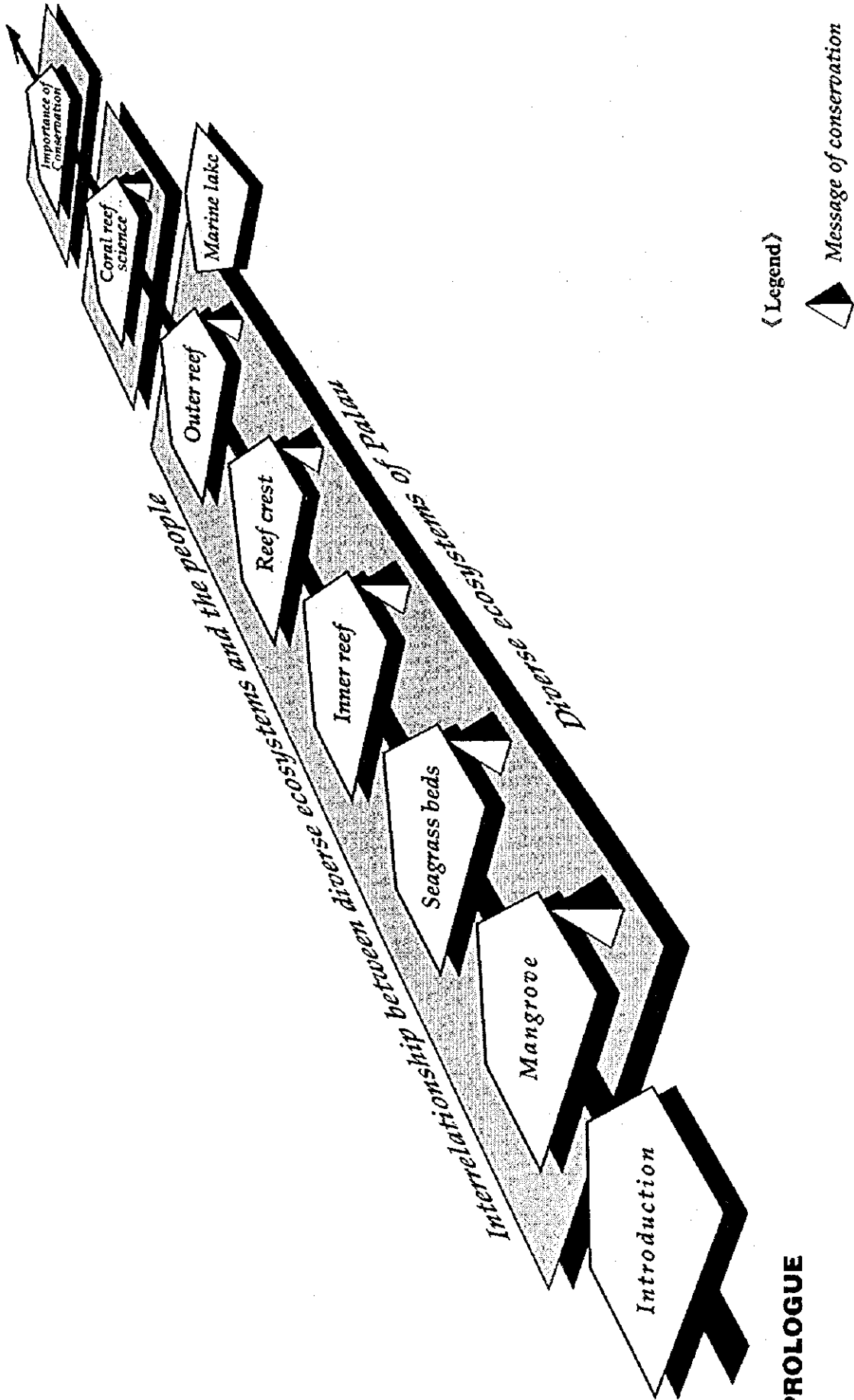


**EPILOGUE**



<Legend>

Message of conservation

**PROLOGUE**

Exhibition Scenario

## Contents and Methods of Exhibits

Exhibit Theme	Sub-theme	Content of the Exhibit / Major Exhibit Items	Exhibit Method
Introductory part	The nature of Palau: an overview Nature and the life & culture of the people	<ul style="list-style-type: none"> <li>- Overall topography</li> <li>- Unique ecosystem of Palau and its diversity</li> <li>- Historical overview of the culture and lifestyle</li> <li>- Folk tales, festivals</li> </ul>	<ul style="list-style-type: none"> <li>- Models</li> <li>- Panel (Explanation, diagrams, photographs)</li> <li>- Story board</li> <li>- Panel (Explanation, diagrams, photographs)</li> </ul>
1. The diverse ecosystems of Palau	Mangrove	<ul style="list-style-type: none"> <li>- Fauna/flora and food chain; role as nursery grounds of larvae/juveniles; role of</li> <li>- Fishing grounds               <ul style="list-style-type: none"> <li>· Mangrove, fish (mud skipper, fish fry), mangrove crab, shrimps</li> <li>· Fishing gear and methods</li> </ul> </li> <li>- Destruction of mangrove</li> </ul>	<ul style="list-style-type: none"> <li>- Outdoor pond</li> <li>- Panel (Explanation, display of animal)</li> <li>- Fishing gear models</li> </ul>
2. Interrelationship between the diverse ecosystems of Palau and the culture and lifestyle of the inhabitants	Sea grass bed	<ul style="list-style-type: none"> <li>- Habitats for dugong, sea turtles, small fishes, bivalves, sea cucumbers</li> <li>- Threat to endangered species</li> </ul>	<ul style="list-style-type: none"> <li>- Panel (Explanation, diagrams)</li> <li>- Outdoor pond</li> <li>- Panel (Explanation, display of organisms)</li> </ul>
	Inner reef	<ul style="list-style-type: none"> <li>- Ecosystem of broad lagoon unique to Palau</li> <li>- Fishing grounds supporting human livelihoods               <ul style="list-style-type: none"> <li>· Corals, soft corals, giant clams, sea anemones, cephalopods, crustaceans, fishes</li> <li>· Fishing gear and methods, traditional fishery resource management</li> </ul> </li> <li>- Development and pollution, harmful fishing method and coral reef destruction</li> </ul>	<ul style="list-style-type: none"> <li>- Outdoor pond</li> <li>- Panel (Explanation, display of organisms)</li> <li>- Fishing gear models</li> </ul>
	Reef crest	<ul style="list-style-type: none"> <li>- Reef crest ecosystem               <ul style="list-style-type: none"> <li>· Reef crest as food source</li> <li>· Various species of invertebrates</li> <li>· Fishing gear</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Outdoor pond</li> <li>- Panel (Explanation, display of organisms)</li> <li>- Fishing gear models</li> </ul>
	Outer reef	<ul style="list-style-type: none"> <li>- Unique topography and fauna/flora</li> <li>- Importance as a fishing ground</li> <li>- Significance as a tourism resource               <ul style="list-style-type: none"> <li>· Corals, soft corals, sponges, sea anemones, small and large size fishes</li> <li>· Fishing gear</li> </ul> </li> <li>- Diving and damage of corals</li> </ul>	<ul style="list-style-type: none"> <li>- Indoor tanks</li> <li>- Panel (Explanation, diagrams, photographs, display of organisms)</li> <li>- Fishing gear models</li> <li>- Panel (Explanation, diagrams)</li> </ul>

## Contents and Methods of Exhibits

Exhibit Theme	Sub-theme	Content of the Exhibit / Major Exhibit Items	Exhibit Method
3. Coral reef science	Marine lake	- Unique topography fauna, isolation mechanism, food chain	- Indoor tank
		- Jelly fish	- Panel (Explanation, diagrams, photographs, display of organisms)
		- Special environment & protection	- Panel (Explanation, diagrams)
	Coral biology	- Classification of corals and their related forms, identification of species	- Indoor tanks
		- Hard corals, sea anemones, horny corals	- Preserved specimens
		- Morphology of corals	- Panel (Explanation, diagrams, photographs, display of organisms)
		- Coral life - reproduction, growth, nutrient supply by symbiotic algae	
	Coral reef ecology	- How symbiosis works?	- Indoor tanks
		- Corals, crustaceans, sea anemones, clown fish	- Panel (Explanation, diagrams, photographs, display of organisms)
		- Coral fish	
Coral reef geology	- Structure and origin of coral reefs	- Models	
	- Coral reef geomorphology	- Panel (Explanation, diagrams, photographs, display of organisms)	
	- Global distribution of coral reef		
	- Characteristics of the geological structure of the Palauan Islands		
4. Coral reef conservation	Global importance of coral reefs	- Importance of coral reefs as a stage of biological diversity and global environmental components	- Video exhibit
		- Present condition of coral reef destruction	- Panel (Explanation, diagrams, photographs, display of organisms)
	Importance of coral reefs to Palau	- Coral reefs as fishery and tourism resources linked to livelihood and culture.	- Video exhibit
		- Deterioration of coral reefs by human impacts	- Display of organisms (specimen)
			- Panel (Explanation, diagrams, photographs)
	Coral reef conservation and sustainable use	- Global movement towards conservation	- Video exhibit
		- Conservation activities in Palau	- Indoor tank
		- Role of industrial sector and citizens	- Panel (Explanation, diagrams, photographs)

6) Construction materials

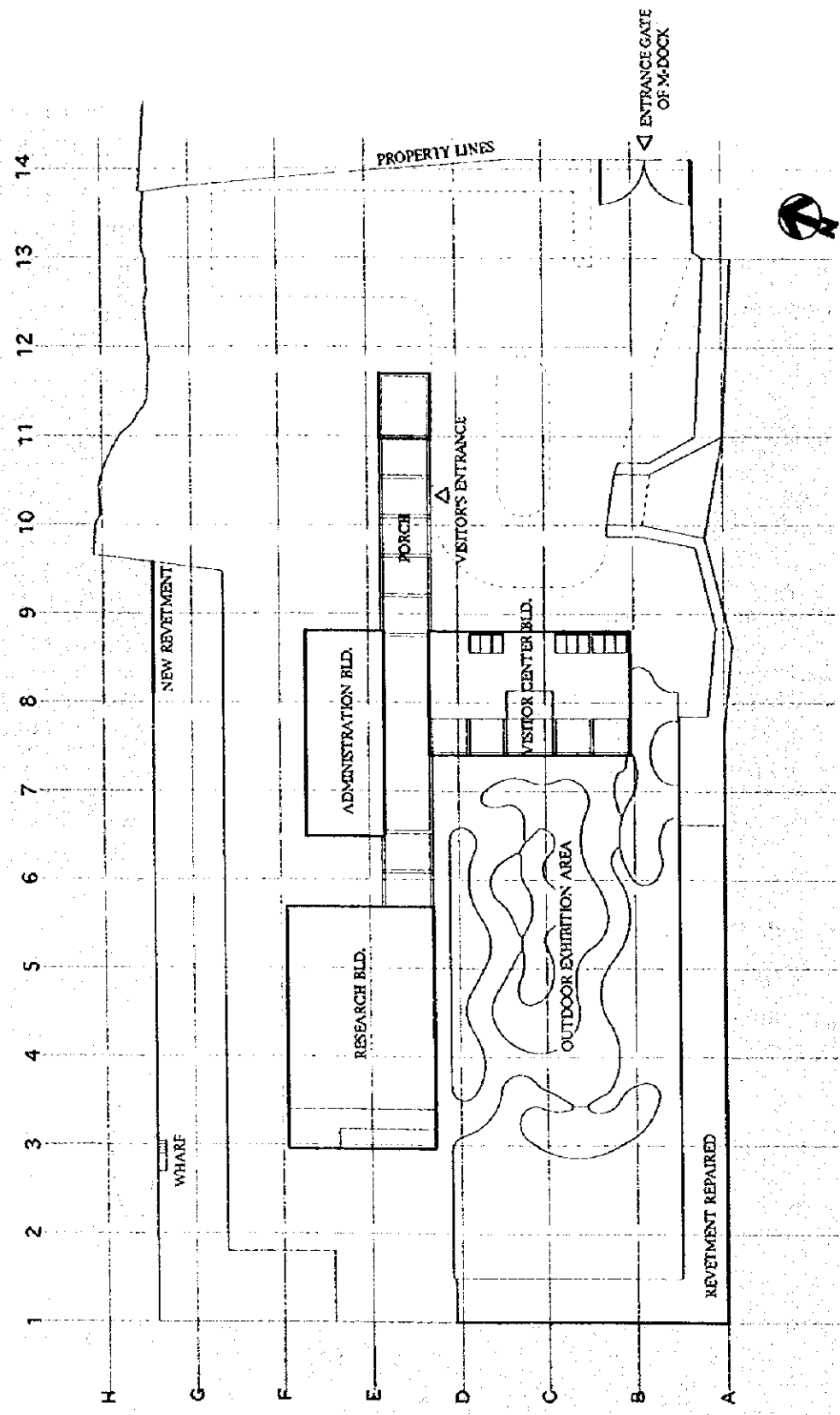
Locally produced construction materials which will be used in the Project are limited to such items as concrete aggregate and concrete block, and most of the construction materials used in Palau are imported. Construction materials that are sold locally will be given priority in the Project and materials that are not stocked in volume and materials of a certain required quality will be supplied from abroad including Japan. The finish specifications for different segments of the buildings are shown in the table below.

Exterior and Interior Finish Specifications

Building Section	Specifications	Remarks
<b>1. Exterior</b>		
Roof	Concrete and membrane waterproofing w/paint	Conventional method
Exterior wall	Concrete block and plaster, w/paint	Conventional method
	Ventilation block	Conventional method
Openings	Aluminum frame and jalousie window	Conventional method
	Fixed window	Conventional method
	Wooden or aluminum door	Conventional method
<b>2. Interior</b>		
Flooring	PVC tile	Conventional method
	Ceramic tile	Conventional method
	Plaster	Conventional method
Walls	Concrete block and plaster, w/paint	Conventional method
	Gypsum board w/paint	Conventional method
	Ceramic tile	Conventional method
Ceiling	Gypsum board w/paint	Conventional method

7) Basic design diagram

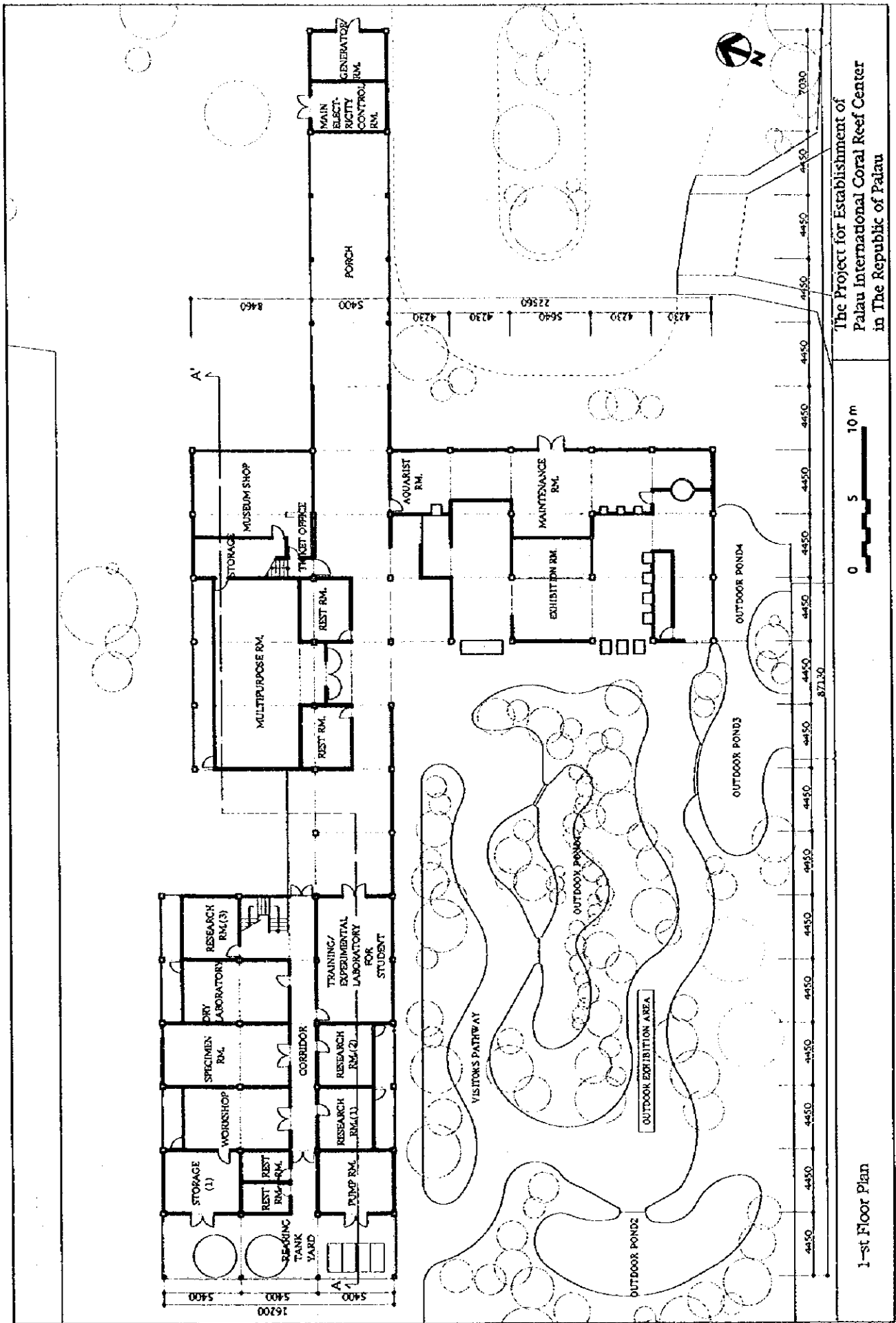
Diagrams of the basic design of the facilities planned for the Center are shown in the following pages.



The Project for Establishment of  
 Palau International Coral Reef Center  
 in The Republic of Palau



Site Plan

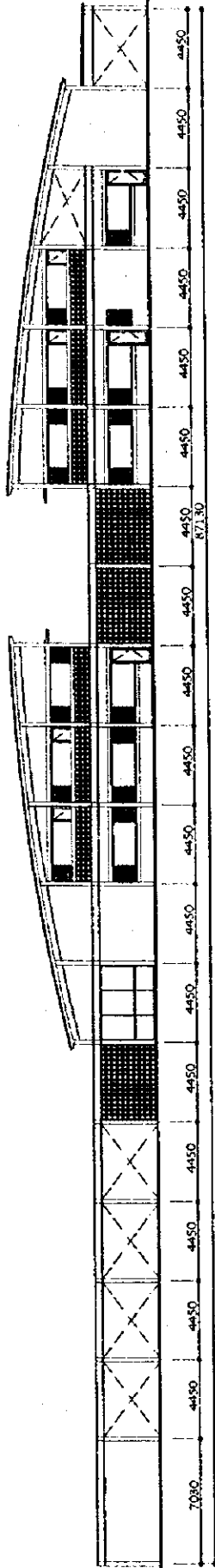


The Project for Establishment of  
Palau International Coral Reef Center  
in The Republic of Palau

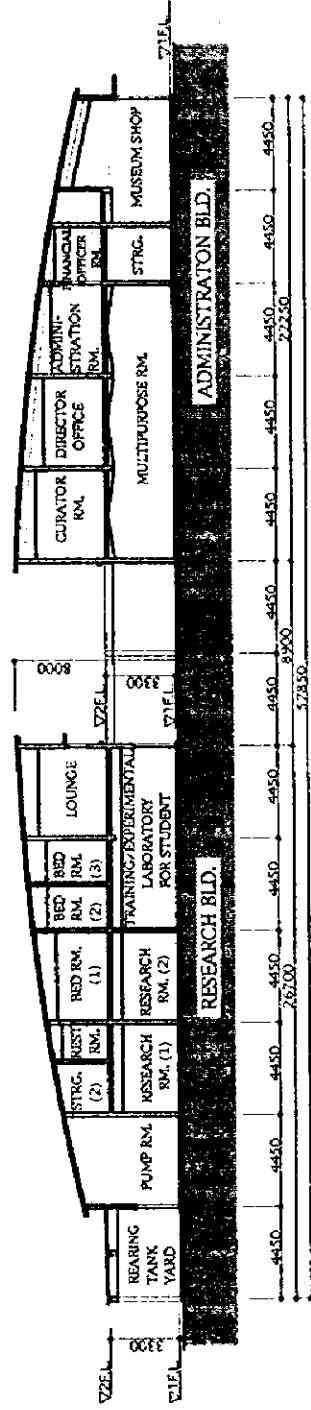
0 5 10 m

1-st Floor Plan





NORTH ELEVATION



A-A' SECTION

The Project for Establishment of  
Palau International Coral Reef Center  
in The Republic of Palau



Elevation & Section



(3) Basic plan on the revetment

Based on the policy for the renovation plan described in section 2.3.1(7), repairs on the revetment will be carried out. The renovation will be made according to the five zones, A to E as shown in the figure below.

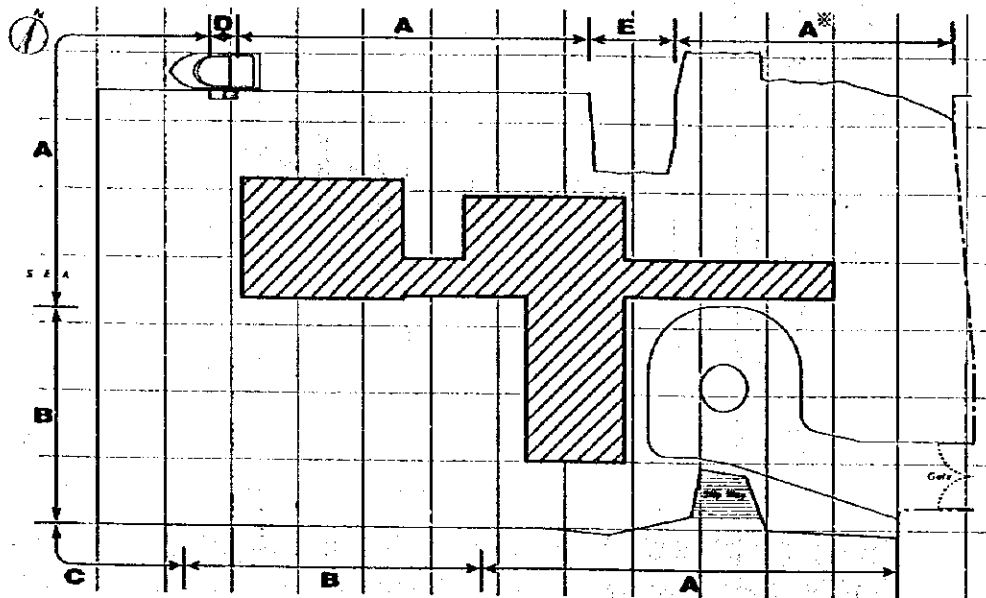


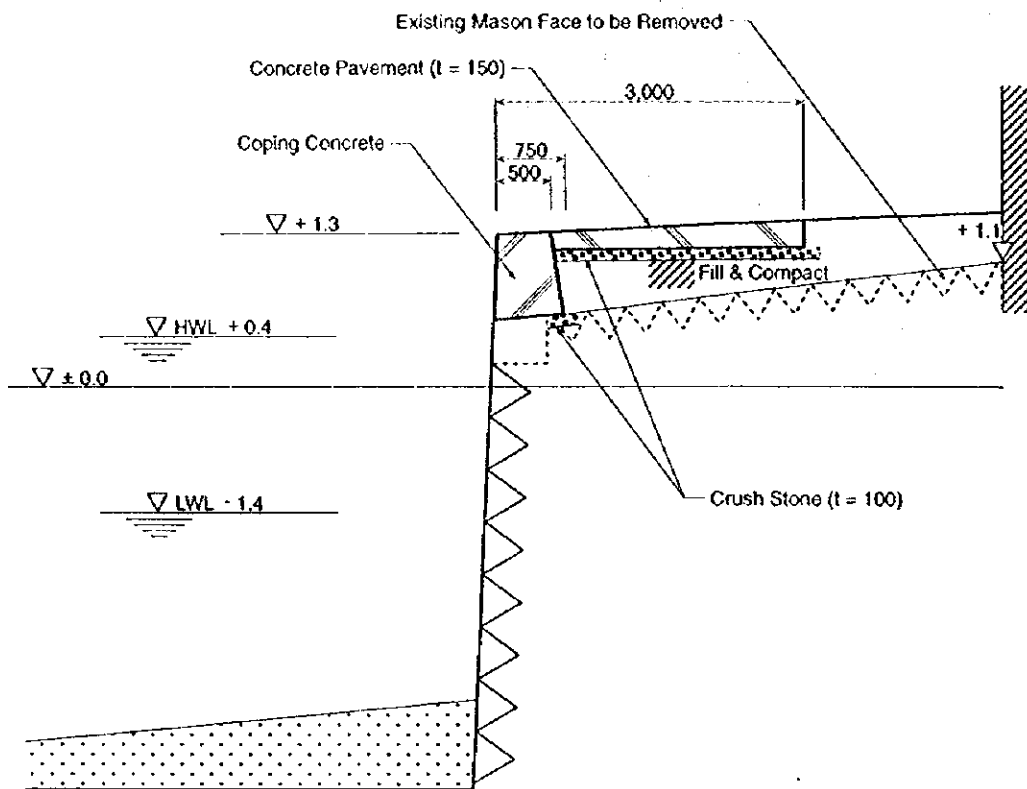
Fig. Zone of Embankment Repair

The renovation work planned for each zone is summarized below.

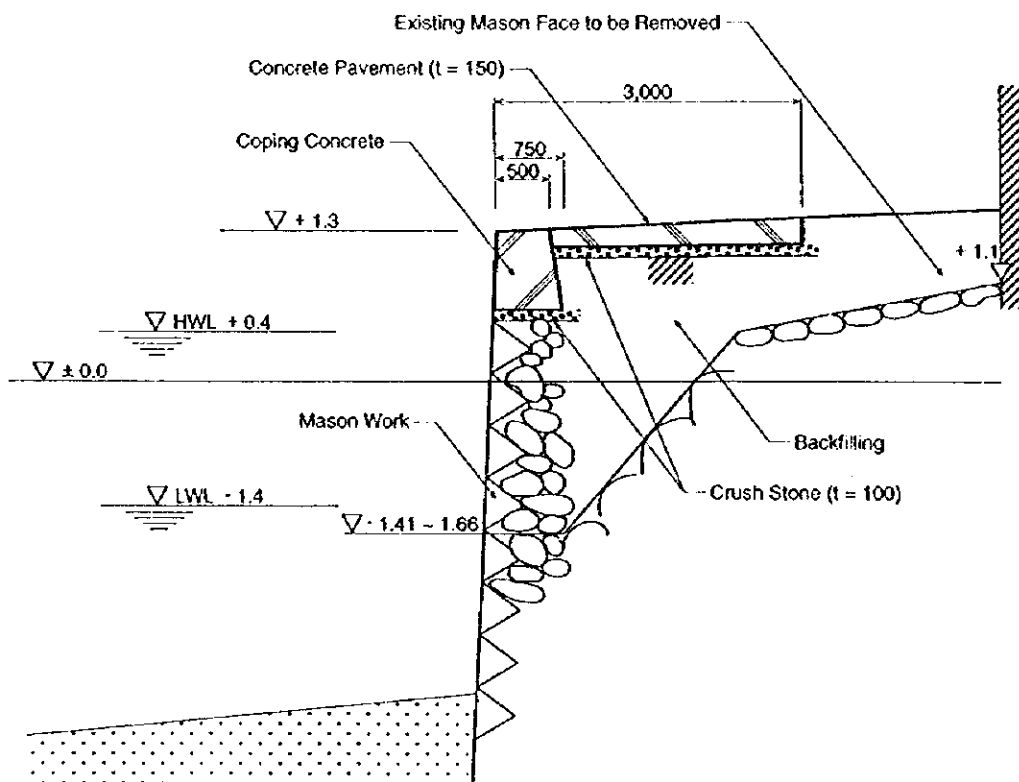
- Zone-A: The existing revetment and configuration will be utilized and renovation work will not be carried out. However, partial repairs will be done on the portions close to the Project facilities following an adequate review of the height of the revetment. The A\* area in the figure above is partially eroded. Therefore, a minimum erosion countermeasures such as sand bag masonry, etc. will be taken to this area.
- Zone-B: Due to the low revetment crown and the acknowledged need for repairs, the crown will be elevated and repaired at a height of Mean Sea Level + 1.3m. The standard cross-section is shown in the sectional drawing for Zone-B. The existing capping concrete will be removed and capped with new concrete.
- Zone-C: The upper section is damaged and requires repair. As shown in the following sectional drawing on Zone-C, the damaged stone masonry will be rebuilt and the upper section will be concreted with capping concrete. The revetment crown level will be same as in Zone-B.

**Zone-D:** In order to build a boat embarkation facility, the lower section of the stone masonry will be left, and the upper portion including the stairway will be concreted. Cross-section and front elevation sectional drawing are shown in the following figure for Zone-D.

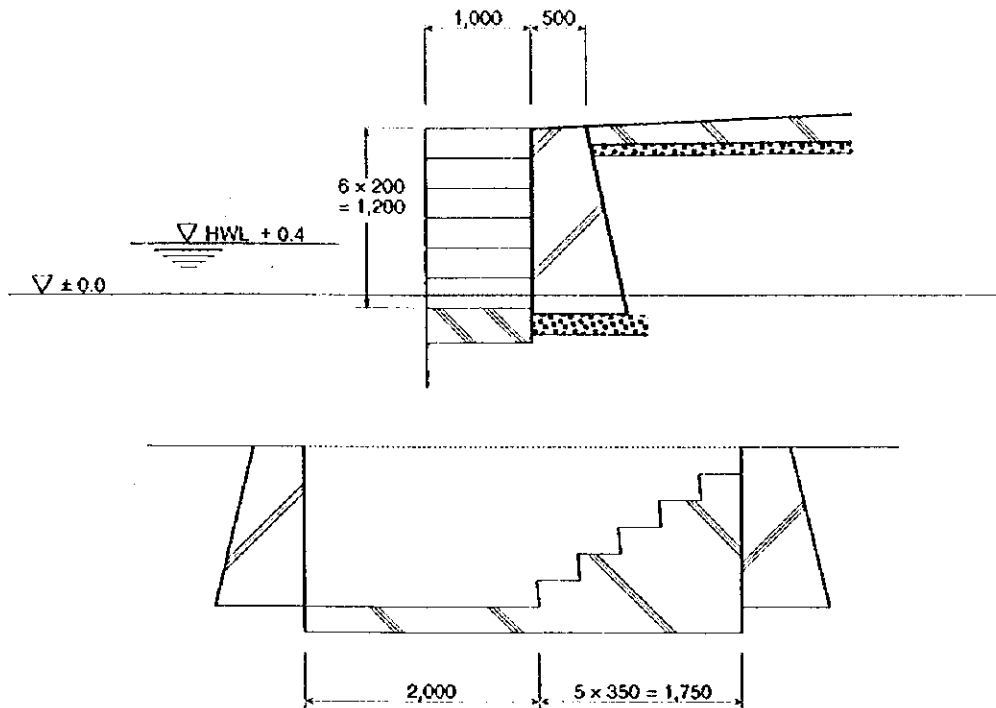
**Zone-E:** A new revetment will be built considering access for people and cars moving toward the administration and research buildings. As shown in the following sectional drawing on Zone-E, the foundation will be leveled and a base mound + block masonry revetment will be built.



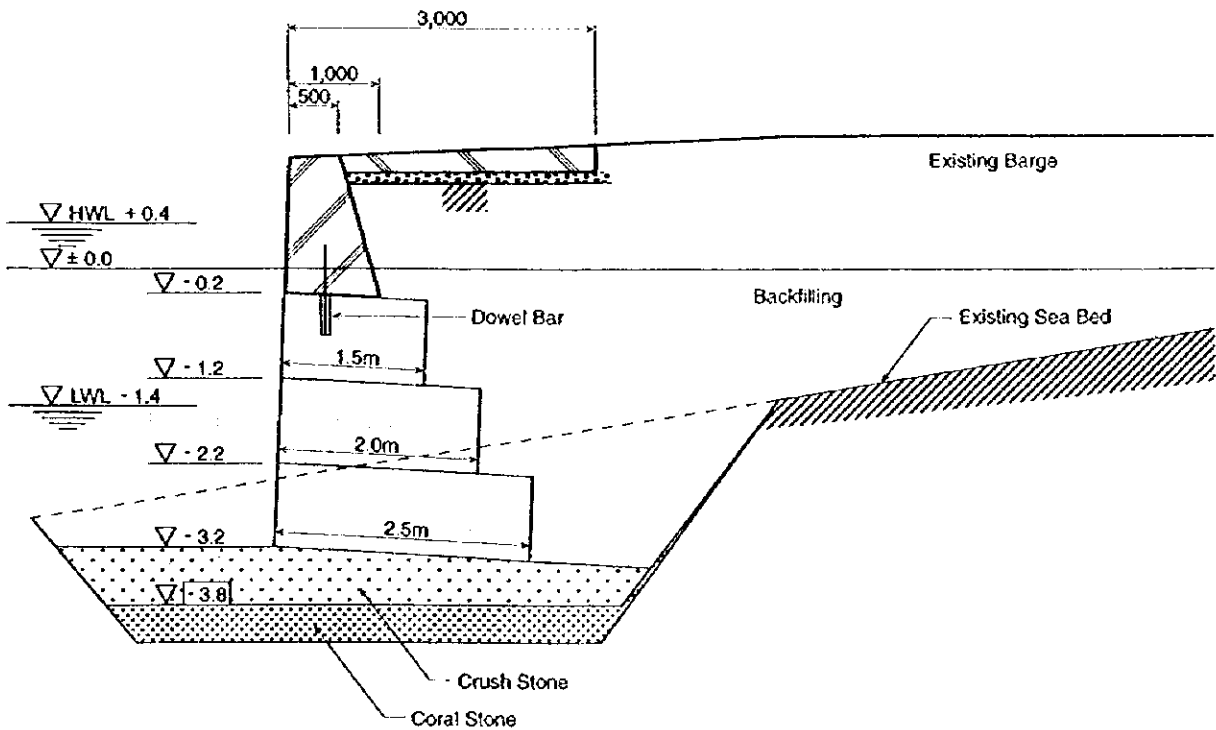
**(Zone - B : Sectional Drawing of Repair Works)**



**(Zone - C : Sectional Drawing of Repair Works)**



⟨Zone - D : Sectional Drawing of Repair Works⟩



⟨Zone - E : Sectional Drawing of Repair Works⟩

(4) Equipment Plan

Based on the basic concept of the project as delineated in section 2.2, the minimum amount of equipment required to carry out the activities of the center will be determined. The equipment specifications and the number of units to be provided will be fixed according to the basic policy on equipment selection delineated in section 2.3.6(2). The location where each unit of equipment will be installed and a description of its major use are shown in the lists of planned equipment that will be presented later. The equipment is divided into two lists; one list will contain equipment that will be provided by the Japanese side and the other will contain equipment that is expected to be provided by the Palauan side.

1) Equipment provided by the Japanese side

The equipment for the following categories will be provided in accordance with the Center's activities.

- Equipment for field survey and observation
- Equipment for research and experiment
- Equipment for the Visitor Center
- Equipment for education and public awareness activities
- Equipment of administration
- Equipment for maintenance

The required equipment for each category is summarized as follows.

a. Equipment for field survey and observation

Category A research activities are concerned with field/underwater survey and observations and indoor/outdoor research and experimental work. The field survey activities can be divided into the following four categories.

- ① Trips and communication between the Center and the field survey point
- ② Underwater observation and photography
- ③ Collection of specimens for indoor experiments
- ④ Routine observation of oceanographic conditions

The equipment to be provided by the Project for this category was selected based on the activities listed above and is listed in the table below.

### Equipment for Field Survey and Observation

Field Survey Work	Basic Scope of Activities	Equipment To Be Provided
<b>(i) Trips, communication</b> • Sea  • Land  • Communication	Approach all coastal areas of Palau by sea Overland trips on the coastal areas of Babeldaob and Koror Islands Communication between the Center and research boats and motor vehicles	Survey boat (for both long and short distance), Pickup truck  Wireless equipment for base station
<b>(ii) Underwater observation recording, sampling</b>	Ecological observation, survey, photographing, specimen collection for experiments	Diving equipment, water sampler, plankton net, plankton collector, water quality measuring equipment (salinity, DO, pH, transparency, etc.), current meter, camera, underwater camera, insulated box
<b>(iii) Routine observation of oceanographic conditions</b>	General meteorological and oceanographic observations	Weather instruments (atmospheric pressure, temp., wind speed/direction, rainfall), salinity/thermometer

- **Research boat:** The large research boat will accommodate 5 to 6 persons, including the crew for use in long distance survey trips in the area between Kayangel island off the northern tip of Palau (about 110km on a straight course from the Center) and Angaur island off the southern tip. The boat will be about 35ft. in length in order to contain sleeping quarters for the passengers.  
 The small research boat will be used for one-day short distance survey trips and will be capable of accommodating two to three persons. The boat will be about 15ft. in length. Each boat will be equipped with two outboard engines (one reserve engine), a VHF wireless radio (output 10w), and a GPS. In addition, the large research vessel will be equipped with an echo sounder for survey of underwater topography and fish distribution.
- **Trailer for the boat:** A tow trailer will be provided to land the small research boat during bad weather and to transport the boat over land. Due to the difficulties involved in landing the large research vessel during, it will be moved to a quieter water area in bad weather.
- **Pickup truck:** A pickup truck is needed when traveling overland on the coastal areas of Babeldaob and Koror island. A 4-wheel drive, double cabin passenger/cargo vehicle capable of withstanding poor road conditions will be provided to accommodate survey teams comprising of several members.
- **Wireless radio for base station:** Wireless radio equipment will be installed in the administration room of the Center to enable communication between the research vessels

and the Center. The equipment will be VHF with a generating output of 40W to cover the whole area of Palau.

- **Diving equipment:** The diving equipment that will be provided by the Project will consist of diving apparatus for a total of four people (2 persons/pair; 2 pairs), in order to enable four members of the survey team on the large research vessel to carry out underwater observations simultaneously. The diving equipment will be used by researchers on the small research boat as well.
- **Water sampler and equipment for water condition survey:** One set of simple observation equipment will be provided for each of the two research vessels, but only one set of equipment which is expensive and of less frequent use, such as the video camera, underwater light quantum meter and the current meter, will be provided for use on board both vessels. Portable, easy-to-use DO and pH meters will be provided for use aboard the research vessels. The light quantum meter is essential for measuring the volume of underwater light, which is vital for the life, and growth of corals. In view of its use underwater and on board the vessel, a portable type has been selected.
- **Weather instruments:** Meteorological instruments for monitoring the barometric pressure, humidity, wind direction and velocity, and rainfall with standard specifications will be selected and installed in an instrument screen at the site. In order to avoid maintenance problems, instruments with automatic recording functions will not be selected and only instruments with manual recording functions will be provided. In addition, a salinity/thermometer meter will be provided to enable constant water temperature and salinity readings at the site.

**b. Equipment for research and experiments**

The research activities in category A require instruments that is needed for both indoor and outdoor research and experiments, as well as equipment needed to operate the research equipment and accessory equipment needed to house the other equipment. Experiments and research activities include stocking of samples, preparation of specimens, observation and rearing, analysis, culture, preparation of chemicals, cleaning apparatus, data processing, etc. The list of equipment that is needed to carry out these activities is shown in the table below.

### Equipment for Research and Experiments

Research Activity	Basic Scope of Activity	Equipment To Be Provided
(i) Indoor Activities		
• Stocking specimens	Refrigeration/ storing of samples on a short or medium term basis	Deep freezer, refrigerator
• Preparation of specimens	Preparation of specimens to be used/ deposited at room temperature	Dissecting set, vat*, scales*, measuring instrument*
• Observation, rearing, recording of samples	Detailed observation, measuring, photographing of specimen	Biological and stereoscopic microscopes, profile projector, camera, photomicrographic attachment, digital camera, dark room equipment, light table, small/medium water tank (indoor/outdoor), shading net
• Sample analysis	Analyses of physico-chemical characteristics of samples	Fluorescence microscope, UV-visible spectrophotometer, microtome set, low temperature drying oven, muffle furnace (temperature, DO, salinity, pH, conductivity, turbidity), glassware, plastic utensils, funnel stand, test tube stand, test tube tong
• Sample cultivation	Culture experiments of zooxanthella, etc.	Centrifuge, Millipore filter set, autoclave, clean bench, incubator, shaking bath incubator, plankton counting plate
• Preparation of reagents	Measuring, preparing, mixing, storing reagents for experiments	Electronic balance, water distilling apparatus, magnetic stirrer, tripod, Bunsen burner, alcohol lamp, hot plate, wire net with ceramic, water bath, chemicals, dessicator
• Washing apparatus	Washing glassware, plastic utensils	Pipette washer, test tube brush, bottle brush
• Data processing, etc.	Processing experimental data, analysis, recording, and reporting of findings	Personal computer, printer, scanner, uninterrupted power supply (UPS), copy machine
(ii) Accessory equipment	Equipment which for common use in the laboratory	Bookshelves, specimen shelves, reagent storage cabinet, dry cabinet, steel locker, center table (lab), side table (lab), white board

Remarks \*: Equipment that will be used jointly by the Visitor Center

The specification of each unit of equipment will meet a set standard of precision required for ecological and taxonomical observation and analysis. In principle, only one unit of equipment will be provided by the Project. However, one unit of equipment will be installed in both the dry lab and the maintenance room (also the wet lab), due to their anticipated frequency of use.



- **Deep freezer, refrigerator:** A deep freezer will be installed to store fish specimens and other samples, and raw feed in low temperatures of  $-20^{\circ}\text{C}$  for medium term freezing. Refrigerators will be provided to enable short-term freezing and cold storage of samples, chemicals, etc. The refrigerator will have a capacity of 300L since the amount of samples that will be stored is expected to be relatively small. Both the dry lab and the maintenance room will each be provided with one refrigerator.
- **Microscope and profile projector:** The biological microscopes will have a magnification allowing the morphological observation and identification of microscopic plankton (a magnification ratio of 50 to 1500). The stereoscopic microscopes will have a magnification ratio of 10 to 40, which will make up for the difference in the magnification power of the biological microscopes. The profile projector will have a magnification ratio of 2 to 8. One unit each of the profile projector and the photomicrographic attachment will be provided since three items of equipment will only be used in the dry lab. The dry lab and the maintenance room will each be provided with one unit each of the biological and stereoscopic microscopes.
- **Digital camera:** In order to enable digital photographs of corals, fish, etc. to be viewed on the personal computer, the images will be processed and recorded. In order to withstand expansion, the camera will be capable of producing high imaging of up to 1.35 million pixels. The images will be stored as database and will be made available to other researchers in Palau (e.g., CRRF researchers) for discussions and exchange of opinions as well as with foreign researchers via the Internet. One unit will be provided for use by researchers.
- **Darkroom equipment:** One set of darkroom equipment will be provided to develop research photographs and slides.
- **FRP water tank and shading net:** Five each of 30L and 50L water tanks for ecological and biological observation will be provided. In addition, six units of 1.5 ton capacity outdoor water tanks will be provided to enable rearing experiments of corals, which require natural sunlight. Shading nets will also be provided to control the amount of natural sunlight entering the water tanks. Spare nets will be provided since they depreciate with exposure to ultraviolet rays.
- **Fluorescence microscope:** This microscope will be used to observe fluorescent substances such as the chlorophyll within the cells and tissues, lipids, vitamins, etc. Ordinary type with six types of filter will be attached. One unit will be installed in the dry lab.

- **UV-visible spectrophotometer:** This apparatus will be capable of measuring the wave length visible rays, in order to study the physiological characteristics of algae and to analyze water quality.
- **Microtome set, forced convection drying oven, electric muffle furnace:** The microtome set is required to produce tissue sections to observe the cellular structure of organism tissue. Ordinary sliding type will be installed. The forced convection-drying oven is needed to dry and sterilize samples and glassware utensils, etc. One forced convection unit with a range of 50 to 250°C will be supplied. The electric muffle furnace is needed to measure the ash content of organisms and one unit capable of reaching the stipulated 1100°C will be installed.
- **Water quality checker:** The water quality checker is used to measure the quality of coastal water and to maintain the water quality of the rearing tank. The dry lab and the maintenance room will each be provided with one handy easy-to-use checker. In addition, a non-portable water quality checker will be provided for the dry lab for more precise analyses.
- **Centrifuge:** The centrifuge is used to remove or collect suspended matter in the water. A tabletop model capable of 5000rpm will be provided to collect plankton.
- **Millipore filter set:** The Millipore set is used to filter bacteria in seawater and for SS measurements. An easy-to-assemble set capable of accommodating many different filters will be provided.
- **Autoclave, clean bench:** The autoclave is used to culture organisms and to sterilize glass utensils. A unit capable of reaching sterilization conditions of 127°C, 1.2kg/cm<sup>2</sup> will be provided. The clean bench is used when preparing specimens for preservation in formalin and sterilization for algae culture. Because the amount of research work necessitating the use of this item is limited, one small clean bench with a width of about 1.3m will be provided for the dry lab.
- **Incubator, shaking bath incubator:** The incubator is used for stationary culture and incubation of plankton. A unit with fluorescent lighting is needed. Since there are experiments requiring changes in temperature conditions, two units will be provided. The shaking bath incubator is used for suspension culture. In order to maintain room temperatures of less than 30°C, one unit with a cooler unit will be installed.

- **Electronic balance, water-distilling apparatus:** The electronic balance is used to measure precise amounts of chemicals and samples. Two types of balance (0.001g and 0.01g), with digital reading for efficiency and easy reading, will be provided. Since this instrument is expected to be used frequently, one unit will be installed in the dry lab and one in the maintenance room. For water distilling, apparatus with expensive ion exchangers and a microfilter supplement will be avoided, and ordinary glass distiller using potassium permanganate analysis method will be provided. The distilling apparatus is made of glass and as a precautionary measure against possible breakage, two units will be supplied.
- **Bunsen burner, alcohol lamp, and hot plate:** All three instruments are required as a source of heating in experiments. Several units of each apparatus will be provided for the dry lab.
- **Personal computer, printer, etc.:** A total of five personal computers with standard word processing, data processing and graphic processing (microscopic and specimen photos) functions will be provided for researchers (3), curator (1), and the chief aquarist (1). An uninterruptible power supply (UPS) serving as an electricity backup source and two color printers will be provided for the research building and the aquarist room. One high-speed laser printer and one scanner will also be provided for the research building for shared used among the researchers.
- **Steel locker:** Five double-type steel lockers will be provided according to the number of staff members for the research rooms, the curator room, and the aquarist room.
- **Copy machine:** One monochrome copy machine will be provided for copying general material and its use will be shared by each section in the research building.
- **Specimen shelves, reagent storage cabinet:** Due to the rich diversity of the corals in Palau, many specimens are expected to be collected. Therefore, the specimen shelves will have the capacity to contain 1000 specimens. The dry lab and the maintenance room will each be provided with one reagent storage cabinet. Their size will be dependent on the room arrangement.

#### c. Equipment for the Visitor Center

The equipment for the Visitor Center will be selected according to its activities, which include the exhibits, maintenance (including wet lab activities), the public awareness activities held in the multipurpose room, and the museum shop sales activities. The equipment, which will be provided by the project, is shown in the table below.

### Equipment for Visitor Center

Visitor Center Activities	Basic Scope of Activity	Equipment To Be Provided
(i) Exhibits	Educational material for coral reef conservation, services for the handicapped	Video deck, TV monitor, brochure stand, wheelchair
(ii) Maintenance of exhibits (including work in the wet lab)	Transporting organisms from the field, acclimatizing, daily maintenance of exhibit tanks, experimental coral rearing tanks, desk work by aquarists	Live fish tank, prefabricated quarantine tank, polycarbonate water tank, open type filtering tank, water tank for acclimatization, water quality checker (water temperature, DO, pH, salinity, conductivity, nitrogen, etc.), hydrometer, hand spring scale, platform scale, micrometer gauge, caliper, divider, stone cutter, scoop, mesh net, air pump, air tube, air stone, branch pipe, water pump, plastic container, bucket, vat, knife, whetstone, step ladder, steel shelves, locker, push cart
(iii) Public awareness activities (multipurpose room)	Public awareness activities targeting visitors/local residents	Video projector, screen
(iv) Museum shop sales	Managing the cash and speedy accounting	Cash box, cash register

- **Video deck, TV monitors:** The video deck and TV monitor will be used to communicate messages to visitors within the exhibit area about coral reef conservation. One set will be provided. The monitor will be 33 inches to accommodate an audience of about 10 people.
- **Water quality measuring instruments:** Measuring instruments, such as salinometer, DO and pH meters, thermometer and hydrometer, for measuring various seawater conditions are needed in the daily maintenance of the exhibit and experimental tanks. Easy-to-use, portable models will be provided.
- **Measuring instruments:** Measuring instruments, such as micrometer, caliper, dial caliper, divider, etc. are instruments that are regularly used in measuring and weighing coral, fish, etc. Several units of each instrument will be provided since they are anticipated to be used simultaneously in different locations.
- **Live fish tank, nets:** The live fish tanks are used to transport fish collected in the field. One unit each of two sizes, 500L/1000L that can be loaded onto a compact pickup truck, will be provided. Scoop and netting are essential for handling organisms being reared in the exhibit and experimental tanks. Due to their high frequency of use, extra units will be provided.

- **Water tanks:** The prefabricated panel quarantine tanks are used to temporarily house and rear marine organisms for a specific period of time. Two tanks with a diameter of 3m will be provided to accommodate small to comparatively large fish. Open type filtering tanks are used to filter the water of rearing tanks. They are portable and can be combined with prefabricated (reassemble) water tanks as the need arises. Their treatment capacity will correspond to the water quantity of the reassemble tanks. The acclimatization tanks are used to acclimate marine organisms to the artificial conditions prior to introducing them into the exhibit tanks. One acclimatization tank will be provided for every two-exhibit tanks for a total of eight units, in addition to one spare tank. Polycarbonate water tanks that will allow the tanks to be observed from the side will be provided for the wet lab as experimental tanks. In order to rear comparatively large amount of live organisms, each two units of tanks with water capacities of 0.5t and 1.0t will be provided.
- **Aeration equipment:** The air pump, air tube, air stone, etc. are used in the air supply of each indoors experimental tank. Several units paralleling the number of tanks will be provided.
- **Stonecutter:** The stone cutter is an electrical tool with a round blade that is used in stonemasonry. At the Visitor Center it will be used to cut and process coral specimens. A hand-held model with a blade diameter of 250mm will be provided.
- **Water pump:** The water pump will be mainly used changing water in small tanks that are not connected to the plumbing and for draining the bottom water of tanks. A water pump with a capacity of approx. 200L/minute will be provided to handle the anticipated volume of water. Two units will be supplied to enable their simultaneous use in different areas.
- **Video projector, screen:** The video projector and screen will be used in education and public awareness activities targeting visitors and local residents. A 100-inch projector and screen will be provided for use in the multipurpose room, which has a seating capacity for about 90 people.
- **Cash box, cash register:** The cash box and cash register will be used in the museum shop. The cash box is for temporal safekeeping, and hence will be small and portable.

**d. Equipment for Education and Public Awareness**

Equipment for lecture and biological experiment/training targeting primary and secondary school students and for outdoors-public awareness work, etc. will be provided as shown in the table below.

**Equipment for Education and Public Awareness**

Activity	Basic Scope of Activity	Equipment To Be Provided
• Public awareness	Indoor and outdoor AV education on coral reef conservation	Slide projector, OHP, screen, video deck, TV monitor, sound instrument
• Observation of organisms	Basic indoor observation for primary and secondary students	Dissecting set, biological microscope for students, white board, bookshelves

- **Visual aid equipment (slide projector, etc.):** Visual aid equipment includes the slide projector, video deck, etc. that will be used in educational and public awareness activities. The slide projector, OHP, video deck, and TV monitor that will be provided will have the specifications required to accommodate an audience of 25 people in the training and experiment room.
- **Sound instruments:** The sound instrument set includes the microphone, amplifier, and speakers. Two sets will be provided, one set for regular use at the Visitor Center and another set for use in public awareness activities outside the Center.
- **Practical training equipment (dissecting set, microscope, etc.):** The specifications of the practical training equipment will meet the requirements for use in science classes for junior and high school students. One dissecting set will contain five varieties of tools and the biological microscopes will have a magnification ratio of 600. A total of 26 dissecting sets will be provided for the students and one teacher and a total of 7 microscopes that will be shared by three to four students will be supplied.

**e. Equipment for the Administration Facility**

Equipment for the administration facility is divided into the categories of information processing and document management. They are shown in the table below.

### Equipment for Administration

Activity	Basic Scope of Activity	Equipment To Be Provided
(i) Information processing	Processing and storage of information including communication with external parties	Facsimile machine, personal computer, printer, UPS, copy machine
(ii) Document management	Management of various documents and cash, treatment of emergencies	Bookshelves, locker, safety box, first aid kit

- **Facsimile machine, copy machine:** The facsimile machine will meet the world standard of GIII. One unit will be provided for shared use by the entire Center. The specifications of the copy machine will be monochrome and it will be used for copying general material. One unit will be provided in the administration room for shared use by the management personnel.
  
- **Personal computer, printer, etc.:** As in the use for research and experiment, personal computers capable of handling general word processing, table calculations, and graphics will be provided. A total of four units will be provided. The director and the financial officer rooms will each be allocated one unit, and two units will be provided for office work, accounting and the preparation of printed materials for education/public awareness activities. UPS and a color printer will be provided for each computer. One high speed, high capacity laser printer will be provided for shared use with all computers and the other sections in the administration building.
  
- **Steel lockers:** A total of five lockers of double type will be provided in accordance with the number of staff members using the director, financial officer and administration rooms.
  
- **First aid kit:** Two first aid kits will be provided and placed in the administration room.

#### f. Equipment for maintenance

In order to reduce maintenance costs, repairs of the center's facilities and equipment will be carried out in principle by staff members. The Project will provide the tools and equipment necessary for such repair work.

The repair work will include 1) all repairs on the Center's buildings (simple repairs to the interior and exterior walls, rain leakage, etc.), 2) regular inspection and repair of the pumps, air conditioners, outboard engines, and other machinery, 3) plumbing repairs related to the water tanks, and 4) repair and construction of the exhibits. The standard equipment, which will be provided to conduct these repairs, is shown in the table below.

### Equipment for Maintenance

Activity	Equipment To Be Provided
(i) Basic ironworks, metal work	Working table, vice, drilling machine, bench grinder
(ii) Woodworking, FRP acrylic processing, iron piping, PVC pipe processing	Electric tools (electric circular saw, angle grinder, drill, planer, jig saw) manual tools (spanner, wrench, etc.), hack saw, pipe vice, tool caddy, cable drum
(iii) Welding	Electric welder
(iv) Electrical measurement	Multi tester
(v) Air pressure source	Air compressor (Cleaning pipes/trenches, spray gun drive, etc.)
(vi) Accessories	Tool cabinet, push cart, step ladder, steel locker

Specialized tools will be avoided and only standard tools will be included. While one unit each of the drilling machine and grinder will be provided, several units will be provided for manual tools, the hack saw and the cable drum to enable simultaneous use in different locations.

- **Working table, metal work machines:** A steel working table, which allows the vice, drilling machine and bench grinder to be attached will be provided. The vice, drilling machine and bench grinder are basic tools in metalworking and one unit of each tool will be provided.
- **Electric tools:** The electric circular saw, angle grinder, drill, planer, and jig saw are tools regularly used in woodwork and metal working. They are also used in processing and making FRP acrylic water tanks and processing steel and PVC pipes. One case will be provided to allow the tools to be easily carried to different areas of the Center.
- **Multi tester:** A multi tester capable of making easy electrical measurements of the voltage and conductivity of electrical facilities and electrical appliances will be provided.
- **Electric welding machine:** A compact electric welding machine with a 200A capacity enabling hand welding of the steel frames on the water tanks, the pipe brackets, etc. will be provided.
- **Air compressor:** The air compressor will be used for filling the air in the motor vehicle tires, as a power source for the paint spray gun, for cleaning the pipes and trenches, etc. A compact model with castors for easy movement will be provided.

The equipment, which has been selected according to the criteria summarized above, is shown in the following pages.



## Equipment to be Provided in this Project

Item No.	Q'ty	Brief Specifications
<b>a. Equipment for field survey &amp; observation</b>		
<b>(i) Trips and Communication</b>		
- On sea		
1	1	35ft.78 outboard engine x 2, with GPS, radio & fish detector
- On land		
2	1	Double cabin, 4WD, 1.5ton, 5 passengers
- Communication		
3	1	VHF radio for base station
(ii) Underwater observation, recording and sampling		
4	4	Regulator, BCD, weight, dive CPU etc.
5	1	Van Dorn type, 5L
6	2	Norpack type; mesh 0.10mm, 0.33mm
7	1	45cm dia.
8	1	DO/temp. 0.00 - 19.99mg/L
9	1	pH/temp. 0.00 -14.00pH
10	1	30cm dia, 30m
11	1	35mm , tripod, with accessories
12	1	15, 20, 35 mm, operating depth 50m, with accessories
13	1	Digital, S-VHS, with underwater housing
14	2	100L
15	1	2 ranges
(iii) Monitoring of sea water		
16	1	Meteorological monitoring system (barometer,temp.wind speed/direction.rain gauge)
17	1	Portable type, measuring range, salinity 0-40, temperature -5 ~ 40°C
18	1	Portable type
<b>b. Equipment for research and experiment</b>		
<b>(i) Indoor activities</b>		
- Stocking of samples		
1	1	500L, (-18°C), chest type
2	2	300L, 2-door
- Preparation of specimens		
3	4	For small animal/fish dissecting, 2.5pcs./set

## Equipment to be Provided in this Project

Item No.	Qty	Brief Specifications
- Observation, measurement & photography		
4	2	Trinocular, 50x - 1500x, with illuminator
5	2	Trinocular, 10x - 40x, with illuminator
6	1	For stereoscopic microscope
7	1	Desk-top
8	1	NTSC system, digital, 1.35 million pixels
9	4	Square type, 1500L
10	10	30L, 50 L
11	4	2m x 50m
12	1	Table Top, A3, FL10W
- Analysis		
13	1	Trinocular, 40x - 1000x, with illuminator
14	1	Recording type, wavelength 326 - 1.100
15	1	0.5 - 12 um, slide system
16	1	150L 1 ph/1.5 kW
17	1	100. - 1100. C, 1ph/2 kW
18	1	Temp./DO/pH/Conductivity/Salinity
19	1	Portable type, N-NH <sub>3</sub> , N-NO <sub>2</sub> , KMnO <sub>4</sub> , Cl <sub>2</sub> , with Reagent set.
20	1	Slide glass, beaker, flask, pipette, etc.
21	1	0-100
22	2	Double type
23	8	For 12mm & 15mm
24	10	Plastic
- Cultivation		
25	1	Table-top, 5000rpm/2000 x g, 1ph/0.5 KW
26	1	Flask 1000mL, with compressor
27	1	150L with light, 1ph/1.5 KW
28	1	30L, 1ph/2 KW
29	1	1300 x 900 x 1500Hmm, with ventilation fan and sterilization lamp
30	2	0.5mm vertical line
31	1	10-50 C, 12-120 rpm
- Preparation of chemicals		
32	4	Digital, 210g/0.001g, 3,100g/0.01g
33	2	Glass distilling, 5000mL flask
34	1	30 to 1500rpm
35	1	4L, AC110V, 700W
36	2	240mm
37	2	LPG
38	3	120mL

**Equipment to be Provided in this Project**

Item No.	Q'ty	Brief Specifications
39 Tripod	3	90 mm x 130 H mm
40 Wire net with ceramic	10	155 x 155 mm
41 Hot Plate	2	120 v, 1ph, 1Kw
42 Chemicals	1	Chemicals for water quality kits, formalin, etc.
- Washing apparatus		
43 Pipette Washer	1	240 H mm, with basket
44 Test Tube Brush	20	Pig fur, 210 x 30mm & 240 X 40mm
45 Bottle Brush	30	Pig fur, 350 x 55mm & 470 x70mm & 710 x 120mm
- Data processing & analysis		
46 Personal Computer	5	Desk-top, PC/AT compatible, 32 MB
47 Printer	2	Colour, Inkjet, A3
48 Printer	1	Monochrome laser, A3
49 Scanner	1	Color, 600dpi, A-4 size
50 Uninterrupted Power Supply (UPS)	5	0.5KVA
51 Copy Machine	1	Monochrome with 2 trays
(ii) Accessory equipment (laboratory furniture)		
52 Book Shelf	12	1200 x 500 x 1800Hmm
53 Specimen Shelf	18	1200 x 500 x 1800Hmm
54 Reagent Storage Shelf	2	900 x 400 x 1800Hmm, steel type
55 Dry Cabinet	2	Inner Size 800 x 400 x 850
56 Steel Locker	4	608W x 1800H mm, for 2 persons
57 Laboratory Center Table	1	1800 x 1200 x 800Hmm
58 Laboratory Side Table	1	1200 x 750 x 800Hmm
59 White Board	2	1800 x 900 mm

**Equipment to be Provided in this Project**

Item No.	Q'ty	Brief Specifications
<b>c. Equipment for Visitor Center *</b>		
<b>(i) Exhibits</b>		
1	1	S-VHS VTR
2	1	33-inch with AV rack
3	2	600W x 1500H mm
4	1	40 cm width
<b>(ii) Maintenance of exhibition</b>		
5	2	Polyethylene, 500L/1000L
6	10	Mercury, with metal case
7	2	0 - 100
8	1	DO/temp.
9	1	pH/temp.
10	2	Akanuma type
11	2	10kg/100g
12	40	Large, middle, small
13	3	Nylon monofilament, green, with accessories
14	2	4 wheel, 900 x 600mm, 300kg capacity
15	2	100kg/10kg
16	4	Hollow type, taper type
17	4	Rough, fine
18	20	10L/min.
19	3	100m
20	180	Large, middle, small
21	50	3-Way branch pipe
22	5	50L
23	20	10L, 40L
24	2	For seawater, 200L/min
25	2	Standard type, 0-25mm/0.01mm
26	2	150mm, 250mm
27	2	0 - 300mm/0.05mm
28	4	100mm, 200mm
29	4	500L, 1000L
30	2	FRP, 1000L
31	4	FRP, 300L
32	2	Assemble-type FRP, 3 m dim., 1200mmH
33	30	PP, 29 x 23 cm, 42 x 37 cm, 65 x 50 cm

Note: \*) Protein skimmer will be provided as a part of each closed recirculation tank.

**Equipment to be Provided in this Project**

Item No.	Qty	Brief Specifications
34	1	Temp./DO/pH/Conductivity/Salinity
35	1	Portable type, N-NH <sub>3</sub> & others, with Reagent set.
36	1	250mm diam.
37	1	608W x 1800H mm, for 2 persons
38	2	Aluminum made, 2 m height
39	2	2 tons capacity
(iii) Multipurpose room (public awareness)		
40	1	100 inch., 1ph/0.4KW, liquid crystal type, with VTR and sound
41	1	100 inch, manual rolling type
(iv) Museum shop		
42	1	Electronic type
43	2	Steel made, handy type
<b>d. Equipment for education and public awareness</b>		
(i) Education/public awareness		
1	1	Max. capa. 80 pcs. of slide, 1 ph/0.4 KW
2	2	Screen size : 150 x 150 cm
3	1	28 x 28 cm (11.2" x 11.2"), 1 ph/0.5 KW
4	1	S-VHS
5	1	20", with AV Rack
6	1	Microphone, speaker, amplifier, with accessories
(ii) Practical training		
7	26	4pcs./set with case
8	7	Binocular, 100x - 600x
9	1	Board size: 1800 x 900mm

<b>Equipment to be Provided in this Project</b>		<b>Brief Specifications</b>
<b>Item No.</b>	<b>Q'ty</b>	
<b>e. Equipment for Administration Facility</b>		
<b>(i) Information processing</b>		
1 Facsimile Machine	1	GIII, A4
2 Copy Machine	1	Monochrome, A3, 4 trays
3 Personal Computer	4	Desk-top, PC/AT compatible, pentium200M
4 Printer	1	Monochrome, A3, 2 trays
5 Printer	1	Color, Inkjet, A-3
6 Uninterrupted Power Supply (UPS)	4	0.5kVA
<b>(ii) Other accessory</b>		
7 Steel Locker	5	608W x 1800H mm, for 2 persons
8 Safety Box	1	500W x 600H mm, steel and fireproof
9 First Aid Kit	2	Standard type
<b>f. Equipment for Work Shop</b>		
<b>(i) Basic metal works</b>		
1 Working Table	1	800 x 1500 x 740cm, union steel
2 Box Vice	1	120W x 160mm
3 Drilling Machine (bench type)	1	208V/3ph/0.8Kw, 15mm
4 Bench Grinder	1	208V/3ph/1Kw, 200mm
<b>(ii) Wood works, FRP &amp; acrylic processing</b>		
5 Electric Circular Saw	1	120V/1ph/0.5Kw, 350mm
6 Tool set	2	51 pcs./set, w/tool box
7 Angle Grinder	1	120V/1ph/0.5Kw, 115mm
8 Electric Drill	1	120V/1ph/0.4Kw, 13mm
9 Electric Planer	1	120V/1ph/0.5Kw
10 Electric Jig Saw	1	120V/1ph/0.4Kw, 25mm
11 Tool Caddy	1	600 x 500 x 900 H mm, with caster
12 Pipe Vice	1	4 inch with stand
13 Hack Saw	3	300mm
14 Cable Drum	2	15A, 125V, 20m
<b>(iii) Welding works</b>		
15 ARC Welding Machine	1	200 A, with welding set

**Equipment to be Provided in this Project**

Item No.	Q'ty	Brief Specifications
(iv) Electrical measurement		
16 Digital Multimeter	1	ACO 500V, DCO 50V
(v) Air pressure source		
17	1	0.4 KW, 7kg/cm <sup>2</sup> , caster type
(vi) Accessory equipment		
18 Tool Cabinet	2	1000 x 400 x 1800mm, with angles
19 Step Ladder	1	Aluminum made, 2 m height
20 Steel Locker	1	605W x 1800H mm, for 2 persons
21 Push Cart	2	4-wheel, 900 x 600 mm, 300 kg

2) Equipment expected to be provided by Palauan side if necessary

The equipment expected to be provided by Palauan side if necessary is shown in the table below. These pieces of equipment are categorized into the following A~D items:

Category A. General furniture, gardening tools

Category B. Equipment not essential to the Project

Category C. Equipment and consumable that are easy to purchase locally, inexpensive, and will not be a financial burden

Category D. Leased equipment

Equipment List Expected to be Provided by the Palauan side if Necessary (1/2)

Items	Quantity	Location
<b>Category A</b>		
1 Closet	1	for a larger bedroom
2 Dresser	1	- ditto -
3 Microwave	1	for lounge
4 Oven	1	- ditto -
5 Refrigerator	1	- ditto -
6 Sofa set	1	- ditto -
7 TV set	1	- ditto -
8 Iron/Ironing board	1	- ditto -
9 Coffee maker	1	- ditto -
10 Edger/weedeater	1	for storage
11 Gardening tools	1 set	- ditto -
12 Lawn mower	1	- ditto -
<b>Category B</b>		
1 Wishing well/donation container	1	for entrance
2 Brine shrimp hatchery	2	for maintenance room
3 Industrial blender	1	- ditto -
4 Vacuum cleaner	1	- ditto -
5 Fishing poles	3-5	- ditto -
6 Typewriter	2	for dry lab.
7 Ice machine	1	- ditto -
8 Hand held VHF radios except those for boats	2 sets	for administration room
9 Laptop computer and software	1	for training/expt. room
10 Second vehicle	1	- ditto -



**Equipment List Expected to be Provided by the Palauan side if Necessary (2/2)**

Items	Quantity	Location
<b>Category C</b>		
1 Garbage cans	20-30	for overall building
2 Shopping basket	30	for museum shop
3 Credit card processor	1-2	- ditto -
4 Tagging equipment	2	- ditto -
5 Cleaning chemicals	-	for maintenance room
6 Cleaning pad	10-15	- ditto -
7 Plastic bag	-	- ditto -
8 Small Tupperware container	10-20	- ditto -
9 Miscellaneous office tools (hole punch, paper cutter, scissors, stapler, etc.)	10-15	for administration room
10 Janitorial supply (mops, bucket, spray bottles, general service cart)	2 sets	- ditto -
11 Painting equipment	1 set	for storage
<b>Category D</b>		
1 Propane tanks	2-3	for dry lab.

## **Chapter 3 Implementation Plan**



## **Chapter 3 Implementation Plan**

### **3.1 Implementation Plan**

#### **3.1.1 Implementation Concept**

##### **(1) Project Implementation System**

The project implementation agency on the Palauan side is the Technical Working Group (TWG). Following the signing of the Exchange of Notes (E/N) between the Palauan and Japanese governments, a Japanese consultant company will sign a contract with the Palauan government to carry out the detail design and to supervise the construction. A Japanese construction company will sign a contract with the Palauan government to execute the construction work and to procure and install the equipment. The construction company will be placed under the supervision of the Japanese consultant company. Following the completion of the construction work, the newly established public corporation will become the body responsible for the management, operations and maintenance of the facilities.

##### **(2) Execution Policy of Construction Works**

This Project will be implemented as a grant aid project of the Japanese government and all construction work will be executed according to the policy outlined below.

- 1) The project implementing agency of the Palauan government, the Japanese consultant company, and the construction company will carry out a thorough exchange of opinion and will maintain constant, close communication, in order to ensure the steady execution of the works.
- 2) Much of the construction labor force and equipment and materials will be dependent on foreign sources. A plan of execution will be compiled taking into consideration such conditions for the procurement of construction workers and the supply of equipment and materials, and the progress of the work will be managed flexibly in order to cope with the local conditions and to ensure the steady execution of the work.
- 3) The renovation work on the embankment and the construction work of the land facilities will be implemented at the same time. A work schedule will be prepared that will allow both construction works to progress smoothly.
- 4) Adequate storage measures will be taken to protect construction equipment and materials from salt air damage since the site borders the sea.
- 5) The scope of responsibility for utility services such as electricity, water supply, drainage will be defined in order to execute the construction works smoothly and efficiently.

- 6) Precautions will be taken to prevent accidents during the temporary storage and transport of construction equipment and materials and installation and construction work.

### 3.1.2 Implementation Condition

In the execution of the construction works the following items will be considered.

- 1) Due to the narrow area of the Project site, it is difficult to secure a large temporary lot for use as a work yard, etc. Hence a plan to prepare a space for the temporary work must be drawn up in order to prevent a decline in work efficiency.
- 2) Work procedure that minimizes the environmental impact from the run out of sandy soils from the Project site will be adopted.

### 3.1.3 Scope of Works

The work on the Project will be divided between the Japanese and Palauan sides. The scope of works is shown in the table below.

Scope of Works

Scope of Work	Japan	Palau
1. Securing and clearing of land		○
2. Installation of public utilities at the site		
- Replacement and permit to replace the pole-mounted transformer installed outside adjacent to the site.		○
- Water meter		○
- Installation of public phones		○
3. Planting work within the compound		○
4. Construction work		
- Buildings in the compound	○	
- Roads in the compound		○
- Water intake / drainage facilities	○	
- Outdoor exhibition facilities	○	
- Repair of revetment	○	
5. Equipment <1		
- Equipment/material procurement	○	
- Installation work	○	
- Test operation of equipment	○	
- Instruction on equipment use	○	
6. Import / custom procedures		
- Transport to Palau and domestic transport	○	
- Tax exemptions and custom clearance		○
7. Responsibility for all permits/applications required for the execution of construction work.		○
8. Payment of B/A commissions to a foreign exchange bank in Japan.		○
9. Arrangement for the stay and immigration procedures of Japanese nationals going in/out of Palau in conjunction with project-related work.		○
10. Responsibility for all the expenses, other than those borne by the grant, necessary for the construction of the facilities as well as the transportation and installation of the equipment.		○

Remarks <1 : Excluding the equipment expected to be provided by Palauan side if necessary  
[see 3.3.2. (4) "Equipment Plan"]

### **3.1.4 Consultant Supervision Plan**

The basic policy and items to be considered in the supervision for the construction work of the Project are summarized below.

- ① The consultant company will meticulously coordinate with the implementing agency, TWG, in order to ensure the uneventful transport and installation of equipment /materials and progress of the construction work. In particular, the work to be carried out by the Palauan side such as demolishing existing facilities, their removal, land grading and the installation of public utilities must be coordinated with the work to be executed by the Japanese side. The work process and specifications must be adequately discussed by both parties prior to their commencement.
- ② Prior to the construction work, the execution plan and shop drawings submitted by the construction company must be reviewed thoroughly and the appropriateness of the temporary work plan, work process, quality of the planned materials and construction method must be reviewed.
- ③ On the completion of construction work and prior to the transfer of the facility to Palau, the facilities constructed and the specifications of the equipment provided will be inspected. Revisions that are required will be indicated at this time.
- ④ An architect will be assigned to the construction site to supervise the construction work throughout the construction period and the facility and an equipment technician will be dispatched as needed.

### **3.1.5 Procurement Plan**

#### **(1) Construction Equipment and Material**

Equipment and materials for construction, such as cement, wood, tile, furniture, fixtures, telephone lines, cables, electricity distribution panel, lighting fixtures and sanitary equipment, are not manufactured in Palau and most of the equipment and materials are imported from Japan and the United States (Guam). Procuring equipment and materials needed for small construction work is not a problem in Palau. However, in view of the scale, content, specifications, etc. of this Project, procuring the required equipment and material locally is difficult in terms of quantity and delivery date except for a few items. Due to these factors, equipment and materials will mainly be supplied from Japan and a segment will be procured locally. The country of procurement and the means of transporting equipment and materials for this Project are shown below.

### Procurement Origin of Construction Material/Equipment and Transport Method

Equipment and Materials	Palau	Japan	Transport Method
1. Construction materials			
• Reinforcing bar, waterproof materials, sound absorbing plate, glass, etc.		O	Ocean transport
• Others	O		
2. Facility materials			
• Sanitation ceramics	O		
• Others		O	Ocean transport
3. Equipment		O	Ocean transport

#### (2) Equipment

All items of equipment, which will be provided by the Project, are not produced locally and as in the case of construction equipment and materials, all of the equipment being imported from Japan and the United States, etc. There are no agents or companies dealing in research and experimental equipment, and local researcher import their equipment directly from the United States, Japan, and other countries. Although there are companies dealing in motor vehicles, boats, and OA equipment such as personal computers, printers, accessories, etc., computers and their accessories are available only in limited quantities and models in Palau. It is therefore difficult to procure collectively models satisfying the specifications and/or required combinations of apparatus/accessories.

Based on these considerations, most of the equipment will be procured from Japan in order to ensure their timely supply and delivery. However, local procurement will be considered for equipment of which maintenance contracts are desired.

#### 3.1.6 Implementation Schedule

In the event of a Japanese grant aid project, the tender documents are compiled after the E/N between the two countries are signed, and the tendering and contract on construction work and equipment procurement and installation are carried out. Then, the construction work and equipment procurement and installation work is executed. The implementation procedure is as follows.

(1) Detailed Design

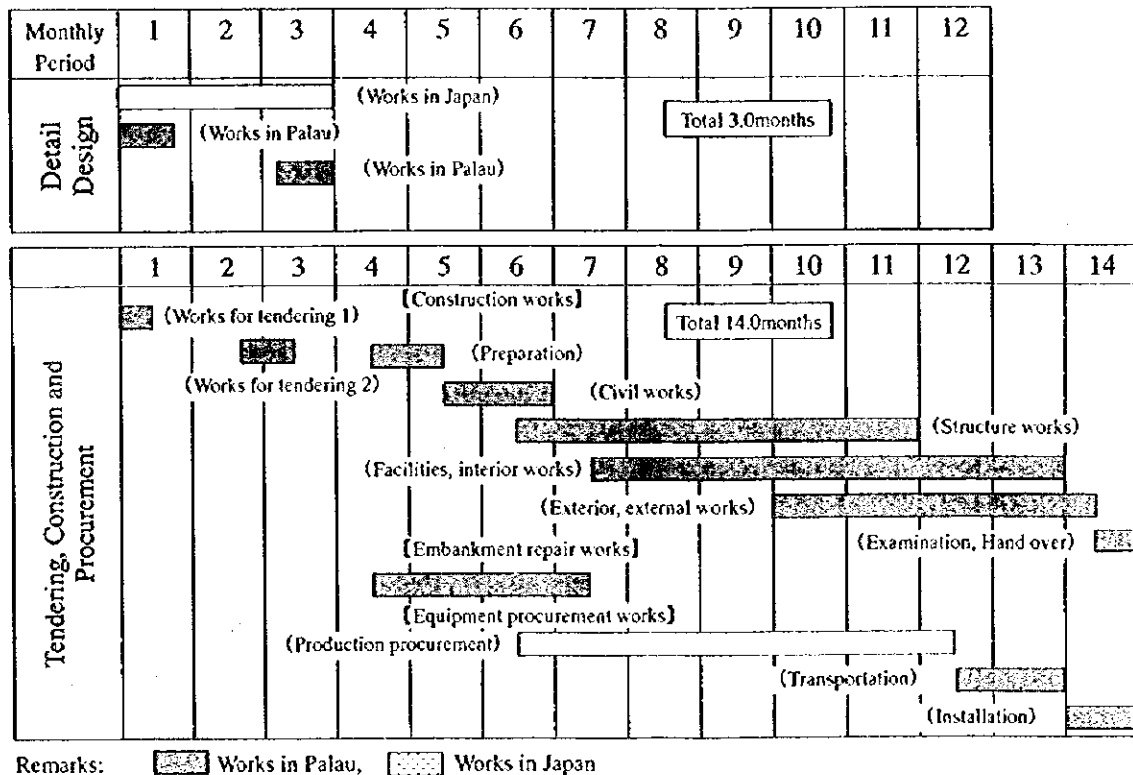
A detailed design based on the basic design study report is drawn up and tender documents are compiled. The time allocated for this period is anticipated to be 3.0 months.

(2) Tendering

Following the completion of the detailed design, its result will be confirmed by the Palauan side. Then potential candidates of the contractor are invited in Japan to participate in the tendering of the Project's construction work and equipment procurement and installation activities. The candidates' qualifications to participate in the tendering are examined. The selected candidates are then invited to the tendering by the implementing agency and tendering is carried out in the presence of relevant witnesses. The time allocated for this period is anticipated to be 2.5 months.

(3) Construction Work and Equipment Procurement and Installation

Following the signing of the construction contract, construction work and equipment provision and installation are executed with the approval of the Japanese government. The time allocated for this period is 14.0 months from the commencement of the works for tendering and 10.5 months from the start of the construction work. The Project implementation schedule is shown below.



**Project Implementation Schedule**



### **3.1.7 Obligations of Recipient Country**

The Technical Working Group, which is the Project implementation agency and relevant bodies on the Palauan side, are responsible for completing the following works within the designated time frame for Project implementation.

- (1) **Removal of existing facilities and obstructions**  
All removal work of the existing facilities and obstructions and land grading activities must be completed prior to the start of the construction work.
- (2) **Application for and work of replacement of the capacity of the existing pole-mounted transformer adjacent to the site including appurtenant work.**  
The replacement work must be completed during the Project construction period.
- (3) **Installation of the water meter**  
The water meter for city water will be installed during the construction period.
- (4) **Installation of public phones**  
The installation of public phones in the site will be completed during the construction period.
- (5) **Planting work**  
The planting work in the Center compound will be prepared during the construction period, and be commenced at the place where it is possible.
- (6) **Procurement of equipment to be shouldered by the Palauan side**  
Equipment that will be procured by the Palauan side will be completed by the completion of construction work.
- (7) **Granting and application for construction permits**  
Applications for permits of all work related to construction and their approval must be completed prior to the start of construction work.
- (8) **Tax exemptions and customs clearance**  
The Palauan side will be responsible for procuring exemptions on domestic tax, etc. on materials, equipment and services purchased by the construction company in Palau during the Project implementation period.
- (9) **Banking Arrangement (B/A) and Authorization to Pay (A/P)**

In order to facilitate the Project implementation, Banking Arrangements to a foreign exchange bank in Japan and the issuance of Authorization to Pay are to be undertaken smoothly during the Project implementation phase.

- (10) Arrangements for stay and immigration procedures of Japanese nationals engaged in the Project.

### 3.2 Operation and Maintenance Plan

#### 3.2.1 Estimated Project Costs of the Palauan Side

The estimated project costs of the Palauan side for this Japanese government grant aid project is about US\$138,000. A breakdown of the costs is shown as follows.

1) Removal of facilities and obstructions	US\$ 58,700
2) Transformer replacement/installation	US\$ 6,300
3) Installation of water meter	US\$ 500
4) Planting in compound	US\$ 29,000
5) Equipment procurement <1	US\$ 37,000
6) Banking Arrangement	US\$ 6,500

Remarks <1 : The equipment expected to be provided by the Palauan side if necessary.

The removal of the old facilities and obstructions in the Project site must be completed before the commencement of the construction work by the Japanese side and the installation of the drainage meter and the transformer replacement work must be completed prior to or during the construction phase.

#### 3.2.2 Operation and Maintenance Costs

The operation and maintenance cost of the Center is shown as follows.

##### (1) Personnel Costs

Based on examination of the wage standards in the Palauan government, the Palau Public Utility Corporation and PCC, the wage standard for the Center's staff was designated as shown in the table below. The annual wages of staff members other than the director, financial officer, chief researcher, curator, and resident scientist include a 5% increase for social insurance and overtime pay. During five years period after opening of the Center, the annual income of staff members is assumed to be raised in accordance with the inflation rate of 2%.

### Plan of Center's Staff and Annual Personnel Costs

Position	No.of person	Annual salary	Annual Personnel costs
<b>A. Administrative Dept.</b>			
1. Director	1	50,000	50,000
2. Secretary	1	14,000	14,700
3. Financial officer	1	27,000	27,000
4. Clerk	1	7,000	7,350
5. Cashier	1	8,000	8,400
	2	5,700	11,970
	0.5	2,850	2,993
6. Chief mechanic	1	12,000	12,600
7. Mechanic	1	8,000	8,400
8. Janitor	1.5	7,000	11,025
9. Security personnel	1.5	14,000	22,050
sub-total	12.5	-	176,488
<b>B. Research Dept.</b>			
1. Senior researcher	1	27,000	27,000
2. Research assistant	1	11,000	11,550
3. Scientist-in-Resident	(1)<1	10,000	10,000
sub-total	2+(1)	-	48,550
<b>C. Education/Public Awareness Dept.</b>			
1. Curator	1	27,000	27,000
2. Education assistant	1	13,000	13,650
3. Chief aquarist	1	15,000	15,750
4. Aquarist	1	11,000	11,550
Sub-total	4	-	67,950
Total	18.5 + (1)	-	292,988

Remarks <1 : Expenditure for scientist-in-resident.

#### (2) Utility Costs

##### 1) Electricity Cost

The electricity charges in Palau are composed of basic and specific charges, which are calculated as shown below.

Basic charge	: ~ 99 KWH/month	US\$30/month
Specific charge	: ~ 1,999 KWH/month	US\$0.12/KWH
	2,000 ~ KWH/month	US\$0.14/KWH

The electricity demand of the Center, calculated according to the electricity consumption of each unit of machinery and electrical equipment provided in this Project, is estimated at 38,045.7 KWH/month or 456,548 KWH/year. Based on this estimated amount of electricity consumption, the annual electricity charges of the Center are projected at US\$63,795 as shown below.

Basic charge	: 30 x 12 =	US\$369.00/year
Specific charge :	1,999 x 0.12 x 12 =	US\$2,878.56/year
	(38,045.7 - 2,000) x 0.14 x 12 =	US\$60,556.78/year
Total		US\$63,795.34/year

The electricity charges for each department of the Center is shown in the table below, on the assumption that electricity rates will not increase in the near future.

#### Projection of Electricity Cost of the Center

Department	Electricity Consumption (KWH/year)	Annual Electricity Charges (US\$/year)
1. Administration	66,000	9,202
2. Research	113,620	15,827
3. Education/Public Awareness	277,028	38,766
Total	456,548	63,795

## 2) Tap Water/Sewerage Costs

The city water and sewerage costs are US\$85/1000 gallons (3,780 liters). The annual cost was calculated based on the estimated amount consumed per person shown below.

- One-third of visitors = 10 liters/time (365 days/year)
- Aquarist, researcher and research assistant = 100 liters/day (aquarist 365 days/year, researcher 300 days/year)
- Other staff = 40 liters/day (300 days/year)

Due to the yearly transitions in the number of visitors and researchers, the costs are anticipated to increase as shown in the table below. This charge rate is assumed not to be raised in near future by the government.

#### Projection of Water Use Volume by Departments of the Center

Year	Administration	Research <sup>&lt;1</sup>	Education/Public Awareness				Unit: Ton/year		
			No. of Visitors <sup>&lt;2</sup>			Aquarists	Total		
			Case 1	Case 2	Case 3		Case 1	Case 2	Case 3
2000	156	126	183	183	183	73	538	538	538
2001	156	129	197	190	183	73	555	548	541
2002	156	132	212	197	183	73	573	559	545
2003	156	141	229	204	183	73	599	574	553
2004	156	180	246	212	183	73	655	621	587

Remarks <1 : Since the no. of visiting researchers will increase, the volume of water use will also increase [see Appendix I.2 (2)].

<2: The projection of the number of users [see 3.2.3(3) Number of users to the Visitor Center.].

**Projection of Tap Water/Sewerage Costs by Department of the Center**

Unit : US\$/year

Year	Administration	Research	Education/Public Awareness				Total		
			No. of Visitors			Aquarists	Case 1	Case 2	Case 3
			Case 1	Case 2	Case 3				
2000	3,507	2,833	4,115	4,115	4,115	1,646	12,101	12,101	12,101
2001	3,507	2,900	4,429	4,272	4,272	1,646	12,482	12,325	12,168
2002	3,507	2,968	4,767	4,429	4,429	1,646	12,888	12,550	12,236
2003	3,507	3,170	5,149	4,587	4,587	1,646	13,472	12,910	12,436
2004	3,507	4,049	5,531	4,767	4,767	1,646	14,731	13,967	13,315

**(3) Communication Costs**

The estimated telephone charges of TNC, CRRF, PCS, and other institutions engaged in similar activities in Palau are US\$1,000/month. Because the volume of international calls made by the Center is anticipated to be more than at the institutions mentioned above, the annual telephone cost is estimated at US\$2,000/month x 12 months = US\$24,000. During five years period after the opening of the Center, this cost is assumed to be kept within the planned amount. The cost is assumed to be shared evenly by the three departments.

**(4) Protocol Cost**

The public relation expenses per person are estimated at US\$20 and the expenditure for 100 people/year is estimated at a cost of US\$2,000/year. During five years period after the opening of the Center, this cost is assumed to be kept within the planned amount. The cost is assumed to be spent only by Administration Department.

**(5) Cost of Consumables**

The cost of consumables for each department is estimated as shown below. The cost is assumed to be raised in accordance with an inflation rate of 2%.

**Projection of Cost of Consumables of the Center** (Unit: US\$/year)

Type	Administration	Research	Education / Public Awareness	Total
1. Gasoline (boat)	-	3,000	1,500	4,500
(car)	300	-	700	1,000
2. Feed	-	-	5,000	5,000
3. Chemicals	-	500	500	1,000
4. Purchase of organisms	-	-	1,000	1,000
5. Office consumables	1,200	600	1,200	3,000
6. Others	4,800	4,800	6,000	15,600
<b>Total</b>	<b>6,300</b>	<b>8,900</b>	<b>15,900</b>	<b>31,100</b>

(6) **Printing/Duplicating Costs**

The cost is assumed to be raised in accordance with an inflation rate of 2%.

Printing Cost of the Center				Unit: US\$/year
Type	Management	Research	Education / Public Awareness	Total
1. Guide brochure	-	-	2,500	2,500
2. Annual report	1,000	1,000	-	2,000
3. Center manual	1,800	-	-	1,800
4. Learning materials	-	-	1,000	1,000
5. Business cards	400	100	100	600
Total	3,200	1,100	3,600	7,900

(7) **Traveling Expenses**

The overseas travel expenses of one person for 10 days is estimated at US\$5,000. An expenditure of about US\$20,000 is estimated for a total of four trips made by the director (two times), the senior researcher (one time), the foreign member of the science/policy advisory committee (one time). During five years period after the opening of the Center, this cost is assumed to be kept within the planned amount. Of these costs, the cost of the senior researcher's trip is regarded as the expense of the Research Department, and others are as the expense of the Administration Department.

(8) **Professional Service Cost (of the management and research sections)**

The estimated cost of outside contracts is shown below.

Projection of Professional Service Cost	
a. Legal advisor	US\$10,000/year
b. Public accountant	US\$5,000/year
c. Grant writing	US\$5,000/year
Total	US\$20,000/year

During five years period after the opening of the Center, this cost is assumed to be kept within the planned amount. Of these costs, a and b are expenses by the Administration Department, and c is by the Research Department.

(9) **Museum Shop**

Purchasing cost is estimated at 53% of the sales amount based on the actual figure at Waikiki Aquarium. Sales will increase with a rise in number of visitors and purchasing costs will also rise. The purchasing costs for the initial five years after the Center's opening

is shown in the table below, assuming that Palauan visitors will not purchase goods at the museum shop (see Appendix I.1). The cost is assumed to be spent by the Education and Public Awareness Department.

#### Stocking Cost of Goods for Museum Shop

Year	No. of Foreign Visitors			Sales of goods (US\$/year)			Costs of goods (US\$/year)		
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
2000	53,448	53,448	53,448	133,620	133,620	133,620	70,819	70,819	70,819
2001	57,583	55,497	53,448	143,958	138,742	133,620	76,295	73,533	70,819
2002	62,077	57,636	53,448	155,193	144,090	133,620	82,252	76,368	70,819
2003	66,964	59,868	53,448	167,410	149,670	133,620	88,727	79,325	70,819
2004	72,284	62,197	53,448	180,710	155,492	133,620	95,776	82,411	70,819

#### (10) Repainting Costs of the Buildings

The Center's buildings will be repainted once every five years as part of the building maintenance and repair program. The repainting cost for one time is estimated at US\$23,100 and the annual repainting cost at US\$4,620. The cost is assumed to be shared evenly by each Department. The cost is assumed to be raised in accordance with the inflation rate of 2%.

#### (11) Renovation and Repair Costs of the Facilities

**Air conditioning unit:** The construction cost of the air conditioning units is estimated at about US\$300,000 and the life of the units at about 10 years. The renovation cost of the unit will therefore be about US\$30,000 per year. Annual repair cost is estimated at 3% of the direct installation cost at an annual US\$9,000.

**Light bulbs:** The light bulbs of lighting fixtures will be replaced once every three years at an annual cost of about US\$1,100 (initial cost: about US\$3,300).

**Freshwater supply: Pump** The water pump will be replaced once every five years at a pump annual cost of about US\$800 (initial cost: about US\$4,000). Repair costs are estimated at 3 % of the direct installation cost at an annual cost of US\$60.

**Special facilities:** Special facilities such as facilities for seawater intake, aeration and water recirculation/filtration will cost about US\$420,000, and will be durable for about 10years. The renovation cost will therefore be about

US\$42,000 annually. Repair cost is estimated at 3% of the direct installation cost at an annual cost of US\$12,600.

These costs are assumed to be spent by each department according to the consumption rate of electricity and be raised in accordance with an inflation rate of 2%.

(12) Repair Cost of Equipment

The cost of the equipment is estimated at about US\$461,000. Although there are boat and other long-term durable items among the equipment, if the average durability is estimated at seven years, the annual replacement cost will be US\$65,800. Repair cost is estimated at 1% of the direct installation cost at an annual cost of US\$4,610. These costs are assumed to be spent by each department according to the share of the equipment cost distributed to each department and be raised in accordance with an inflation rate of 2%.

(13) Annual Operation and Maintenance Costs

The annual operation and maintenance costs of each department for the first year of the Center's operation are given in the table below. According to these data, the annual expenditure for the entire Center is estimated at about US\$577,000.

Estimate of Annual Operation and Maintenance Cost of the Center in the First Year

				Unit: US\$/year
Items	Administration Dept.	Research Dept.	Education / Public Awareness Dept.	Total
1. Personnel	176,488	48,550	67,950	292,988
2. Utilities				
Electricity	9,202	15,827	38,766	63,795
Water/Sewerage	3,507	2,833	5,761	12,101
3. Communication	8,000	8,000	8,000	24,000
4. Development/protocol	2,000	-	-	2,000
5. Materials & Supplies	6,300	8,900	15,900	31,100
6. Printing/Duplicating	3,200	1,100	3,600	7,900
7. Travel	15,000	5,000	-	20,000
8. Professional service	15,000	5,000	-	20,000
9. Cost of goods sold	-	-	70,819	70,819
10. Painting of building	1,540	1,540	1,540	4,620
11. Repair & Maintenance				
Air conditioning facility	2,250	5,250	1,500	9,000
Lighting fixtures	360	360	380	1,100
Pump (freshwater)	20	20	20	60
Special facility	-	1,292	11,308	12,600
12. Equipment	506	2,734	1,368	4,608
Total	243,373	6,406	226,912	576,691



The anticipated income and expenditures of the Center for the first five years after the Center's commencement are estimated based on the admissions and sales/cost of the museum shop for the below-listed three cases differing in the rate of increase in number of visitors to the Visitor Center (see Appendix I-1 for detailed calculations).

- Case 1: Rate of increase in number of visitors was estimated based on the mean annual increase rate for the past five years (1992-1996) by countries.
- Case 2: The rate in Case 1 was adopted for 1992-2000, and the rate from 2001 to 2004 was assumed to be one-half (1/2).
- Case 3: The rate in Case 1 was adopted for 1992-2000, and the rate from 2001 to 2004 was assumed to be zero (0).

According to these data, the income and expenditures of the Center for the first five years will be in constant deficit. The deficit will be about US\$205,000 for the first year in all cases. In Case 1, the deficit will decrease gradually to about US\$94,000 in the fifth year. In Case 3, the deficit will decrease only slightly, and the amount in the fifth year will be about US\$199,000. The total deficit amount for this five-year period will reach about US\$771,000 in Case 1 and about US\$1,020,000 in Case 3. Therefore, in order to implement this Project, the amount equivalent to this total five-year deficit should be loaned interest free to the Center or subsidies should be provided in this amount.

Projection of Revenue and Expenditure for Five Years After Construction of the Center

Unit : US\$/year

		2000	2001	2002	2003	2004
<b>I Revenues</b>						
1. Admissions	Case 1	229,413	247,635	267,504	289,183	312,859
	Case 2	229,413	238,440	247,869	257,729	268,032
	Case 3	229,413	229,413	229,413	229,413	229,413
2. Giftshop sales	Case 1	133,620	143,958	155,193	273,953	296,898
	Case 2	133,620	138,742	144,090	149,670	155,492
	Case 3	133,620	133,620	133,620	133,620	133,620
3. Bench fee		1,980	(2,970)	3,960	(6,930)	9,900
4. Housing		1,200	(2,700)	4,200	(5,100)	6,000
5. Research grants		-	-	-	-	-
6. Membership fees		220	440	660	880	1,100
7. Certification fees		-	-	-	-	-
8. Visitor Center rental		1,200	1,200	1,200	1,200	1,200
9. Vending net profit		880	946	1,018	1,096	1,181
10. Boat usage		3,000	4,500	6,000	7,500	15,000
Total Revenues	Case 1	371,513	404,349	439,735	479,299	527,950
	Case 2	371,513	389,938	408,997	430,105	457,905
	Case 3	371,513	375,789	380,071	385,739	397,414
<b>II Expenditure</b>						
1. Personnel		292,988	296,028	299,128	302,291	305,517
2. Utilities	Case 1	75,896	76,276	76,683	77,267	78,526
	Case 2	75,896	75,120	76,348	76,706	77,762
	Case 3	75,896	75,963	76,031	76,231	77,730
3. Communication		24,000	24,000	24,000	24,000	24,000
4. Protocol		2,000	2,000	2,000	2,000	2,000
5. Materials & Supplies		31,100	31,722	32,356	33,003	33,664
6. Printing/Duplicating		7,900	8,058	8,219	8,383	8,551
7. Travel		20,000	20,000	20,000	20,000	20,000
8. Professional Service		20,000	20,000	20,000	20,000	20,000
9. Cost of Goods Sold	Case 1	70,819	76,295	82,252	88,727	95,776
	Case 2	70,819	73,533	76,367	79,325	82,410
	Case 3	70,819	70,819	70,819	70,819	70,819
10. Cost of Goods Sold		4,620	4,712	4,806	4,903	5,000
11. Repair & Maintenance		22,760	23,125	23,680	24,153	24,636
12. Equipment		4,610	4,702	4,796	4,892	4,990
Total Expenditure	Case 1	76,691	87,011	597,920	609,619	622,660
	Case 2	76,691	84,090	591,700	599,655	608,530
	Case 3	76,691	81,219	585,835	590,675	596,287
Net	Case 1	-205,178	-192,662	-158,185	-130,320	-94,710
	Case 2	-205,178	-194,152	-182,703	-130,320	-94,710
	Case 3	-205,178	-205,430	-205,764	-204,936	-198,873

(14) Renovation Costs of the Facilities and Equipment

Renovation costs for equipment and facilities are required when they have exceeded their durable years. The content of the exhibits at the Visitor Center should also be renovated every four to five years in order to maintain their attractiveness. A summary of the major costs that are anticipated within the first 10 years of the Center's operation is shown in the table below.

Renovation Costs of the Center's Facilities and Equipment

Major Renovation Items	Estimated Durability (years)	Estimated Cost (US\$/year)
(1) Air conditioning facility	10	30,000
(2) Pump (freshwater)	5	800
(3) Special facility	10	42,000
(4) Lighting fixtures	3	1,100
(5) Equipment	7	65,800
(6) Exhibition content <sup>1</sup>	5	18,700
Total	-	158,400

Note: <sup>1</sup> Only for materials (based on the premise that the Palau side will provide original exhibition content)

(15) Personnel cost and other major cost required prior to the opening of the Center

Prior to the opening of the Center, about US\$110,000 of the operation cost will be required as explained below.

1) Personnel Cost

Prior to the anticipated opening of the Center in the early stage of the year 2001, the following main staff members of the Center are to be employed by the newly established corporation and trained. Required personnel cost and training period is shown in the table below.

Required Personnel Cost and Prior Training Period

Center's Staff Requiring Prior Training	Training Period (months)	Personnel Cost (US\$)
(1) Director	2	8,333
(2) Financial Officer	1	2,225
(3) Senior Researcher	3	6,750
(4) Curator	3	6,750
(5) Chief Aquarist	3	3,750
(6) Chief mechanic	2	2,000
Total	-	29,833

2) Cost for Collecting Specimens

Expenditure will arise during about two months after the completion of the Center's facilities for the field collection of specimens to be exhibited. Assuming

that one boat is used daily during the period, fuel cost of about US\$1,800 ( $50\text{l/day} \times 60 \text{ days} \times \text{US}\$0.60/\text{l}$ ).

3) Others

Prior to the opening of the Center, advertise activities and stocking of goods for the museum shop is to be done. These cost are estimated at the same amount of US\$7,900 for printing/duplicating and US\$70,819 for stocking of goods, respectively, shown in the above paragraph (13) "Annual Operation and Maintenance Costs".

## **Chapter 4 Project Evaluation and Recommendation**

## Chapter 4 Project Evaluation and Recommendation

### 4.1 Project Effects

The present Project is expected to have the following effects.

#### (1) Direct effects

- ① Palau is known to have one of the world's most diverse coral faunas and coral reef ecosystems. However, the deterioration of the coral reefs and their ecosystems due to the increasing number of visitors to the country since the latter half of the 1980's has been a matter of concern. Hence the country is in need of working out coral reef conservation measures and marine park plans that are compatible with the development of the tourism industry, but the accumulation of scientific information, as well as the number of scientists, necessary for these activities is insufficient. With the establishment of the Center, researcher fostering and coral reef monitoring systems necessary for studying conservation measures/policies can be built, and thus scientific information can be provided for coral reef conservation. In addition, systems and organization will be established so that the Center can play a role as one of the field bases of the Global Coral Reef Monitoring Network as a part of the activities of the common agenda between Japan and the United States. The studies undertaken at the Center will also contribute to make effective the public awareness activities of the Center through utilizing their results and findings to improve the contents of the exhibits at the Visitor Center.
- ② Most of the international visitors come to Palau to enjoy the nature of Palau featured by the coral reefs. Because of their insufficient understanding as to the vulnerability of corals to physical injury and environmental changes, behaviors of visitors inflicting damages on coral reefs have been observed rather frequently. The Center is expected to fulfill its public awareness/education function through the activities of the Visitor Center to raise the visitors' awareness of coral reef conservation. If about 57% of the total number of visitors to Palau visit the Visitor Center as assumed in this study and if about 70,000 visitors come to Palau as in 1997, about 40,000 people visit the Visitor Center and receive messages concerning coral reef conservation, suggesting a great effect on coral reef conservation. In Palau, about 12,000 people, accounting for 71% of the total population (ca.17,200), inhabit Koror Island. Of these Koror inhabitants, 7,644 (labor force population, 1995 census) are expected to visit the Visitor Center within five years after the opening of the Visitor Center.

- ③ Field practice/lab experiment courses on marine biology and ecology for elementary, secondary and PCC students can be conducted at the Visitor Center in collaboration with PCC and PCS, in order to raise the awareness of the oncoming generation of Palau on the conservation of coral reefs. It is expected that at least about 1,000 elementary/secondary school pupils and about 40 PCC students in the Science Center and the Tourism Course will participate in these courses in each year.
- ④ The Visitor Center is also expected to conduct training courses/seminars on coral reef conservation for all tourist guides and diving instructors stationed in Palau. Their number is about 200 at present.

(2) Indirect effects

In recent years, the production of the tourism industry of Palau has reached as much as about 47% of GDP. Sustainable development of the tourism industry is an essential condition to achieve the self-sustaining economy of the country. Inasmuch as the beautiful natural environment featured among others by coral reefs is far and away the most important tourism resource of Palau, the utilization and conservation of the coral reefs must be compatible and harmonized with each other. Indirectly, the present Project will make a great contribution towards the establishment of systems for the realization of such compatibility and harmony, thus towards the sustainable development of the tourism industry and economic self-reliance of Palau.

#### 4.2 Recommendation

As mentioned earlier, great benefits are anticipated from this Project and it is expected to contribute to the economic self-reliance of the country and its citizens. Therefore, it is concluded that the implementation of this Project is extremely meaningful. However, there are problems pertaining to the operation of the Center as follows:

- ① Although the Palauan government has decided to establish a public corporation with a financially independent system to implement the Project, the operation costs of the Center can not be covered solely by its operation revenue. It is required for the Palauan government to cover the deficit continuously.
- ② Due to the insufficiency in number of qualified key staff personnel with administrative and technical capabilities for the Center, long-term technical assistance is required.
- ③ The Center is largely dependent on admission revenues generated by the Visitor Center. However, the effect of the exhibits will decline in four to five years according to past experiences, resulting most probably in a decline of the number of visitors if the

contents of the exhibits are not renovated. It is therefore important to ensure financial resources for such renovation works. Financial resources for the renovation of basic facilities and equipment will also be needed, although there is a time allowance of seven to 10 years.

In order to cope with these constraints, the following counter measures should be taken by the Palauan government:

- ① In order stabilize the Center's operation under financially independent system, the director of the Center is required to have such capacity that he or she can generate revenues through effective use of the Center's facilities, acquiring overseas research grants, etc., apart from the revenue derived from the Visitor Center. Therefore, the Palauan government should select an appropriate person for the Center's director taking this viewpoint into consideration.
- ② In order to improve the capabilities of the Palauan staff, Japan, Palau and US should determine the scope of technical cooperation and coordinate the scheduling at an early date. In addition, in order to maintain consistency and to enlarge the effectiveness of this type of cooperation, experts should be selected and recruited through close contact with collaborative such as universities, research institutes, science societies and public aquariums. And ties with universities and research institutions where cooperation may be anticipated through research work should be developed in parallel with Center's growth.
- ③ Following Congressional approval of the public corporation law, the Palauan government must begin the immediate tasks of organizing a board of directors, recruiting staff members for the Center, and compiling immediately the operation budget (about US\$110,000) for the next fiscal year, prior to the opening of the Center.
- ④ The Palauan government should create a consensus within government circles to subsidize regularly the deficit in operation funds, fully recognizing the enormous indirect benefits from the Project.
- ⑤ Since it is most probable that the renovation costs of the Center's facilities, equipment and exhibit content can not be funded from operation revenues, the Palauan government must provide the required finances by five to seven years after the Center's opening.

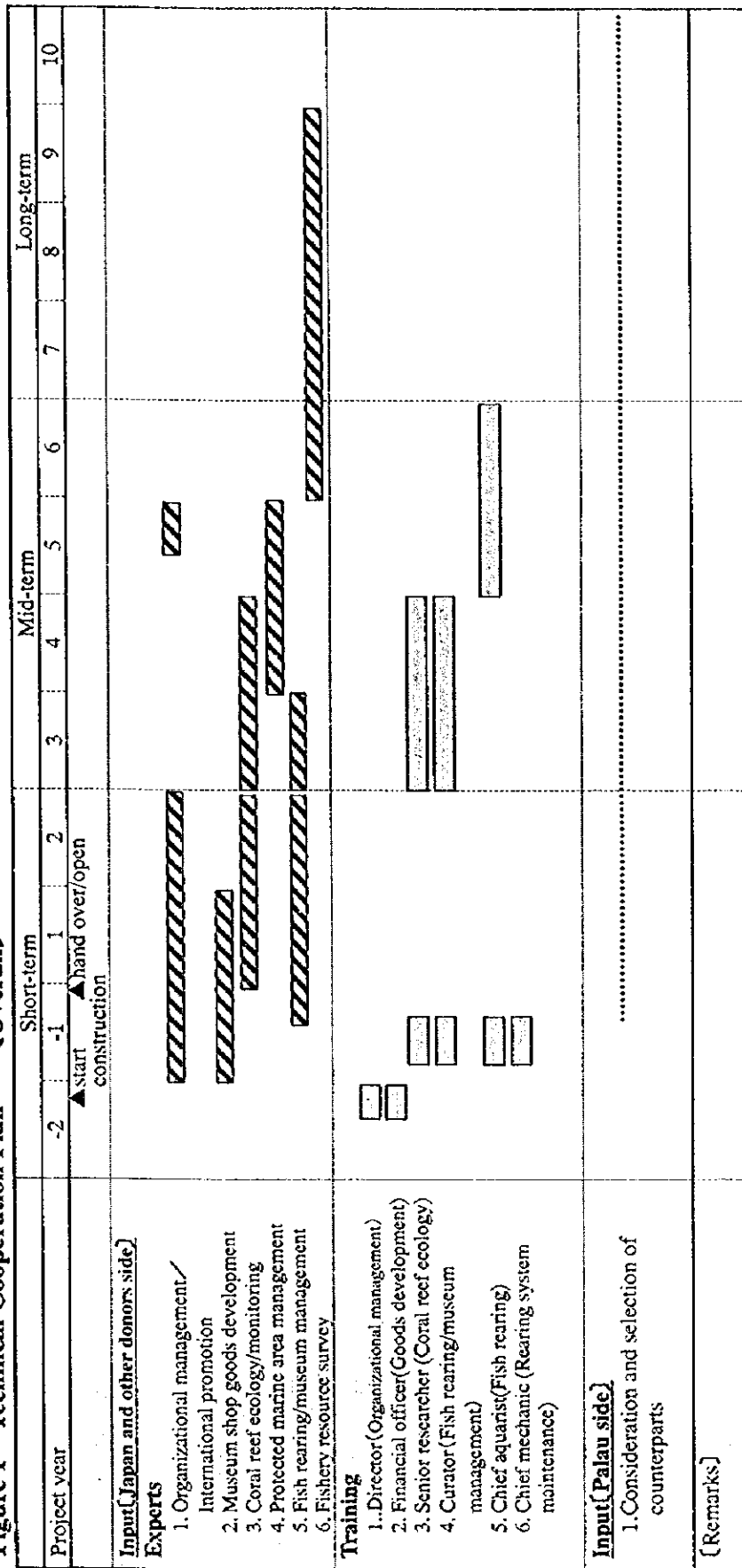


- ⑥ The revetment of the Project site was constructed more than 50 years ago and several portions have been destroyed by typhoons. Due to the lack of information on wave conditions during a typhoon, the renovation work on the revetment planned in the Project will focus on temporary renovations on the existing damaged sections. It is recommended that the Palauan government collect data on the wave conditions during rough weather at the site, as well as data on the current velocity in the channel in front of the site for use when the revetment needs to be completely repaired in future.
  
- ⑦ As a second-stage activity of the Center, international training in coral reef conservation is expected to be conducted. Although this training is not included in the early-stage activities in the present Study, it is recommended that the Palauan government shape a course of implementation of such training to provide for the future.

## **Figures and Tables**



**Figure 1 Technical Cooperation Plan [Overall]**







Legend:  Technical transfer period by experts,  Overseas training period, ..... Undertakings by the Palau side.

Figure 2 Technical Cooperation Plan (Director and Financial Officer)

Project year	Short-term			Mid-term			Long-term					
	-2	-1	1	2	3	4	5	6	7	8	9	10
<b>Targets</b>	<p>▲ start ▲ hand over/open construction</p> <p>1. Acquire basic management skills to manage the Center.                      2. Standardize the information system agreed on in the Coral Reef Initiative and establish a data base. Participation in GCRMN.                      3. Improve capabilities in evaluating and managing coral reef resources.</p> <p>1. Acquire skills in presentation, public relations activities, and introducing the Center's activities at international conferences, etc.                      2. Establish a network with international research institutes.                      3. Evaluate the impact of the Center.                      4. Develop museum shop goods</p> <p>1. Establish a framework for coral reef conservation activities with related domestic institutes.                      2. Acquire skills in comprehensive coastal resource management.</p>											
<b>Input (Japan and other donor side)</b>	<p>1. Organizational management/ International promotion                      2. Museum shop goods development</p> <p>1. Acquire basic management skills to manage the Center.                      2. Standardize the information system agreed on in the Coral Reef Initiative and establish a data base. Participation in GCRMN.                      3. Improve capabilities in evaluating and managing coral reef resources.</p>											
<b>Training</b>	<p>1. Director (organizational management)                      2. Financial Officer (goods development)</p>											
<b>Input (Palau side)</b>	<p>1. Consideration and selection of counterparts</p>											
<b>[Remarks]</b>												



Legend  Technical transfer period by experts,  Overseas training period,  Undertakings by the Palau side.



**Figure 3 Technical Cooperation Plan [Senior Researcher]**

Project year	Short-term			Mid-term			Long-term					
	-2	-1	1	2	3	4	5	6	7	8	9	10
<b>Targets</b>	<p>▲ start construction</p> <p>▲ hand over/open</p> <ol style="list-style-type: none"> <li>1. Acquire methodology for carrying out basic oceanographic observations.</li> <li>2. Learn the basic monitoring techniques.                             <ul style="list-style-type: none"> <li>• Basic method of species identification</li> <li>• Survey on coverage of coral reef communities (Manta Tow survey method)</li> <li>• Analysis of aerial photographs on coral coverage and dominant species</li> </ul> </li> </ol>			<ol style="list-style-type: none"> <li>1. Expand techniques on monitoring methods.                             <ul style="list-style-type: none"> <li>• Monitoring techniques using the permanent transect method</li> <li>2. Learn survey methods on fish ecology/distribution.</li> <li>3. Accumulate knowledge/techniques for the evaluation of marine environments and formulation of protection plans based on monitoring data.</li> <li>4. Acquire ability to publish research results.</li> <li>5. Senior researcher will acquire a master's or higher degree.</li> </ul> </li> </ol>			<ol style="list-style-type: none"> <li>1. Establish a framework of coordinations with related institutions on coral reef conservation.</li> <li>2. Acquire ability to carry out joint research with international and overseas research institutions and to accept consigned surveys.</li> </ol>					
<b>Input [Japan and other donors side]</b>	<p>██████████</p>			<p>██████████</p>			<p>██████████</p>			<p>██████████</p>		
<b>Experts</b>	<ol style="list-style-type: none"> <li>1. Coral reef ecology/monitoring</li> <li>2. Management of protected marine area</li> <li>3. Marine ecology</li> </ol>											
<b>Training</b>	<ol style="list-style-type: none"> <li>1. Senior researcher (Coral reef ecology)</li> </ol>											
<b>Input [Palau side]</b>	<p>██████████</p>			<p>██████████</p>			<p>██████████</p>			<p>██████████</p>		
	<ol style="list-style-type: none"> <li>1. Consideration and selection of counterparts</li> </ol>											
<b>[Remarks]</b>												

Legend: ██████████ Technical transfer period by experts, ██████████ Overseas training period, ..... Undertakings by the Palau side.

Figure 4 Technical Cooperation Plan [Curator and Chief Aquarist]

Project year	Short-term			Mid-term			Long-term								
	-2	-1	0	1	2	3	4	5	6	7	8	9	10		
Targets	<p>▲ start ▲ hand over/open construction</p> <ol style="list-style-type: none"> <li>1. Acquire basic know-how in museum management and exhibition.</li> <li>2. Acquire disciplines and techniques for the rearing of living marine organisms.</li> <li>3. Establish methods for general public education/training</li> <li>4. Establish a system of providing the latest information on coral reefs</li> </ol>			<ol style="list-style-type: none"> <li>1. Learn applied rearing techniques of marine organisms.                             <ul style="list-style-type: none"> <li>• Breeding of hard and soft corals</li> <li>• Techniques on displaying symbiosys</li> </ul> </li> <li>2. Coordinate conservation activities with relevant institutions.</li> <li>3. Acquire a master's degree as curator.</li> </ol>											
Input [Japan and other donor countries]	<p>Experts</p> <p>Fish rearing/Museum management</p> <p style="text-align: center;"></p>														
Training	<ol style="list-style-type: none"> <li>1. Curator (fish rearing/ museum management)</li> <li>2. Chief aquarist (fish rearing)</li> <li>3. Chief mechanic (Rearing system maintenance)</li> </ol> <p style="text-align: center;"></p>														
Input [Palau side]	<ol style="list-style-type: none"> <li>1. Consideration and selection of counterparts</li> </ol> <p style="text-align: center;">.....</p>														
{Remarks}															

Legend:  Technical transfer period by experts,  Overseas training period, ..... Undertakings by the Palau side.

**Table 1. Function/Exhibition Contents of the Visitor Center Expected by Visitors to Palau**

Function / Exhibition Contents	Percentage of Persons Indicated Expectation		
	Taiwanese	Japanese	American
	(N=206)	(N=166)	(N=84)
1. Live fish (aquarium)	89.8	75.3	78.8
2. Diving information	67.5	58.4	56.0
3. Information to learn how to conserve coral reef	51.5	42.8	65.5
4. Publications, Library	55.8	30.7	58.3
5. Panels, Diorama, Audio Visuals	47.6	41.0	67.9
6. Class, Eco-tour	58.7	18.7	61.9

Source: Interview survey by Basic Design Team, Nov. 1997.

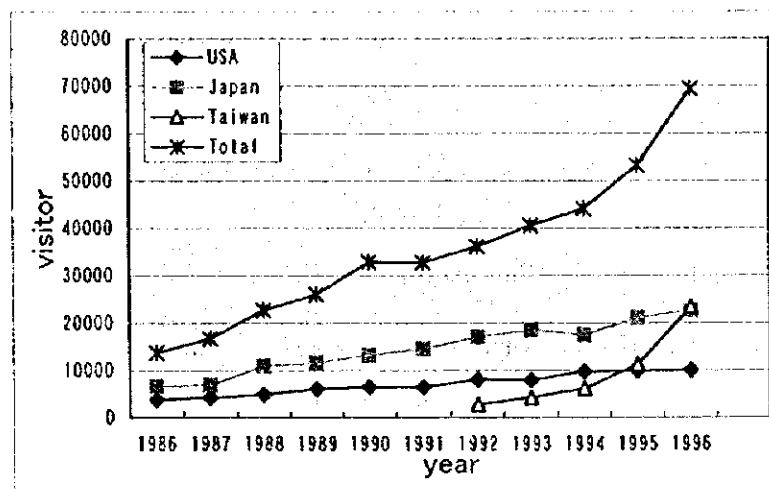


## **Appendix I**

## Appendix I-1 Projection of Admissions and Revenue of Visitor Center, and Sales of Museum Shop

### (1) Number of visitors and income from admissions

The number of visitors to Palau has been mainly composed of Japanese and Americans. While the rise in the number of visitors from both of these countries has stagnated in recent years, the number of tourists from Taiwan has grown rapidly (Fig. 1). The unstable global economic condition that emerged in the latter half of 1998 seems to prolong its period, and is considered to be a restrictive factor of the growth of the number of visitors. Hence, it has become difficult to forecast the number of tourists for a long-term. The number of tourists is projected in this report for five years (2000-2004) after the initial commencement of the Center.



Source: Bank of Hawaii, 1997

Remarks: Growth Rate of Tourists to Palau from 1992 to 1996.

Taiwanese:	53.3%
Japanese:	7.3%
Americans:	5.5%
Others:	12.5%

Fig. 1 Trends of Number of Tourists to Palau According to Country (1986-1996)

The number of visitors to Palau was projected for the following three cases.

- Case 1 : Projection based on average annual growth rate in number of visitors over the last five years (1992-1996). However, the growth rate for Taiwanese visitors was revised and reduced considering other external factors.
- Case 2 : The growth rate was assumed to be same as in "Case 1" in the period of 1999-2000, and to reduce one-half (1/2) in the period of 2001-2004.
- Case 3 : The growth rate was assumed to be same as in "Case 1" in the period of 1999-2000, and to become zero (0) in the period of 2001-2004.

1) Projection for Case 1

① Number of visitors to Palau

- The annual growth rate in number of visitors to Palau excluding Taiwanese over the last five years (1992-1996) was 7.3% for Japanese, 5.5% for Americans, and 12.5% for others.
- Since it is difficult to forecast the number of Taiwanese visitors for the long term due to the rapid growth rate from 1994, the annual growth rate of 6% in hotels' accommodation capacity, which serves as a restrictive growth rate factor, was used to make the projection (see Table 1).

Table 1 Trend of Number of Hotels and Hotel Rooms in Palau (1993-1997)

Year	Number of Hotels	Number of Hotel Rooms
1993	26	577
1994	25	645
1995	29	699
1996	30	716
1997	31	726
Number of hotels planned*	23	4,569

Source: PVA

Remarks: \* Based on hotels which have submitted PVA application for a construction permit as of July 1997.

- The number of visitors to Palau thus estimated is shown in Table 2.

Table 2 Projected Number of visitors to Palau by Country (1997-2005)

Unit: Persons

Year	Total	Taiwanese	Japanese	Americans	Others
1997	75,139	32,166	19,679	10,000	13,294
1998	80,717	34,096	21,116	10,550	14,956
1999	86,754	36,142	22,657	11,130	16,825
2000	93,292	38,310	24,311	11,742	18,928
2001	100,377	40,609	26,086	12,388	21,294
2002	108,061	43,045	27,990	13,070	23,956
2003	116,400	45,628	30,033	13,788	26,951
2004	125,458	48,366	32,226	14,547	30,320
2005	135,302	51,268	34,578	15,347	34,110

② Estimation of the number of tourists (sightseers)

Businessmen who are included in the visitor population, were not considered potential visitors to the Center. Hence, their numbers were subtracted in the number of overall visitors (See the ratio of businessmen shown in Table 3).

Table 3 Ratio of Businessmen Within Overall Visitors

Unit: %

Total	Taiwanese	Japanese	Americans	Others
8	1	4	18	35

Source: PVA

③ Estimation of the number of potential visitors to the Center

The ratio of respondents in this study's interview survey on the Visitor Center who answered "willing to visit" or "interested in visiting" was calculated (Table 4). The potential number of visitors to the Center was estimated by multiplying this ratio and the number of tourists together.

Table 4 Tourist Interest in the Visitor Center

	Unit: %			
	Taiwanese (N=217)	Japanese (N=186)	Americans (N=83)	Others (N=5)
1. Willing to visit	73	45	76	60
2. Interested	25	52	24	40
3. Not interested	2	3	0	0
4. Willing to visit & Interested	98	97	100	100

Source: B/D Study Team Interview Survey (November 1997)

Remarks: Figures refer to percentage of number of respondents on each item divided by total number of respondents.

However, it is anticipated that the higher the admission fee is set, the lower the number of visitors to the Center. Furthermore, an admission fee considered reasonable by the Japanese and the Americans was not considered reasonable for many Taiwanese (Table 5).

Table 5 Reasonable Admission Fee for Tourists

	Unit: %							
Fee (US\$)	Taiwanese N=200	Cumulation	Japanese N=177	Cumulation	U.S. (N=84)	Cumulation	Others (N=5)	Cumulation
\$1	45	100	10	100	1	100	0	100
Less than \$3	33	55	33	90	18	99	0	100
Less than \$5	18	22	43	57	44	81	80	100
Less than \$7	2	4	5	14	16	37	20	20
Less than \$10	2	2	9	9	21	21	0	0

Source: B/D Study Team Interview Survey (November 1997)

Remarks: Figures refer to percentage of number of respondents on each item divided by total number of respondents.

④ Based on these observations, calculations were made according to combinations of admission fee levels and countries for the target year, 2000, as shown in Table 6.

Table 6 Projected Number of Visitors to the Visitor Center According to Admission Fee (2000)

Admission Fee \$	Total	Taiwanese	Japanese	U.S.	Others	Admission Revenue \$/yr	Admission Ratio %
\$1	81,737	37,168	22,638	9,628	12,303	81,737	88
\$3 <sup>&lt;1</sup>	62,651	20,442	20,374	9,532	12,303	187,953	67
\$5 <sup>&lt;2</sup>	41,183	8,177	12,904	7,799	12,303	205,915	44
\$7	10,679	1,487	3,169	3,562	2,461	74,753	11
\$10	4,802	743	2,037	2,022	0	48,020	5
\$3 & 5 <sup>&lt;3</sup>	53,448	20,442	12,904	7,799	12,303	226,356	57

Remarks <1 : Admission fee is uniformly set at \$3.

<2 : Admission fee is uniformly set at \$5.

<3 : Admission fee is set at \$5 for individual, but group admission is set at \$3 in consideration of Taiwanese group tours.

According to the above table, the number of visitors to the Visitor Center is the highest when the admission fee is low, but the total income generated from admissions is the largest when the admission fee is set at \$3 per person for group tours (in fact, nearly all Taiwanese tourists are group tour members) and \$5 per person for individual rates.

The admission revenue generated from Palauan visitors was calculated based on the following assumptions.

- (a) The residents of Koror town, numbering 7,644 between the ages of 18 to 59 years (1995 census), are anticipated to visit the Center once within a five-year period.
- (b) The admission fee for Palauan citizens will be set at US\$2/per person which is less than the admission fee for foreign tourist groups which will be set at US\$3/per person. The admission revenue generated from Palauan citizens is assumed to be:  
 $7,644 \text{ people} \div 5 \text{ years} \times \$2/\text{person} = \$3,057/\text{year}.$

Based on the estimated data and the assumption explained above, the projected number of visitors and admission revenue for the initial five year period of the Center are shown in Table 7.

Table. 7 Projected Number of Visitors and Admission Revenue of the Visitor Center <sup><1</sup>

Year	Number of Visitors to Palau (persons/yr)	Number of Visitors to V.C (persons/year)		Admission Revenue (\$/year)		
		Foreigner	Palauan	Foreigner	Palauan	Total
2000	93,292	53,448	1,529	226,356	3,057	229,413
2001	100,377	57,583	1,529	244,578	3,057	247,635
2002	108,061	62,077	1,529	264,447	3,057	267,504
2003	116,400	66,964	1,529	286,126	3,057	289,183
2004	125,458	72,284	1,529	309,802	3,057	312,859

Remarks <1 : Admission fee is set at \$5.00 for individual and at \$3.00 for group, and all the Taiwanese visitors are assumed to be group members.

## 2) Projection for Case 2

On the assumption that the growth rate will be the same as "Case 1" in the period of 1999-2000, and will reduce to one-half (1/2) in the period of 2001-2004, the projected number of visitors and admission revenue of the Visitor Center are as shown in Table 8.

Table. 8 Projected Number of Visitors and Admission Revenue of the Visitor Center

Year	Number of Visitors to Palau (persons/yr)	Number of Visitors to V.C (persons/year)		Admission Revenue (\$/year)		
		Foreigner	Palauan	Foreigner	Palauan	Total
2000	93,292	53,448	1,529	226,356	3,057	229,413
2001	96,805	55,497	1,529	235,383	3,057	238,440
2002	100,466	57,636	1,529	244,812	3,057	247,869
2003	104,284	59,868	1,529	254,672	3,057	257,729
2004	108,262	62,197	1,529	264,975	3,057	268,032

### 3) Projection for Case 3

On the assumption that the growth rate will be the same as "Case 1" in the period of 1999-2000, and will reduce zero (0) in the period of 2001-2004, the projected number of visitors and admission revenue of the Visitor Center are as shown in Table 9.

**Table. 9 Projected Number of Visitors and Admission Revenue of the Visitor Center**

Year	Number of Visitors to Palau (persons/yr)	Number of Visitors to V.C (persons/year)		Admission Revenue (\$/year)		
		Foreigner	Palauan	Foreigner	Palauan	Total
2000	93,292	53,448	1,529	226,356	3,057	229,413
2001	93,292	53,448	1,529	226,356	3,057	229,413
2002	93,292	53,448	1,529	226,356	3,057	229,413
2003	93,292	53,448	1,529	226,356	3,057	229,413
2004	93,292	53,448	1,529	226,356	3,057	229,413

### (2) Sales and Purchasing Costs of the Museum Shop

#### 1) Sales criteria

The component in the purchase amount of gifts per person of tourists in Palau are shown in Table 10.

**Table 10. Component of Per Capita Purchase Amount of Gift by Tourist in Palau<sup><1</sup>**

Nationality	\$0~\$9	\$10~\$29	\$30~\$49	\$50~\$69	Above \$70
Japanese (divers), N= 191	2(2) 1.0%	37(23) 19.3%	32(19) 16.8%	24(15) 12.6%	96(56) 50.3%
Taiwanese (divers) N=238	33(0) 13.9%	35(4) 14.7%	53(1) 22.3%	57(9) 23.9%	60(8) 25.2%
American (divers) N=92	2(0) 2.2%	19(6) 20.6%	10(5) 10.9%	13(6) 14.1%	48(26) 52.2%

Source: Data from B/D Study Team Interview Survey on departing tourists (November 1997)

Remarks <1: Figures in parentheses indicate number of divers.

According to the data shown in the table above, the majority of the Japanese and American tourists (and others) purchased souvenirs, more than 60% spending US\$50 or more. In the case of Taiwanese tourists, nearly 14 % did not make any purchases or purchased less than US\$10, but nearly 50% spent more than US\$50. The trend was the same for visiting divers. If the admission fee is set at US\$5/person, there is a very high likelihood that 57% of the Japanese tourists and 82 to 100% of the American tourists (including others) will visit the Visitors Center. It is very likely that they will purchase gifts and souvenirs at the museum shop if the merchandise is attractive. In addition, the purchase amount is expected to be high.

In the case of Taiwanese visitors, approximately 55% of the group tourist members are anticipated to visit the Visitor Center. Of this figure, about 80% of the visitors are expected to make purchases at the museum shop. Therefore, the sale generated by the museum shop is calculated according to the following formula.

$$\text{Sales} = \text{visitors} \times \text{average purchase amount per person}$$

The average purchase amount per person at nine public aquariums in the United States is US\$2.13, with a median value of US\$1.92 (information provided by Kuroda, Business Manager, Waikiki Aquarium). The actual figure for the Belau National Museum is US\$5.00 (Table 11).

Table 11 Number of Visitors and Sales Revenue at the Belau National Museum (March 1997)

Number of Visitors (persons/month)	Admissions Revenue (\$/month)	Shop Sales (\$/month)	Total Revenue (\$/month)	Purchase Amount/person (\$/person)
1,486	2,961	7,432	10,393	5.0

Source: Belau National Museum

In view of the fact that the majority of the tourists who visit Palau are adults, the purchase amount for souvenirs is large, and the Center is one of the few on-land attraction spots in Palau, the average purchase amount per visitor is assumed at US\$2.50 in the period of the initial five years from the Center's commencement.

2) Determination of purchasing cost in relation to retail price

While the purchasing cost of the National Museum was said to be 75% of the retail price, it is generally about 50% of the retail price for private gift shops in Koror town. The actual figure for the Waikiki Aquarium in Hawaii was 53% (information by Kuroda). Since the Center will operate on a self-supporting accounting system in accordance with the public corporation law, the cost calculation methods used in the private sector should be employed. Therefore, the actual figure for the Waikiki Aquarium or (53%) was determined to be the purchasing cost of the museum shop of the Visitor Center.

3) Projection of sales/purchasing costs of the museum shop

Assuming that resident Palauan visitors would not make purchases at the museum shop, the sales/purchasing costs of the museum shop are calculated according to 1) and 2) above and are shown in Table 12 below.

Table 12 Projected Sales and Purchasing Costs of the Museum Shop <sup>1</sup>

Year	Number of Foreign Visitors to V.C (persons/year)	Average Purchase Amount per person (\$/person)	Sales Amount (\$/person)	Purchasing Cost (\$/person)
2000	53,448	2.5	133,620	70,819
2001	57,583	2.5	143,958	76,298
2002	62,077	2.5	155,193	82,252
2003	66,964	2.5	167,410	88,727
2004	72,284	2.5	180,710	95,776

Remarks <sup>1</sup>: Based on projected number of foreign visitors by Case 1.

According to the same calculation method, the annual sales amount in 2004 in Case 2 and Case 3 will be about US\$155,000 and US\$134,000, respectively, and the annual purchasing cost in 2004 about US\$82,000 and US\$71,000, respectively.

**(3) Projected Revenue of the Visitor Center**

Based on the projected income generated by admission fees shown in (1) and the projected sales of the museum shop shown in (2), the revenue of the Visitor Center for Case 1 is calculated as shown in Table 13 below.

**Table 13 Projected Revenue of the Visitor Center**

Year	Admission Revenue	Museum Shop Sales	Total
2000	229,413	133,620	363,033
2001	247,639	143,958	391,593
2002	267,504	155,193	422,697
2003	289,183	167,410	456,593
2004	312,859	180,710	497,569

According to the same calculation method, the annual revenue in 2004 for Case 2 and Case 3 will be about US\$423,000 and US\$363,000, respectively.



## Appendix I-2 Other Estimated Revenue of the Center

### (1) Glass-bottom boat rental fees

Due to competition from the private sector for similar services, this Project will not include glass-bottom boat rental.

### (2) Bench fees of research facilities

#### 1) Determination of the bench fees per day

The usage fees collected from researchers utilizing the Center's research facilities (excluding the boats) will be used to cover utility costs such as electricity, water, sewerage, etc., and equipment costs. The maximum annual utility cost of the research building is about US\$19,872, and under the assumption of annual 300 days of research activities in a year, the cost per day is about US\$66.20. Since the maximum number of researchers using the facilities during peak hours is five persons, the utility cost per person is about US\$13.20/day. (This estimated figure might be lower than the actual cost since the number of researchers will not always be five throughout the year. However, in order to simplify the assumption, total number of researchers of five persons obtained from planned capacity of each research room was used for the estimation of daily per capita utility cost.) If the average durability of the equipment is assumed to be seven years and the repair cost to be 1% of the direct purchase cost, the prime cost of the equipment is US\$24,600 per annum or about US\$182.00 per day. Accordingly, the prime cost of the equipment used by one person is \$16.40/day. In other words, the cost generated by one researcher utilizing the research facilities is US\$29.60/day. If 10% is added to this cost, the bench fee to be collected under this plan is US\$33/day.

#### 2) Annual frequency of use and anticipated revenue

At CRRF, the number of days in which its facilities are utilized by visiting researchers is 200 days per year. The frequency of use by visiting researchers at the Center is assumed to increase in stages as follows.

- ① During the initial year of operations, two visiting researchers, one from Japan and one from the U.S., are anticipated to stay at the Center for one month each. The total amount of stay is 2 man-months.
- ② Visiting researchers from Japan and the U.S. are anticipated to stay for a total of 4 man-months during the spring and summer holidays in the third year of operations.
- ③ The stay of visiting researchers from Japan and the U.S. will be 4 man-months during the spring and summer holidays, in addition to one long-term visiting researcher staying for 6 months in the fifth year of operations.

The revenue generated from the Center's facilities by the visiting researchers delineated above is estimated to be US\$1,980 for the first year, US\$3,960 in the third year, and US\$9,900 in the fifth year.

**(3) Housing fees**

**1) Determination of housing fees**

CRRF collects US\$20/day for the use of a daybed and US\$30/day for a bedroom. The Marine Laboratory of the University of Guam charges US\$20/day for a bedroom. Based on the premise that each researcher will be responsible for washing their own linen, the Center will charge US\$20/day for a bedroom.

**2) Estimated annual number of boarding days and revenue**

In the foregoing section, the annual use of the Center's facilities by visiting researchers was estimated to be 2 m/m (60 man-days) in the first year, 4 m/m (120 man-days) in the third year, and 10 m/m (300 man-days) in the fifth year. Since the boarding fee has been set at US\$20/day, the estimated amount of revenue generated from boarding facilities is US\$1200 from the first year, US\$4,200 in the third year, and US\$6,000 in the fifth year.

**(4) Research grants**

Research grants are basically issued to researchers who have been selected according to their capabilities and achievements. Because the Center is in need of accumulation of research achievement before getting a contract of a research grant, research grants are not foreseen in the immediate future following the Center's commencement. Even if a research grant is obtained through the assistance of a grant writer, it will be necessary for the Center to engage in joint research activities with another qualified institution. In such cases, the Center's portion of the funds will not be large and it is difficult to make estimations at the present time. Therefore, revenue generated from research grants will not be included in the initial five years of the Center's operations.

**(5) Tax subsidies (diving and hotel taxes, etc.)**

The issue of granting tax subsidies to the Center will be decided by the Palauan government. The revenue and expenditure will be submitted to the relevant government agency, but revenue stemming from subsidies will not be included in the income projection.

**(6) Membership fees**

**1) Projected number of members**

A traditional practice of the Palauan villages is for the village chief to manage the resources of the coral reefs. As part of the Center's education and public awareness activities, a "Coral Reef Conservation Society" will be created and members will be recruited. Although the number of members that are recruited at the outset of the Center's operations is anticipated to be small, it is expected to increase gradually with the implementation of appropriate events and activities. The number of Palauan visitors to the Center for the initial five years has been projected at about 1,500 annually (see Appendix I.1) in this basic plan. Of this figure, it is conjectured that 1 to 2% (15 to 30 members) will join the "Conservation Society". Based on this assumption, the number of members in the first year is projected at 22, with an annual increase thereafter by 22 people, totaling 110 members by 2004. Foreign visitors to the Center are also expected to join, but their membership has not been included in the projected revenue.

2) **Membership fees and projected revenue**

The membership fee of PCS is US\$10/year. The membership fee for the Center's conservation group will also be set at US\$10/year. Members will be issued a certificate and a sticker. They will be given free admission to the Visitor Center and expected to join periodic member meetings and other various events planned. The revenue generated from membership dues is shown in the table below.

**Projected Revenue from Membership Fees**

Year	Number of Members	Projected Revenue (\$/year)
2000	22	22
2001	44	440
2002	66	660
2003	88	880
2004	110	1,100

(7) **Certification fees**

Possible items of certification activities by the Center are as follows.

- ① A completion certificate to tourist guides and diving instructors who have completed the coral reef conservation training course (this will be enacted following legislation of this requirement).
- ② Certification in relation to the export of marine organisms through biological examination.

This certification activity by the Center is dependent on the legislation of relevant laws by the Palauan government and coordinated authority by government departments and agencies. Therefore, revenue stemming from certification activities is foreseen as a future issue and it has not been included in the initial five-year revenue projected for the Center.

(8) **Rental fee of the Visitor Center facility**

Due to the shortage in Palau of meeting and assembly halls for parties and other events of Palauan residents, there is a large demand for such facilities (information provided by Mr. Eleldui, PCS Director). The use of the Center's multipurpose room for such gatherings at night is a potential source of revenue for the Center. The Center will not provide added services other than the use of its multipurpose room as a gathering/meeting place. The actual cost of utilities such as air conditioning, lighting, the use of microphone, chairs, etc. is estimated at about US\$2 per hour. In addition, the cost of night security during the use of the multipurpose room for three to four hours will not be high. If about US\$100 is collected each time for the use of the Center's multipurpose room, the actual revenue earned is high. If the facility will be rented on an average of once a month, the annual revenue earned will be US\$1,200.

(9) **Sales profit from vending machines**

A vending machine selling soft drinks will be installed in the Visitor Center. The estimated profit earned from one 12-ounce can is US\$0.16. At the Waikiki Aquarium, about 10% of the total number of visitors utilize the vending machine (information supplied

by Kuroda, Waikiki Aquarium). The projected sales profit from the vending machine based on the anticipated number of visitors to the Center is shown in the table below for Case 1.

**Projected Sales Profit from Vending Machine**

Year	Number of Visitors (including Palauans) (persons/year)	Number of Cans Sold by the Vending Machine (can/year)	Profit Ratio (US\$/can)	Sales Profit (US\$/year)
2000	54,977	5,497	0.16	880
2001	59,112	5,911	0.16	946
2002	63,606	6,360	0.16	1,018
2003	68,493	6,849	0.16	1,096
2004	73,813	7,381	0.16	1,181

For Cases 2 and 3, the estimated profit will be US\$1,020 and US\$880, respectively.

**(10) Revenue from Rental Services of Research Boats**

**1) Establishing rental fees**

Rental fees will be collected from visiting researchers who utilize the Center's boat. The prime cost of these boats is US\$46.40/day. In addition, the cost of the boat driver employed by the Center is about US\$44/person/day.

In order to maintain clear management responsibility for the boat and outboard engines, the boat will be rented with the driver. Therefore, the total prime cost will be US\$90.40/day excluding gasoline. If 10% is added to these costs, the rental fee will be US\$100/boat/day. The researcher will be responsible for footing the gasoline cost.

**2) Annual revenue from rental fees**

The annual revenue generated from rental fees collected from the anticipated number of visiting researchers is shown in the table below.

**Projected Annual Revenue from Boat Rental Fees**

Year	Number of Visiting Researchers (man-days)	Boat Rental Days <sup>&lt;1</sup>	Rental Fees (US\$/day)	Revenue from Rental Fees (US\$/year)
2000	2 persons, each 30 days	30	100	3,000
2001		(45) <sup>&lt;2</sup>	100	(4,500)
2002	2 persons, each 30 days	60	100	6,000
2003		(75) <sup>&lt;2</sup>	100	(7,500)
2004	1 person each 180 days 2 persons each 60 days	90 60	100	15,000

Remarks <1 : It is projected that researchers will spend 50% of their stay in field surveys.

<2 : ( ) is the average value of the preceding and subsequent years.

**Appendix I-3 Estimation of SS and BOD of Seawater Discharged  
from Exhibition Tanks and Ponds**

**(1) Types of exhibition tanks/ponds and supply/discharge methods of seawater for these tanks/ponds**

Type of Tanks / Ponds	Water Volume	Supply Method	Water Circulation Rate (times/day)	Daily Discharge Volume (t/day)	Cleaning Method of Filtration and its Frequency <sup>2</sup>	Water Volume for Cleaning (t/time)
<b>I. Out-door Ponds</b>						
1. (Mangrove)	24.0	Running	18	432.00	-	-
2. (Seagrass bed)	43.2	- ditto -	18	777.60	-	-
3. (Inner reef)	36.0	- ditto -	24	864.00	-	-
(Sub-total)	-	-	-	2,073.60 (99.87%)	-	-
4. (Inner reef /Reef crest)	21.6	Closed circulation	24	1.08 <sup>&lt;1</sup>	Backwashing of <sup>&lt;3</sup> 4 filtration tanks, 2 times/month/tanks	9.0/tank/ time
<b>II. Indoor Tanks</b>						
1. (Outer reef)	21.7	- ditto -	24	1.09 <sup>&lt;1</sup>		
2. (Coral reef organisms)	0.2	- ditto -	24	0.01 <sup>&lt;1</sup>	Direct cleaning of filtration material (2 times/month)	0.16/time
	0.2	- ditto -	24	0.01 <sup>&lt;1</sup>		- ditto -
3. (- ditto -)	0.2	- ditto -	24	0.01 <sup>&lt;1</sup>	- ditto -	- ditto -
4. (- ditto -)	0.2	- ditto -	24	0.01 <sup>&lt;1</sup>	- ditto -	0.64/time
5. (- ditto -)	0.8	- ditto -	24	0.04 <sup>&lt;1</sup>	- ditto -	- ditto -
6. (- ditto -)	0.8	- ditto -	24	0.04 <sup>&lt;1</sup>	- ditto -	- ditto -
7. (- ditto -)	0.8	- ditto -	24	0.04 <sup>&lt;1</sup>	- ditto -	0.48/time
8. (- ditto -)	0.6	- ditto -	24	0.03 <sup>&lt;1</sup>	- ditto -	- ditto -
9. (- ditto -)	0.6	- ditto -	24	0.03 <sup>&lt;1</sup>	- ditto -	- ditto -
10. (- ditto -)	0.6	- ditto -	24	0.03 <sup>&lt;1</sup>	- ditto -	- ditto -
11. (- ditto -)	0.6	- ditto -	24	0.03 <sup>&lt;1</sup>	- ditto -	- ditto -
12. (Jellyfish)	1.8	- ditto -	24	0.09 <sup>&lt;1</sup>	- ditto -	1.44/time
13. (Corals)	3.0	- ditto -	24	0.15 <sup>&lt;1</sup>	- ditto -	2.40/time
14. (Coral propagation)	0.6	- ditto -	24	0.03 <sup>&lt;1</sup>	- ditto -	0.48/time
Sub-total	-	-	-	2.71 (0.13%)	-	-
<b>Total</b>	-	-	-	<b>2,076.31</b> <b>(100%)</b>	-	-

Remarks <1 : Five (5) %of sea water volume of each tank will be changed daily by fresh sea water.

<2 : Waste water by backwashing and cleaning of filtration material will be deposited in the sedimentation tank and only its supernatant will be discharged into the sea by mixing with the effluent from outdoor tanks.

<3 : In order to reduce the volume of waste water by backwashing each time, the filtration tank is divided into 4 cells, and each cell will be backwashed twice a month.

(2) Estimation of SS and BOD of seawater discharged from the Visitors Center

Two kinds of seawater will be discharged into the sea from the Visitor Center.

- Sea water discharged daily mainly from the outdoor ponds
- Sea water used for cleaning filtration material in the filtration tanks (back-washing)

SS and BOD levels of these kinds of seawater were estimated as follows:

1) Estimation of SS and BOD of daily discharged sea water

As shown in the table above, the total volume of sea water discharged daily is 2,076.31 tons, of which 2,073.60 tons (99.87%) are from the outdoor ponds and 2.71 tons (0.13%) from the indoor recirculation tanks (in the recirculation tanks 5% of the tank water is replaced with new sea water and discharged daily). SS and BOD values will be higher in sea water discharged from the outdoor ponds to which sea water is supplied directly from the sea, and the quantity of water discharged will be much greater from the outdoor ponds than from the recirculation tanks. Therefore, SS and BOD levels have been estimated only for the outdoor ponds, as shown in the table below.

SS, BOD Load of Seawater Discharge from Outdoor Ponds

	a	b	c	d	e	f	g	h	i	j	k	l
	Water Vol.	Water circul. Rate	Stocking density of exhibit organism	Wt. of organism	Feed- ing rate	Feed amount	Dry wt. of feed	Ash	Org. sub.	Org. waste	SS load /day	BOD load /day
Formula	-	-	-	(a x c)	-	(d x e)	(f/3)	(g x 0.2)	(g x 0.8)	(i/3)	(h+j)	(j/1.5)
Unit	x 1000 lit	time per day	% <1	kg	% <2	kg	g	g	g	g	g	g
Outdoor Pd. 1	24.00	18.00	0.10	24.00	2.00	0.48	160.00	32.00	128.00	42.67	74.67	28.45
Outdoor Pd. 2	43.20	18.00	0.10	43.20	2.00	0.86	287.00	57.40	229.60	76.80	134.20	51.20
Outdoor Pd. 3	36.00	24.00	0.10	36.00	2.00	0.72	240.00	48.00	192.00	64.00	112.00	42.67
Total	103.20	-	-	-	-	-	-	-	-	-	320.87	122.32

Remarks <1 : Weight relative to water volume  
<2 : Weight relative to living organisms

Mean Values of SS, BOD of Seawater Discharge from Outdoor Ponds

	a	b	k	l	m	n	o
	Water Vol.	Water Circulation rate	Daily SS load	Daily BOD load	Daily discharge vol.	SS	BOD
Formulae	-	-	(h+j)	(j/1.5)	-	-	-
Unit	m <sup>3</sup>	times / day	g	g	m <sup>3</sup>	mg/L	mg/L
Outdoor Pd. 1	24.00	18.00	74.67	28.45	432.00	0.17	0.07
Outdoor Pd. 2	43.20	18.00	134.20	51.20	777.60	0.17	0.07
Outdoor Pd. 3	36.00	24.00	112.00	42.67	864.00	0.13	0.05
Total	103.20	-	320.87	122.32	2,073.60	0.15	0.06

Remarks <1 : Weight relative to water volume  
<2 : Weight relative to living organisms

As shown in the table above, the mean values of SS and BOD of sea water discharged from the outdoor ponds, which is the major source of water discharge, are estimated at 0.15 ppm and 0.06 ppm, respectively.

Effects of SS on marine organisms at lower than 5 ppm are known only in the case of cold-water seaweed (*Undaria*) and oysters. Unfavorable effects of BOD at lower than 3 ppm on marine organisms have not been reported. Although the SS and BOD of the discharged water will fluctuate diurnally, i.e. increase during feeding times, the SS and BOD of the discharged water are not expected to affect unfavorably marine organisms even if the values become greater temporally. Therefore, it was concluded that the seawater in the outdoor ponds could be discharged directly into the sea.

2) Estimation of SS and BOD of sea waste water derived from backwashing of filtration tanks of recirculation tanks.

It is known empirically that, when a filtration tank of a recirculation tank is cleaned or backwashed after rearing live organisms for a certain period of time, waste water with SS of 150 ~ 300 ppm and/or BOD of 50 ~ 100 ppm is discharged. The maximum volume of such wastewater per day in the case of recirculation tanks at the Visitor Center is calculated at 9.0 tons daily. All of this wastewater is kept in the sedimentation tank for 24 hours, and then its supernatant water will be discharged into the sea spending another 24 hours mixed with the effluent from the outdoor ponds.

Under such conditions, maximum SS and BOD is estimated as follows:

$$\text{SS}_{\text{max}} = 300 \text{ mg/L} \times (9 \times 10^3 \text{ L}) \div (2,073.6 \times 10^3 \text{ L}) = 1.30 \text{ mg/L}$$

$$\text{BOD}_{\text{max}} = 100 \text{ mg/L} \times (9 \times 10^3 \text{ L}) \div (2,073.6 \times 10^3 \text{ L}) = 0.43 \text{ mg/L}$$

Even though these loads are added to the effluent from the outdoor ponds, the SS and BOD values are still maintained at a low level of 1.45 ppm and 0.49 ppm, respectively. It is considered that sea water discharged from the Visitor Center in the manner described above will not give harmful effects on organisms living in the sea.