100
S54~S55	西表島~鳩間島	竹富町	100	40	6,542	75
S54~S55	平良市狩俣(宮古島)~大神島	宮古島(企)	200	80	3,700	75
S55	嶺底島(本部町)~水納島	本部町	140	71	4,300	75
S56~S57	本部町健堅(沖縄本島)~瀬底島	本部町	1,051	473	725	150
S56~S57	平安座島(与那城町)~浜比嘉島	勝連町	1,180	306	1,560	100

出典)沖縄県福祉保健部薬務衛生課:沖縄県の水道概要(平成10年度)

Figure 13: Projects at the Water Source and Water Transmission to Remote Islands



事業実施に到るフローシート

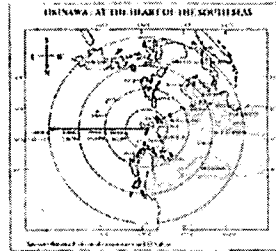


糸満市アクアパーク計画

Figure 14: Reusing Treated Sewage and Wastewater

OVERVIEW:
**Water Resource Issues
of Island Communities**

Case Study of
Sustainable Development In Okinawa Prefecture



Sources: Okinawa Prefectural Government, H. Kakazu

Hosei UEHARA
Director, Uehara Geotec Research Center

Keywords: Speech/Hosei Uehara

Introduction

- The 3rd Promotion & Development Plan (~2002) and the New Okinawa Promotion & Development Plan (2002~)
- Key Concepts: Peace, Comfort, and Vigor
- Goals: Sustainable development for self-sufficiency
Hub of Asia-Pacific cooperation
- 21st Century Trends and Currents
- Development of logistic & transport systems, IT, energy, water resources

Remarks

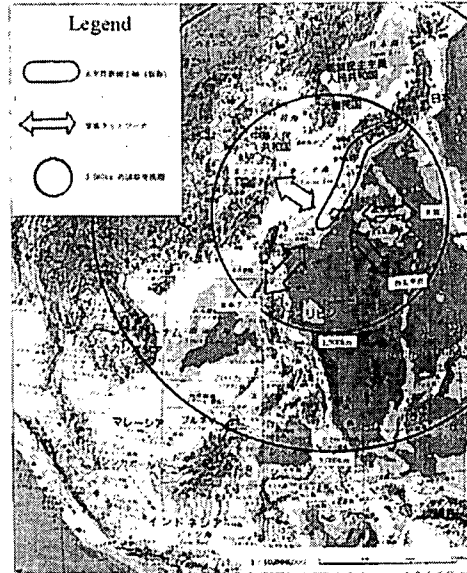
- Environmental Geotechnology
- Okinawa Prefecture's Long Term Plan for Water Supplies & Demand
- Diverse Water Utilization Methods

Keywords: Speech/Hosei Uehara

**Basic Direction for
Okinawa Regional
Development
(PROPOSAL)**

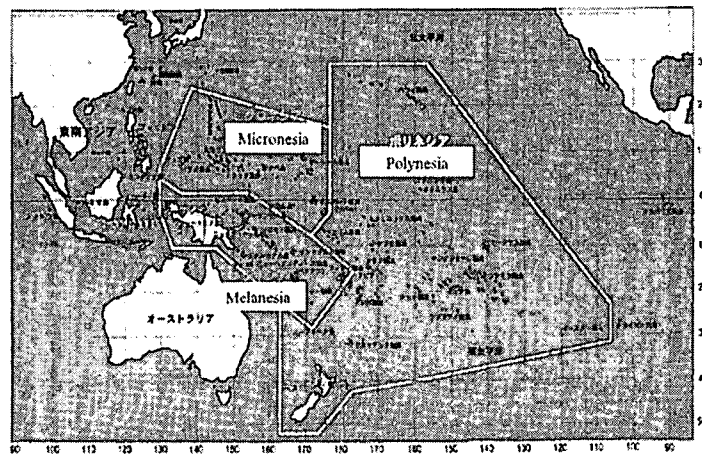
Promote exchange
within a 3,000 km
radius of Okinawa,
with the Asia-
Pacific region.

Source: Okinawa Prefecture



Keynote Speech/Hosel Uehara

**Inland Regions:
Islands of the South & SW Pacific**

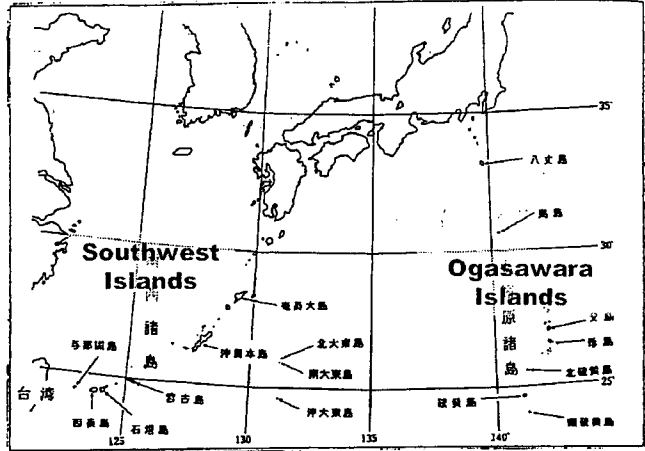
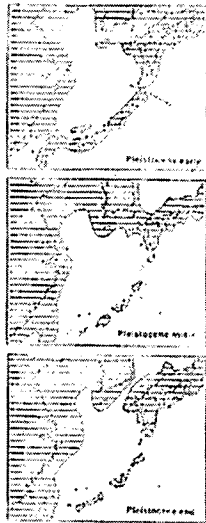


Source: Oceanic Culture Museum,
Ocean Exposition Commemorative Park Management Foundation

Keynote Speech/Hosel Uehara

Japan and the Ryukyu Archipelago

The Southwest Islands & Geological History



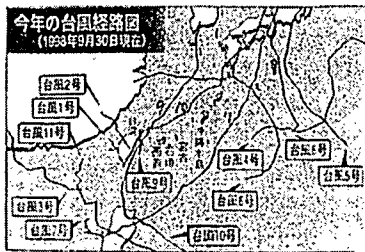
(Source: Old Geography of Ryukyu Islands / Kisaki, Oshiro, 1977)

Keynote Speech/Hosel Uehara

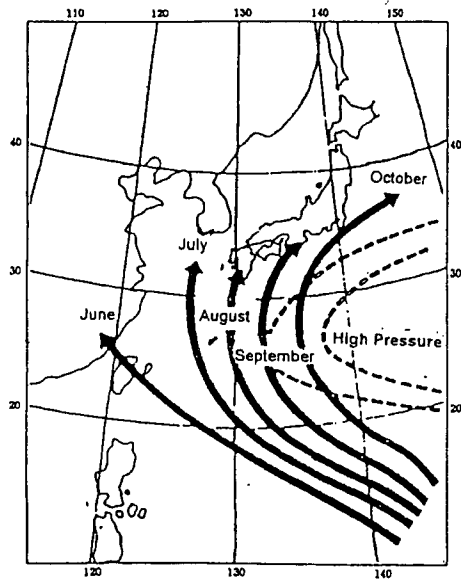
Typhoon Paths and Rainfall

Typhoon Paths, 1998

(As of Sep. 30, 1998)



Usual Typhoon Paths by Month



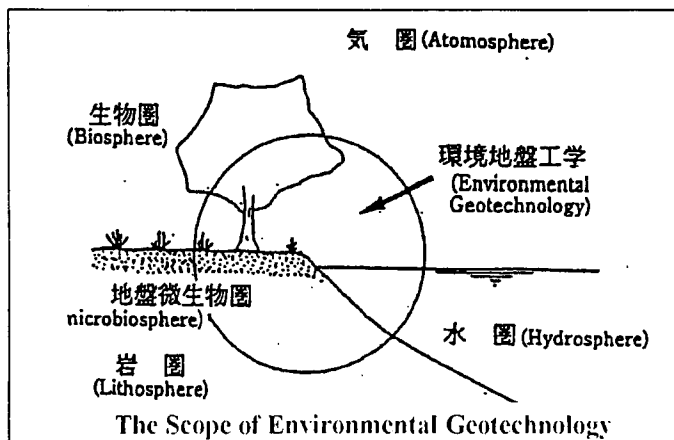
Keynote Speech/Hosel Uehara

Typhoon Paths and Rainfall



Keynote Speech/Hosel Uehara

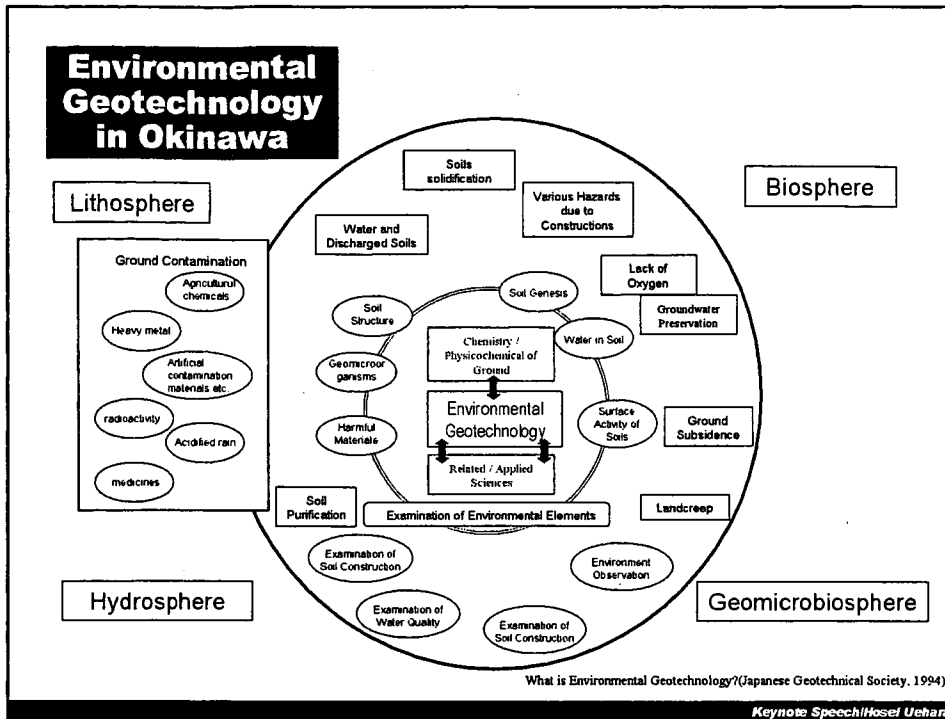
Environmental Geotechnology



(Source: Japanese Geotechnical Society, "What is Environmental Geotechnology?", 1994)

Keynote Speech/Hosel Uehara

Environmental Geotechnology in Okinawa



Environmental Geotechnology on Okinawa

1) Island Surroundings	Weather, sea, tidal plain, latitude/longitude
2) Inland conditions	Area size, topography, geology, soil, water systems, flora & fauna, ecosystem, etc.
3) Human activities	Population, settlements, history, culture, agriculture, wastes, etc.
4) Artificial reformation	Development, construction, facilities, wastes, etc.
5) Imbalances of island nature	Changes in landforms, coast, water systems and ecosystems, public nuisance, etc.
6) Insular characteristics and measures	Island capacities, land usage, water resources development, conservation and preservation of the natural environment, disaster prevention, safety and amenities, etc.

Environmental Factors to be Studied

Keynote Speech/Hosel Uehara

Environmental Geotechnology on Okinawa

Geotechnical Engineering on the Islands

Environmental Factors on Islands	Geotechnical Subjects	
1) Latitude/Longitude, Temperature, Humidity, Sunshine, Precipitation, Evaporation, Water Temperature, Salt, etc.	* Effects of Climates on to the Soil (Genesis) * Effects of Island Topography and Geology on the Soil	Evaluation Projection ↑ Regulations / Contr Countermeasures ↓
2) Area, Topography, Geology, Soil, Water System, Ecology, Underground Resources etc.	* Soil Map and Classifications (Sub-Tropical Soils) * Geological and Geotechnical Problems, Ground water	
3) Residences, Livings, Primary, Secondary, and Tertiary Industries etc.	* Earth Materials and Foundation Problems for Structures and Facilities (Islands Capacity)	
4) Development, Agriculture, Reclamation and Residential Lot Development, Industries, etc.	* Measures for Planning, Designing, and Performance of Public Works, and Observation Data→Analysis→Method→Observation	

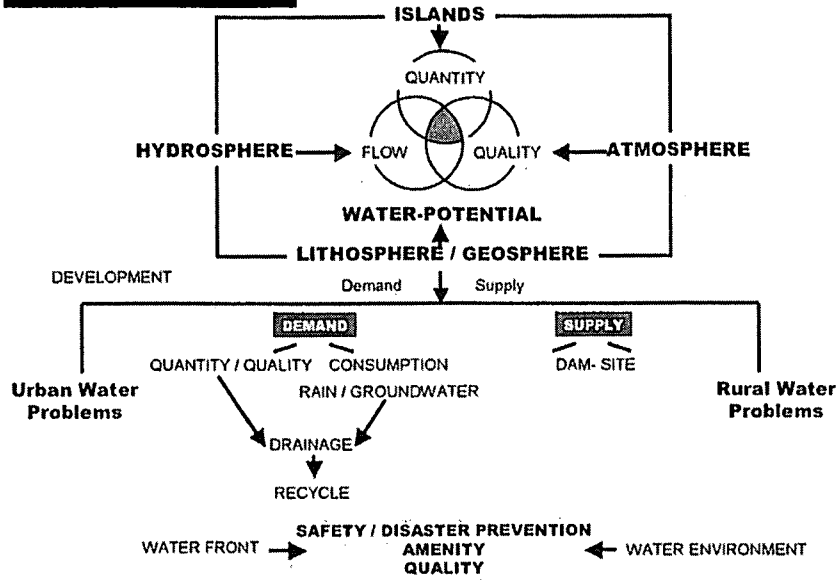
Keynote Speech/Hosel Uehara

The Role of Geotechnology in Insular Regions

1. Construction and disaster control (soil erosion, landslides, cave-in's, etc.)
2. Land development and soil erosion into rivers and oceans
3. Land reclamation and environmental and fisheries concerns
4. Problems associated with water resource development
5. Waste disposal and environmental concerns
6. Construction vs. historical/cultural assets
7. Other environmental issues; reuse, recycling, and use of underground space

Keynote Speech/Hosel Uehara

Island-Water-Environment



Keynote Speech/Hasei Uehara

Insular Water Resources and Strategies in Okinawa

TECHNOLOGIES AND STRATEGIES USED IN OKINAWA
 Third Symposium on Hawaii/Okinawa Water Resources

held in connection with the Fourth WRRRC Conference

Appropriate Technologies and Issues for Water Resources Management on Tropical Islands in the Asia/Pacific Region

University of Hawaii at Manoa
 WATER RESOURCES RESEARCH CENTER
 in cooperation with the
 UNIVERSITY OF THE RYUKYUS
 and OKINAWA PREFECTURE
 Okinawa, Japan

June 1996

PROBLEMS OF GROUNDWATER QUALITY IN INSULAR ENVIRONMENTS

PROCEEDINGS OF MIYAKOJIMA SYMPOSIUM ON ISLAND WATER RESOURCES

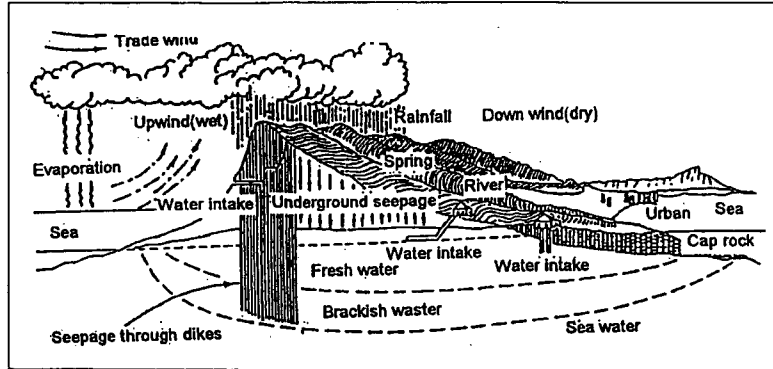
Second Symposium on Hawaii/Okinawa Water Resources (SHOWR II)

University of the Ryukyus
 Miyako Municipal Association
 and
 University of Hawaii at Manoa
 Water Resources Research Center

December 1991

Keynote Speech/Hasei Uehara

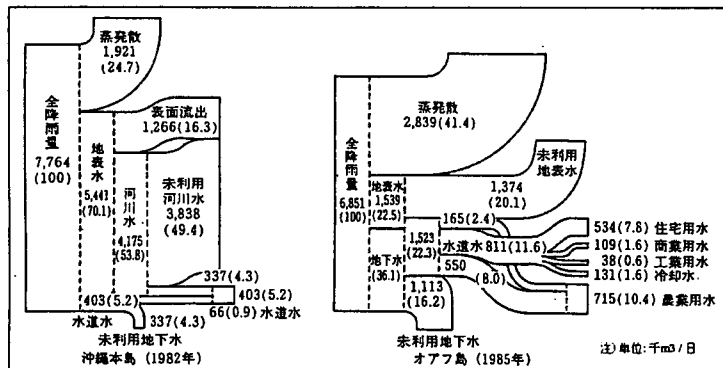
Hydrology of Oahu Is., Hawaii



Source: N. Miwa, "Prospects for Island Water Environments" 1,990-10, Hirugisha

Keynote Speech/Hosel Uehara

Comparison of Water Sources & Use in Okinawa and Hawaii



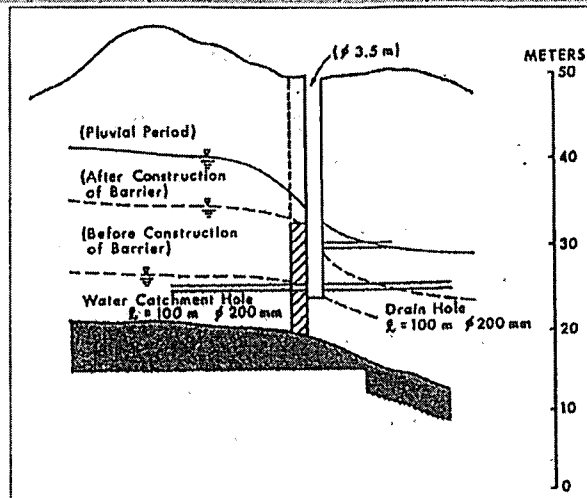
Source: N. Miwa, "Prospects for Island Water Environments" 1,990-10, Hirugisha

- References:
1. Miwa, et al; Water and Survival in an Island Environment(1988)
 2. Hawaii Water Resources Regional Study(1975)
 3. Young; Water Quality, SHOWR(1987)
 4. State of Hawaii; Data Book(1985)

Keynote Speech/Hosel Uehara

Visual Pumping Hole and Drain of Minafuku Underground Dam

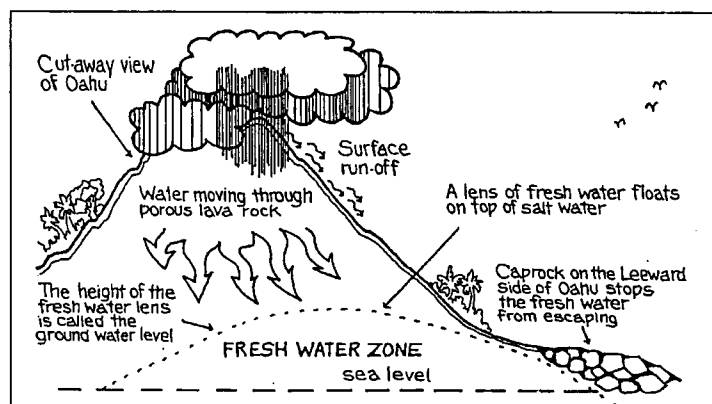
(H. Furukawa, 1987)



Source: H. Furukawa, "Prospects for Island Water Environments" 1,990-10, Hirugisha

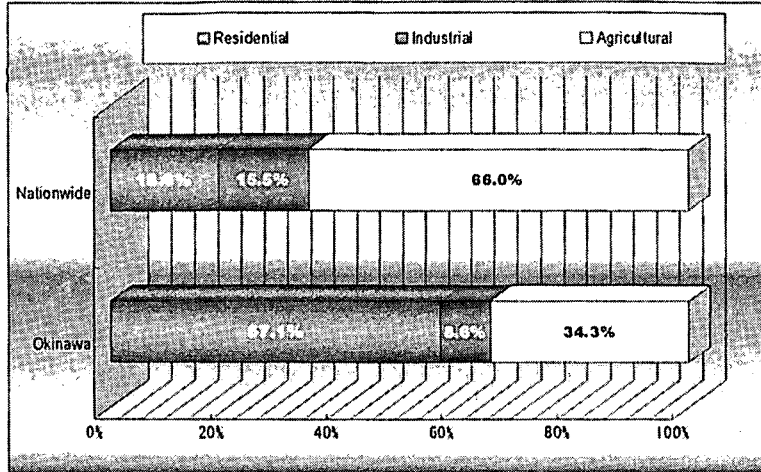
Keynote Speech/Hosel Uehara

How Groundwater Works



Keynote Speech/Hosel Uehara

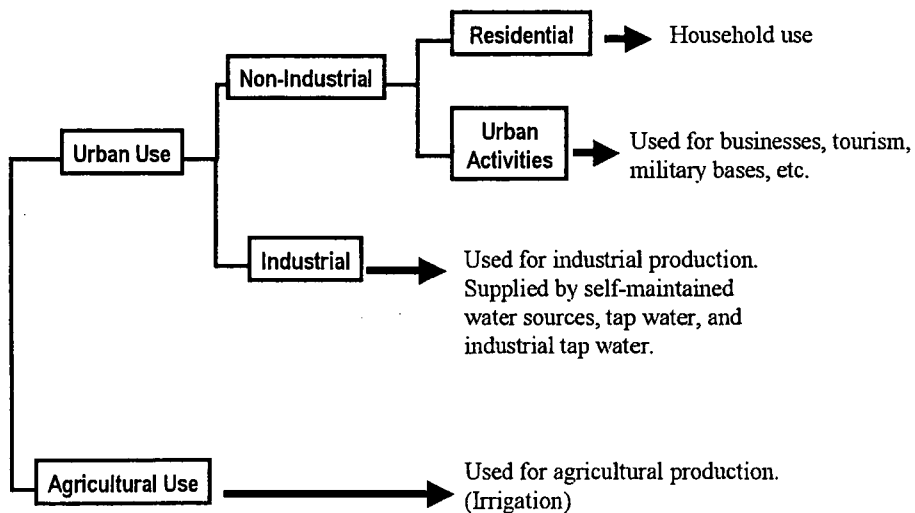
Comparison of Water Usage in Okinawa and Rest of Japan



Source: Ministry of Land, Infrastructure and Transport, Water Resources Bureau, "Water Resources of Japan", 2001

Keynote Speech/Hosel Uehara

Water Usage



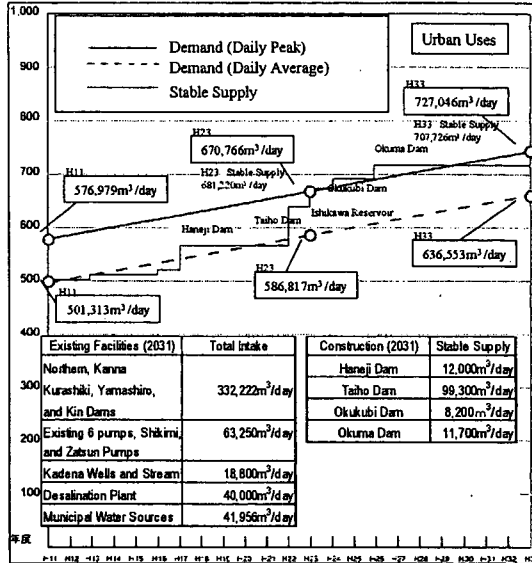
Keynote Speech/Hosel Uehara

Water Supply & Demand in Okinawa

Stable Supply	Construction of multi-purpose dams; western water resources development; development of local water sources; construction of seawater desalination plant
Agricultural Use	Irrigation and drainage facility
Effective Usage	Water conservation, use of rainwater, springs and other water sources, recycling wastewater
Forest Reorganization	Forests to recharge the water sources

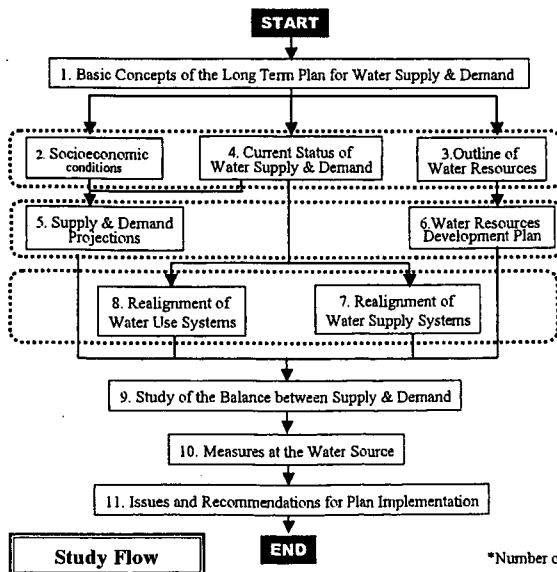
Source: 22nd Conference on Department Projects, Aug. 1, 2002, Department of Development and Construction, Okinawa General Bureau

Supply & Demand (thousand m³ / day)



Keynote Speech/Hosei Uehara

Okinawa's Long Term Plan for Water Supply & Demand (Draft) March 2002



Project Blocs

No.	Bloc	Inhabited Islands	Municipalities
1	Northern Okinawa Is.	3	10
2	Southern Okinawa Is.	2	24
3	Miyako	8	6
4	Yaeyama	12	3
5	Outlying Islands Near Okinawa Is.	14	10

*Number of inhabited islands based on the 1995 National Census

Keynote Speech/Hosei Uehara

Okinawa Prefecture's Long Term Plan for Water Supply & Demand (Draft) March 2002

Water Resource
Development
Methods

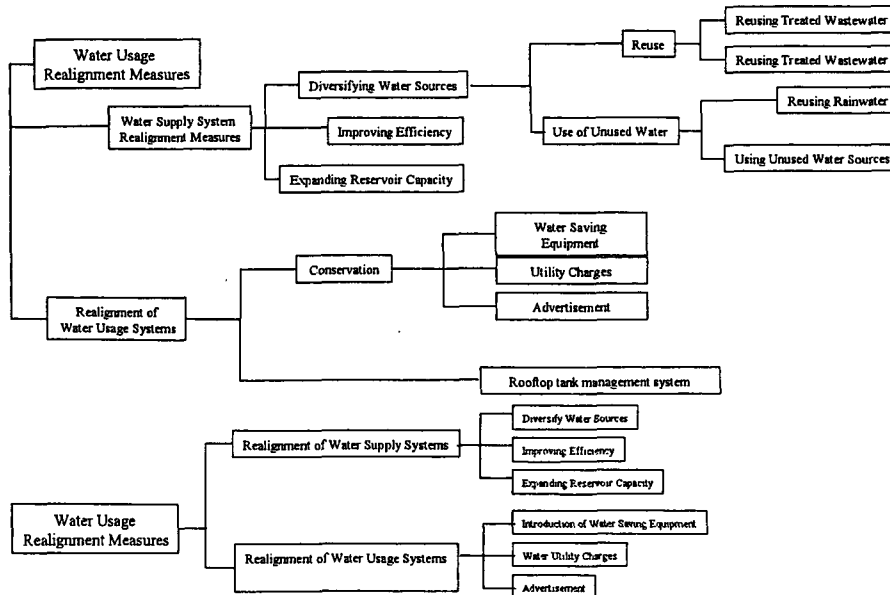
Water Source	Development Methods	Advantages/Disadvantages
Rivers	Intake by pump Dam construction Headrace works	High quality Requires measures at the water source Requires environmental measures
Groundwater	Wells Underground dam construction Spring water collection system	Low cost Requires water quality deterioration
Seawater	Desalination plant construction	Abundant source Not economical Requires environmental measures
Rainwater	Rainwater collection system	Simple, low cost Securing water volume Maintaining water quality
Recycled Water	Advanced treatment plant Drainage system	Reuse Maintaining water quality Not economical

Sources	Development Methods	Usage	Water Volume (m ³ /day)	Timeframe
Rainwater	Individual Circulation	Install tanks on new homes	7,350 (over 10 yrs)	5 yrs
Wastewater Treatment	Regional Circulation	Used in New Naha Urban Center	2,130	5 yrs
	Regional Circulation	Used in new government buildings and school toilets	3,750 (over 10 yrs)	
	Regional Circulation	Central & Southern Okinawa Redevelopment	2,580	
Water Conservation	Water Saving Faucets		-	10 yrs
	Water Saving Toilets (20% savings compared to conventional units)		-	
	Water Saving Washing Machines		-	
	(27% savings compared to conventional units)		-	

Source: Taira, Nema and Shiroma, "Balance of Water Supply & Demand Between Various Uses"

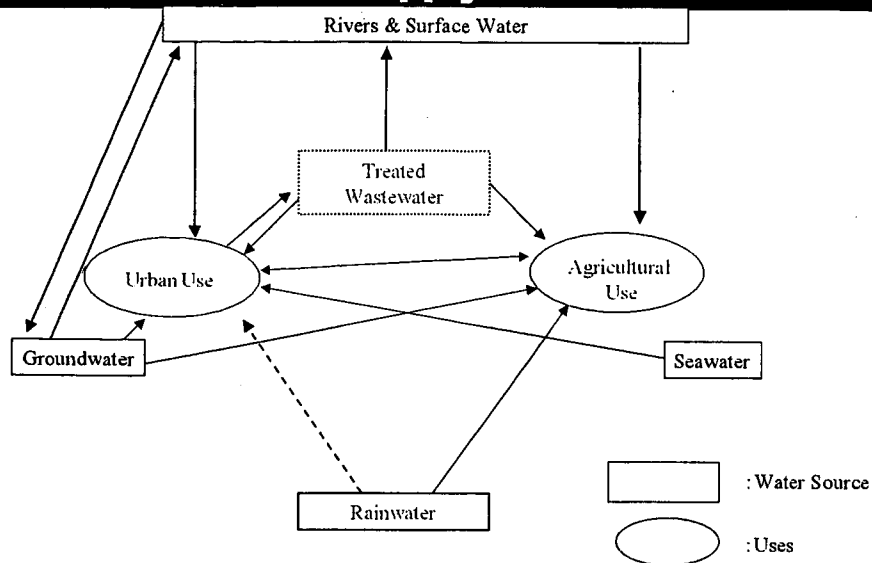
Keynote Speech/Hosel Uehara

Streamlining Water Usage



Keynote Speech/Hosel Uehara

Okinawa's Long Term Plan for Water Supply & Demand



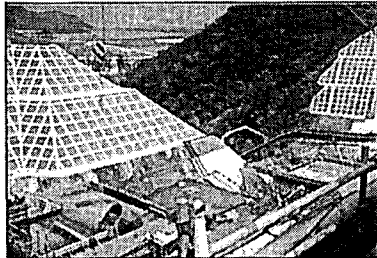
Keynote Speech/Hosel Uehara

CONCLUSION

1. Solutions to Water Issues
 - a. Multi-purpose dams and other infrastructure development
 - b. Alternative water sources
 - (1) Rainwater
 - (2) Treated wastewater
 - (3) Water conservation efforts
2. Recommendations
 - a. Study of future supply vs. demand
 - b. Diversifying water sources
 - c. Improve efficiency, promote conservation
 - d. Water source protection and drought measures
 - e. Environmental conservation

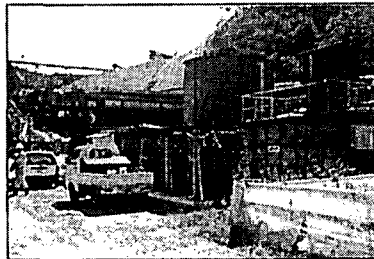
Keynote Speech/Hosel Uehara

Small Dam on a Small Island



Dam Body

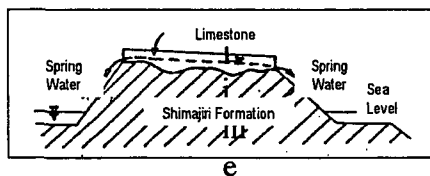
Gakiya Dam,
Iheya Village



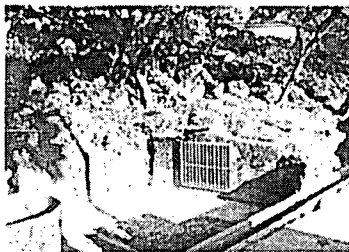
Erosion Control Facility

Keynote Speech/Hosel Uehara

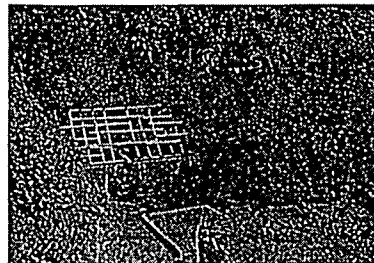
Use of Spring Water



Typical groundwater between
Ryukyu limestone and Shimajiri
formation



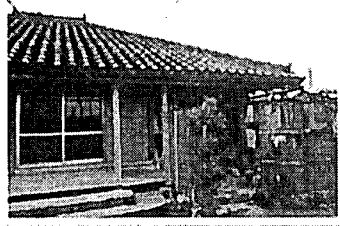
Spring



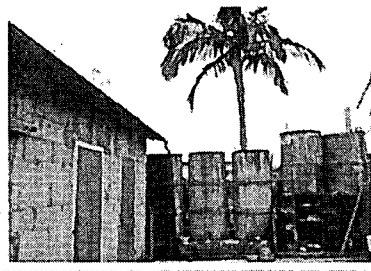
Fountain at Yamagawa, Shuri

Keynote Speech/Hosel Uehara

Use of Rainwater

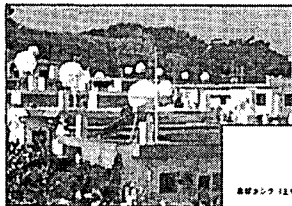


Rainwater Tanks in Old Residences



Keynote Speech/Hosel Uehara

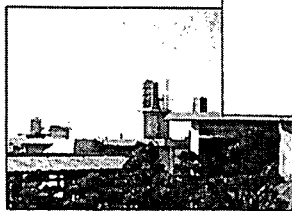
Rainwater Utilization Facilities



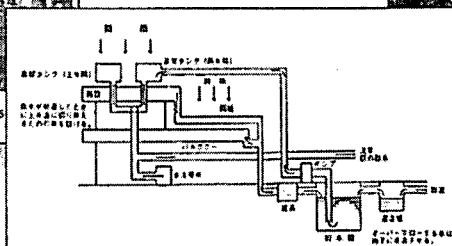
Water tanks on Okinawa's rooftops



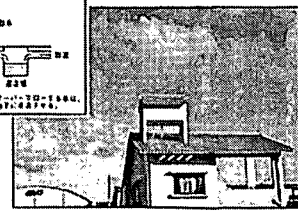
Rooftop water tank of stainless steel



Rooftop water tank of FRP



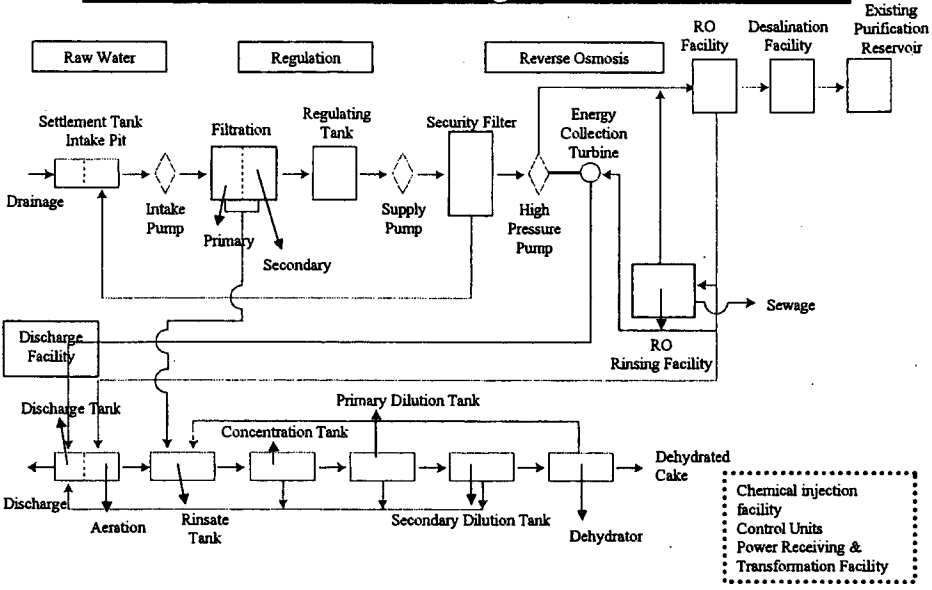
Rainwater Utilization Flow Diagram



Rooftop water tank of reinforced concrete

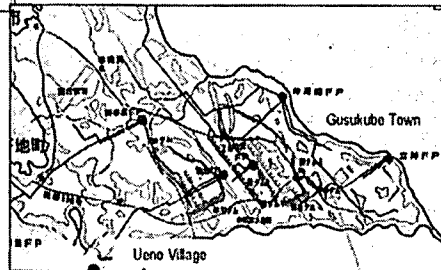
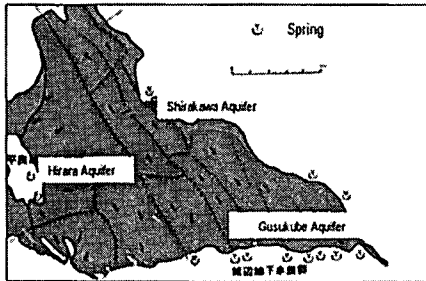
Keynote Speech/Hosel Uehara

Okinawa Prefecture Seawater Desalination Plant Flow Diagram



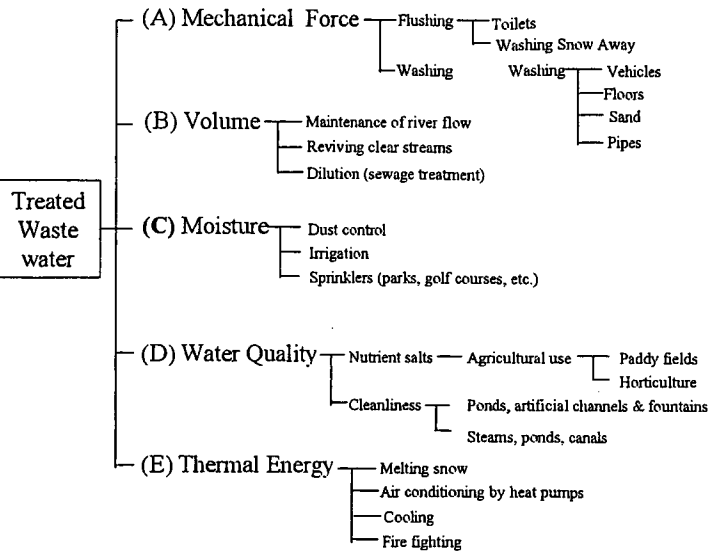
Keynote Speech/Hosel Uehara

Miyako Island Underground Dam Plan



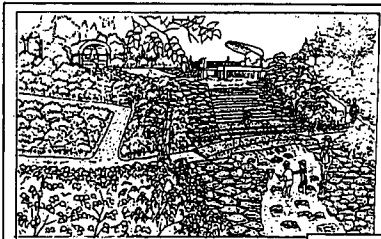
Keynote Speech/Hosel Uehara

Uses for Treated Wastewater



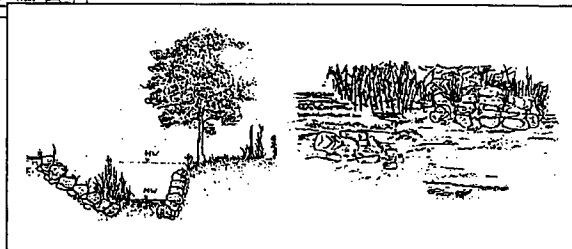
Keynote Speech/Hosel Uehara

Use of Treated Water in Improving the Environment



Amenity

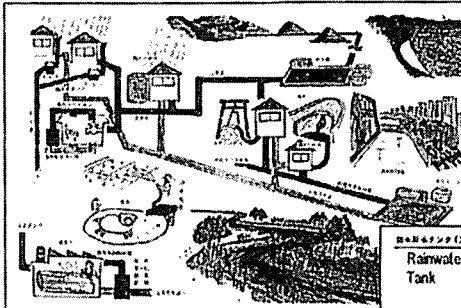
Naha City Well Plan, 1995



Ecology

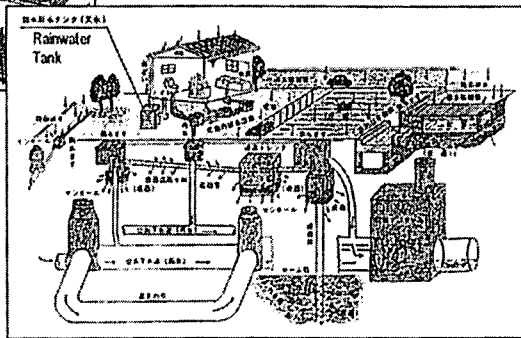
Keynote Speech/Hosel Uehara

Reusing Treated Wastewater



Water Circulation Flow Diagram

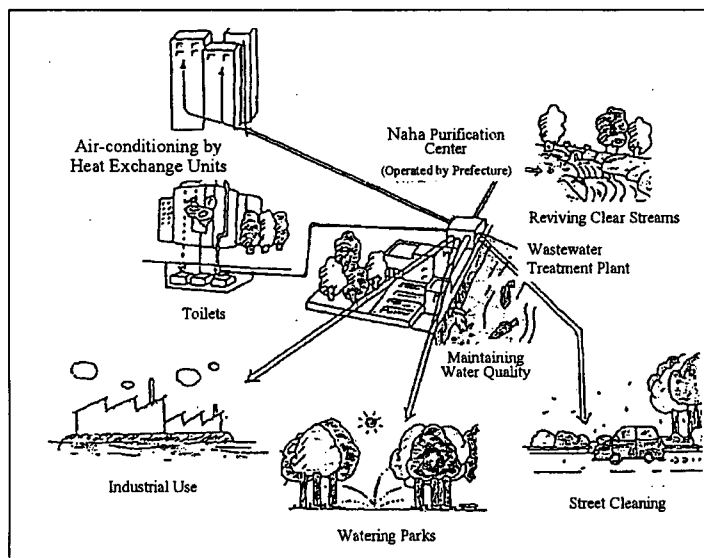
•Naha City Water Environment Conservation Plan, 1995•



Naha City Well Plan

Keynote Speech/Hosel Uehara

Reusing Treated Wastewater



Keynote Speech/Hosel Uehara

Waterfront Projects



Naha City Waterfront

Adopted	Commenced	Completed
FY 1994	Jun-94	Mar-99

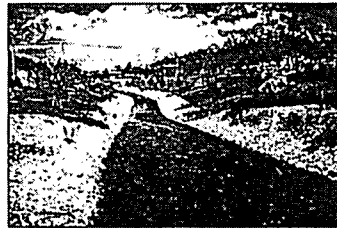
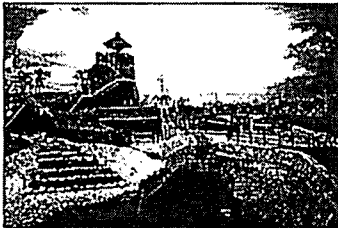


Itoman City Waterfront

Adopted	Commenced	Completed
FY 1993	Oct. 1993	Mar. 1996

Keynote Speech/Hosel Uehara

Water Encounter Park, Itoman City



Keynote Speech/Hosel Uehara

Eco-Dam Declaration: Era of Ecological Conservation

Closing Remarks

1. Sustainable Development
2. Bravo to Civil and Environmental Engineering
3. Think Globally, Act Locally
4. 3R's & Create, Sustain, and Renew



Pryer's Woodpecker



Okinawa Rail



Iriomote Wildcat



Source: Okinawa General Bureau

Keynote Speech/Hosel Uehara