Ministry of Transport
Ghana Ports and Harbours Authority (GPHA)
The Republic of Ghana

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR FISHERIES PROMOTION IN SEKONDI
IN
THE REPUBLIC OF GHANA

February 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ECOH CORPORATION & OAFIC Ltd.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to consist of ECOH CORPORATION and OAFIC Ltd. .

The survey team held a series of discussions with the officials concerned of the Government of the Republic of Ghana, and conducted a field investigation. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Ghana for their close cooperation extended to the survey team.

February, 2014

Teruyoshi Kumashiro
Director General,
Rural Development Department
Japan International Cooperation Agency

Summary

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(1) Project Background

Ghana is leading fisheries country in Africa where fishing is made by large fishing like trawl fishing and inshore fishing by inshore vessels and canoes. Even only marine fish catches approximately 320 thousand tons annually out of 440 thousand tons annual total landing volume in the country (statistic from MOFAD 2011). And, annual consumption of fishery products per capita reaches approximately 25 kg, exceeding 18.6 kg of the world average (15.4 kg/person excepting China) according to the FAO Statistic, 2012. However, domestic fish catch volume cannot catch up with high demand of fisheriy products and therefore, approximately 200 thousand tons of fishery products has imported in a year of 2011.

Tema and Sekondi Fishing Harbours are merely two modern and large fishing harbours in Ghana. Mainly Tema is utilized for deep sea fishing and Sekondi is for inshore fishing.

And, Ghana fishery sector is demanded not only supplying fishery products that are cheaper and people's favored protein but is widely requested to contribute to national economy such as export promotion of added value of fishery products, create an employment opportunity for poverty people and upgrading of fishermen's life. However, disorderly utilization of resources has been still and as continued in the field of fishery production and as the development of fishery infrastructure corresponding to large sized inshore fishing vessels, the existing fishing harbour is seriously congested and faces concerns of the stable supply of fishery products.

Therefore, fishery sector in the upper plans such as "National Development Plan (2010 to 2013)" and "Sekondi-Takoradi District Development Plan (2020)" and future plan of fishery sector in "Ghana National Fishery and Aquaculture Development Plan (2010 to 2015)" require preservation of freshness of fishery products (quality control) and fishery promotion to lead the increase of fishermen's income by improvement of capability and function of fishery facilities and at the same time, require the consideration to sustainable management of marine resources through the cooperation between local communities and MOFAD.

Sekondi Fishing Habour of the objective in this project is located in Sekondi-Takoradi District where is western state capital occupying about 200km out of about 500 km of total length of coast line in this country. This harbour is one of 2 major fishing harbours in this country next to large Tema Fishing Habour where is located at capital urban area. And this is the main fishing harbour base used by many inshore vessels and canoes as their mother harbour. "The Project for the Construction of Sekondi Fishing Port in the Republic of Ghana" was implemented by Japanese Grant Aid Cooperation in 1998 as Phase-I, consisting of Breakwater (200m), Landing Berth (50m), Preparation/Resting Berth (115m), Canoe Jetty (76m) Driveway (490m) and Ice Making Plant (15 ton/day). After Phase-I, inshore vessels more than the plan (about 50 inshore vessels) are using this harbour. And number of registered inshore fishing vessels out of

total vessels reaches to 106 now and 123 fishing vessels in high season use the harbour, which is corresponds to be more than 2 times of the original plan now after 15 years has passed. And, the landing fish catch volume of inshore vessels is increased to about 2,800 tons that is also more than 2 times from 1,300 tons in 2005 (MOFAD Statistic). Additionally, the length of vessels become longer to15m (width 4.1m) in average now from 10m (width 2.5m). Therefore, Sekondi Fishing Harbour is used heavily exceeding the original capacity at the time of Phase-I and declined in function of fishing harbour facility with the congestion of all area of harbour basin, wharf facilities and land facilities. One of the other reasons for the congestion is that many fishing nets are accumulated on the wharf apron and existing fish handling place in spite of narrow area in the harbour. Furthermore, as ice making capacity in the harbour cannot cater for the increase of ice demand in accordance with the increase of landing volume, fishermen are obliged to use of low quality ices transported from neighboring areas.

With the above background, the Government of the Republic of Ghana has requested Grant Aid Cooperation to the Government of Japan in 2010 and 2013 to cope with enhancement of functions as execution base of related measures like resources management and thoroughness of fishery rules taking advantage of main integrated harbour of fishing vessels as well as congestion mitigation of the harbour and the function recovery for related facilities.

Therefore, the Government of Japan decided this project upon studying on necessity, relevancy, urgency and scope of works on the requested components aiming to examine and study possibility by Grant Aid Cooperation and together with the reconfirmation of the requested components and setting up of project target.

(2) Outline of Survey Result and Content of Project

The Government of Japan decided to execute Preparatory Survey against requested contents from the Government of the Republic of Ghana in 2010 and dispatched study team to the field surveys.

Preparatory Survey ① : June 30, 2013 to August 12, 2013
Preparatory Survey ② : December 14, 2013 to December 23, 2013

At the time of Preparatory Survey ①, the revised requested components by Minutes of Meeting are reconfirmed for the requested components made in 2010 and 2013 from the Government of Republic of Ghana .

As the result, “Extension of Inner Breakwater” is excluded from intended component in view of cost-benefit performance. As “Extension of Fish Handling Shed”, the shed now is used for purposes other than the original intent but as the storage of fishing nets, therefore it is excluded but coping with right instruction to handle fishing nets will be done. “Freezer” and “Sanitary Facility” are excluded due to the low necessity. While, “area for fuel supply facility” is included in the components because 39 fuel tanks are installed in narrow limited fishing

harbour area now and it is necessary to consolidate them. And “Additional Administration Office” was included since the increase is for staff enhancement for facility increase and necessary staffs increase for the improvement of harbour operation.

From the result of the field survey, as management body, GPHA is also port management body, facility maintenance management is executed with extreme high standard. However, fishing nets are stacked in wharf and fish handling shed, where are basic facilities in fishing harbour. And it occupied about 70 % of the space, like this they have a problem to cope with “Operation of Fishing Harbour”. Physical improvement plan by expansion of facility and etc. may principally cope with these problems as infrastructure project however in this case, it is considered that clarification of zoning and enhancement of work execution system of facilities are complimentary necessary. For that purpose, “Technical Transfer (Soft Component)” was included for the establishment of operation and maintenance management and the upgrading of management capability. And, target of this project was set as follows, upon the field survey.

Project Objective: “Strengthen the capacity and functions of Sekondi Fishing Harbour through improvement and expansion of harbour facilities for promoting efficient coastal fishery operations”

Based on the result of the field survey, outline design is made by executing detail checking of components, study of facility scale, specifications and construction work execution plan, project cost estimation and etc. As the result of it, “slipway for inshore vessel landing” is excluded from the components in view of cost-benefit performance.

At the time of explanation of outline design during preparatory survey ②, discussion and confirmation are made and agreed on the obligations by the Government of the Republic of Ghana and the contents of the outline design understanding the above.

Facilities to be constructed in this project is planned as follows with proper scale and contents as Grant Aid Cooperation considering the background of project, content, natural conditions, maintenance management system, construction circumstances and etc.

Confirmation of Project Components

Revised Component (July 2013)	M/M Discussion (Preparatory Survey ①)	M/M Discussion (Preparatory Survey ②)
a) Additional lay-by wharf (200m)	a) Additional lay-by wharf	a) Additional lay-by wharf (180m)
b) Extension of inner breakwater (150m)	—	—
c) Slipway for canoe (350m^2)	b) Slipway for inshore vessels	—
d) Extension of fish handling shed	—	—
e) Ice making plant (30t/day)	c) Ice making plant	b) Ice making plant (15t/day)
f) Freezer (50～100m^2)	—	—
g) Ancillary facilities	d) Ancillary facilities	c) Ancillary facilities
・Sanitary facility	—	—
・Other facilities	・Other facilities (water supply facility and etc.)	・Water supply facility, septic tank and etc.
・Net mending area	・Pavement of the area behind the fish handling shed	d) Pavement of the area behind the fish handling shed (parking lot: 695.85m^2, road：1,410.62m2)
・Access driveway	・Access driveway with canoe berthing facilities	e) Access driveway (324m)
	e) Area for fuel supply facilities	f) Area for fuel supply facilities
	f) Additional administration office	g) Additional administration office (384.25m^2)
	g) Technical assistance (Soft component)	h) Technical assistance (Soft component)

Scale and Content of Project Component

Facility	Structure	Dimension
Additional lay-by wharf (Improvement of existing breakwater)	Berth: gravity structure Revetment: rubble stones Pavement: concrete Ancillary facility:	Length L=180, Crown width B=15.5m Water plug (6 pcs), bollard (36 pcs), ladder (1 pc)
Access driveway with canoe berthing facilities	Pavement: interlocking and concrete pavement Revetment：step-type and rubble mounded	Length L=324m、 Crown width (driveway: 5m, pedestrian walk: 2m) L=119m L=205m
Construction of ice making plant	Reinforced concrete, one story rigid-framed structure, flat roof	Floor area of expansion: 444.0m^2 Ice making machine: 15ton/day
Additional administration office	Reinforced concrete, two-story rigid-framed structure, flat roof	Floor area of expansion A=384.3m^2 Floor area of access passage : A=12.4m^2
Pavement of the area behind fish handling shed	Pavement: Interlocking block	Parking lot A=695.85m^2 In port road A=1,410.62m^2 Drainage ditch L=340.5m Demolish/removal of existing seawater pump: A=15.00m^2, paving after removal: A=101.54m^2
Utilities (water supply facilities and etc.)		Street lighting: 19 poles , reservoir: 120m^3, high tank: 12m^3, additional cesspit: V=27.7m^3
Fuel oil tank site		Trenches for piping: L=139.7m (open conduit: 108.7m, culvert: 31.0m)
Technical assistance (Soft component)	Confirmation of operation and maintenance Plan Confirmation of adherence and publicity for utilization regulation	During construction period (1.5 months) Before handing over facilities (1.0 month)

(3) Estimated Project Cost and Implementation Schedule

The project cost born by Ghana side is estimated as approximately 37 million yen in case the implementation by Grant Aid Cooperation of Japan's Government. The implementation period takes 24 months in total, comprising 6 months for detailed design and tender, and 18 months for construction and procurement.

(4) Project Evaluation

This project is to improve the fishing harbour facilities of Sekondi Fishing Harbour implemented by Phase I project that is one of two major fishing harbours in Ghana, stated as Phase II project. Since there are only two major fishing harbours equipping fishery infrastructure in Ghana, namely Tema Fishing Harbour and Sekondi Fishing Harbour. Many fishing vessels call to this fishing harbour for fish landing from other area as well. Therefore, problems and issues that fishery sector in Ghana faces are also the common issues in Sekondi Fishing Harbour. Implementation of this project aims the correspondence to these problems. And this project is according to upper plans like Fishery Development Plan, as well. The implementation of this project has strong impact and relevancy.

Not only congestion on wharf in accordance with increase of fishing vessels and fishing nets but also usage for purposes other than the original intent and facility occupation by specific group could be the cause of the congestion. For this reason, operation aspect of this project implementation is done in concert with Multi-Stakeholder Advisory Committee consisting of stakeholders and fishery related people or MOFAD as well as clarification of zoning so that fishery related people can use facilities fairly and equivalently as public facilities.

Therefore, the relevancy of this project implementation is high due to the improvement expectation in the aspect of public nature.

Furthermore, this project implementation is regarded as "economic infrastructure" as the priority issue in the aid policy of Japan to Ghana and the relevancy of construction of fishing harbour infrastructure for fishery promotion of Ghana by this project.

"Quantitative Effects" and "Qualitative Effects" to be expected by the implementation of this project are summarized as follows,

【Quantitative Effects】

Index	Standard Value (Actual in 2013)	Target Value (2019: 3 years after completion)
Congestion ratio of landing berths and preparation berths (%)	400%	100% or less
Occupation ratio by fishing nets behind preparation berth (%) (except short storage for preparation works)	70%	10% or less
Sufficiency ratio to ice demand in Sekondi Fishing Harbour (annual average) <making ice demand volume at the time of this plan as standard>	45.5%	70% or more

【Qualitative Effects】

The achievement items of qualitative effects by this project are as follows,

1) Not only recovery of the original function but also fair and equivalent utilization of the facilities become possible with the thoroughness of instruction and management to the users by fishing harbour management staff as well as clarification of zoning.

2) With removing fishing nets scattered and stored disorderly in the fishing harbour, the functional recovery of landing, preparation and resting berths and the safety promotion of related works can be made.

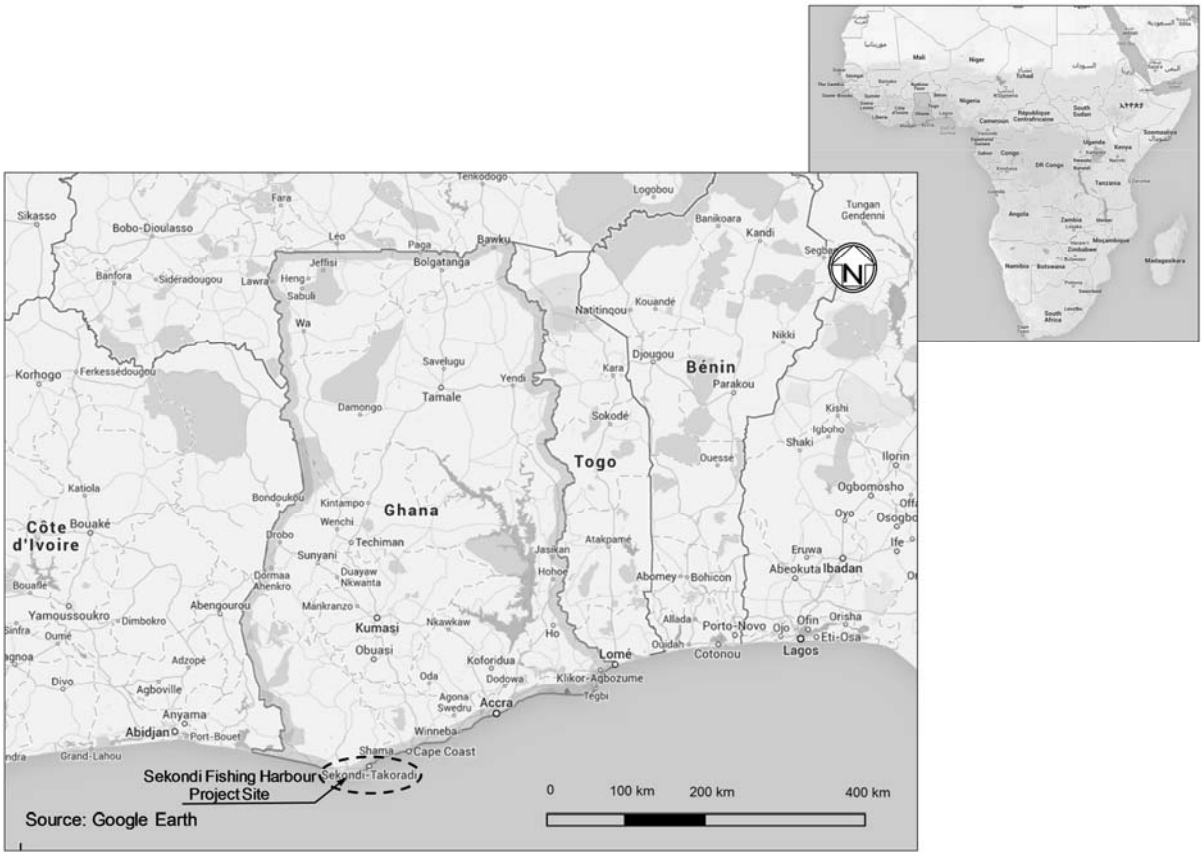
3) The risk of cross contamination for landed fishes and fishes in holds by fuel supply operation will be decreased with the installation of fuel supply facility for fishing vessels.

4) Qualitative promotion of the fishery statistic data being collected in the fishing harbour and promotion of capability for fishing training can be attained to fishermen by means of staff stationing from MOFAD in administration office.

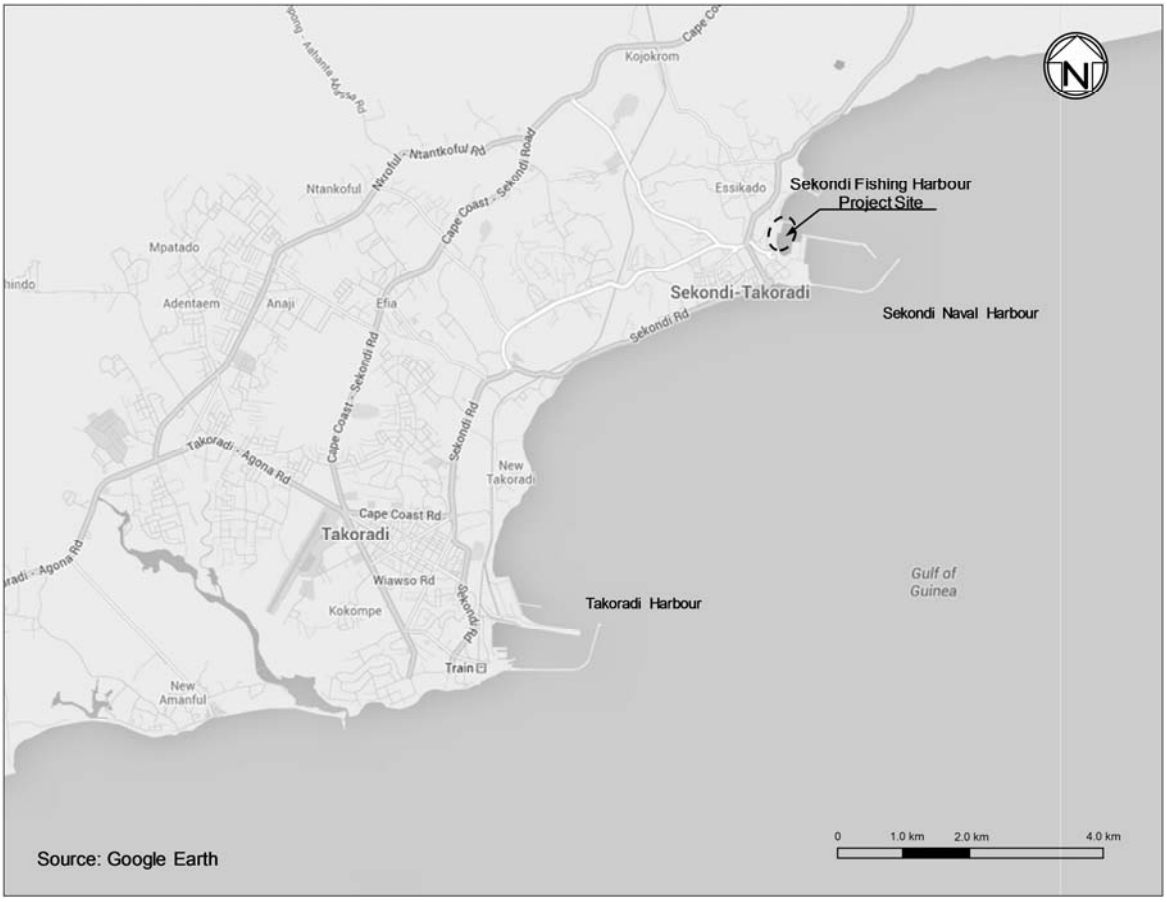
5) Convenience for the access from hinterland and movement of logistic related people will be promoted with the improvement of access driveway from the project site to Old Beach where artisanal fishing vessels are piled up and the distribution between two landing sites will be speeded up.

With the result above, as this project widely contributes to the promotion of Basic Human Needs (BHN) and poverty reduction, the relevancy to implementation under the scheme of Grant Aid Cooperation of Japan can be confirmed for the part of this cooperation.

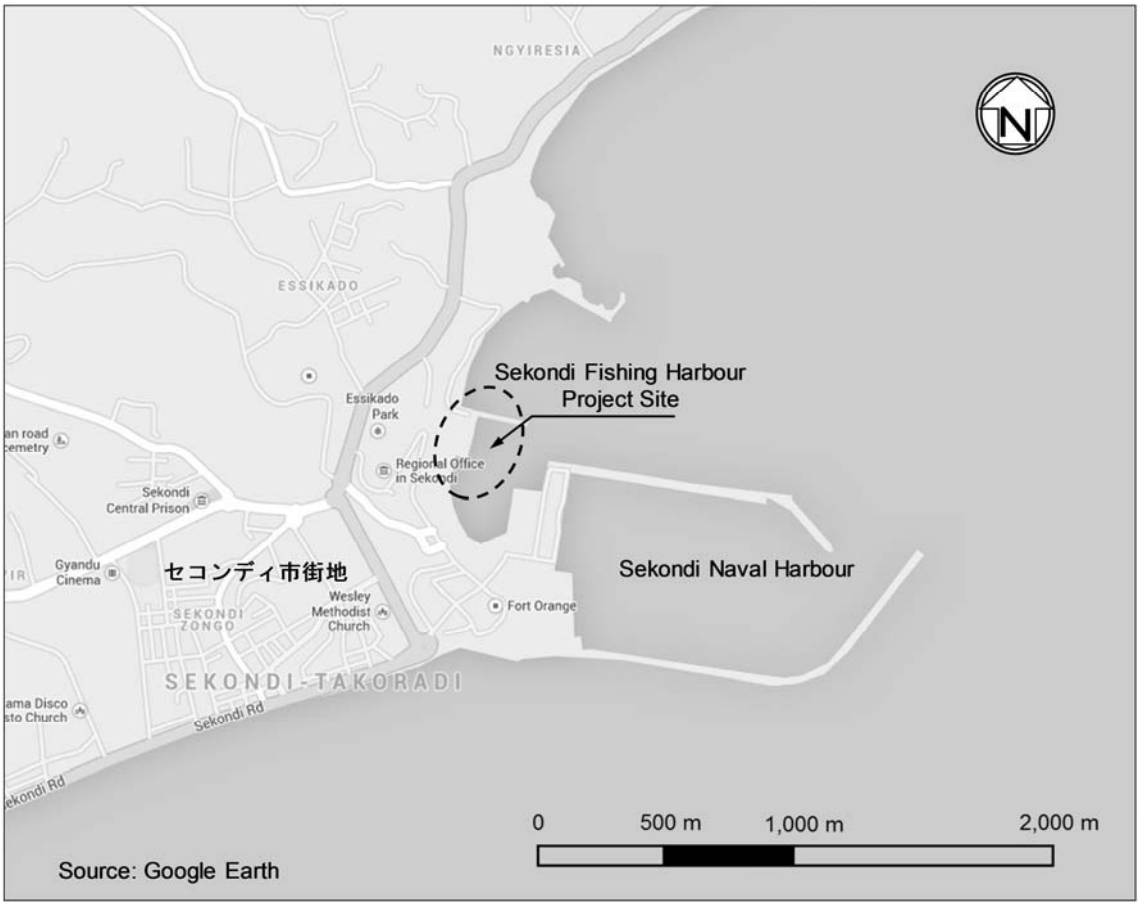
The Preparatory Survey on
the Project for Fisheries Promotion in Sekondi in the Republic of Ghana



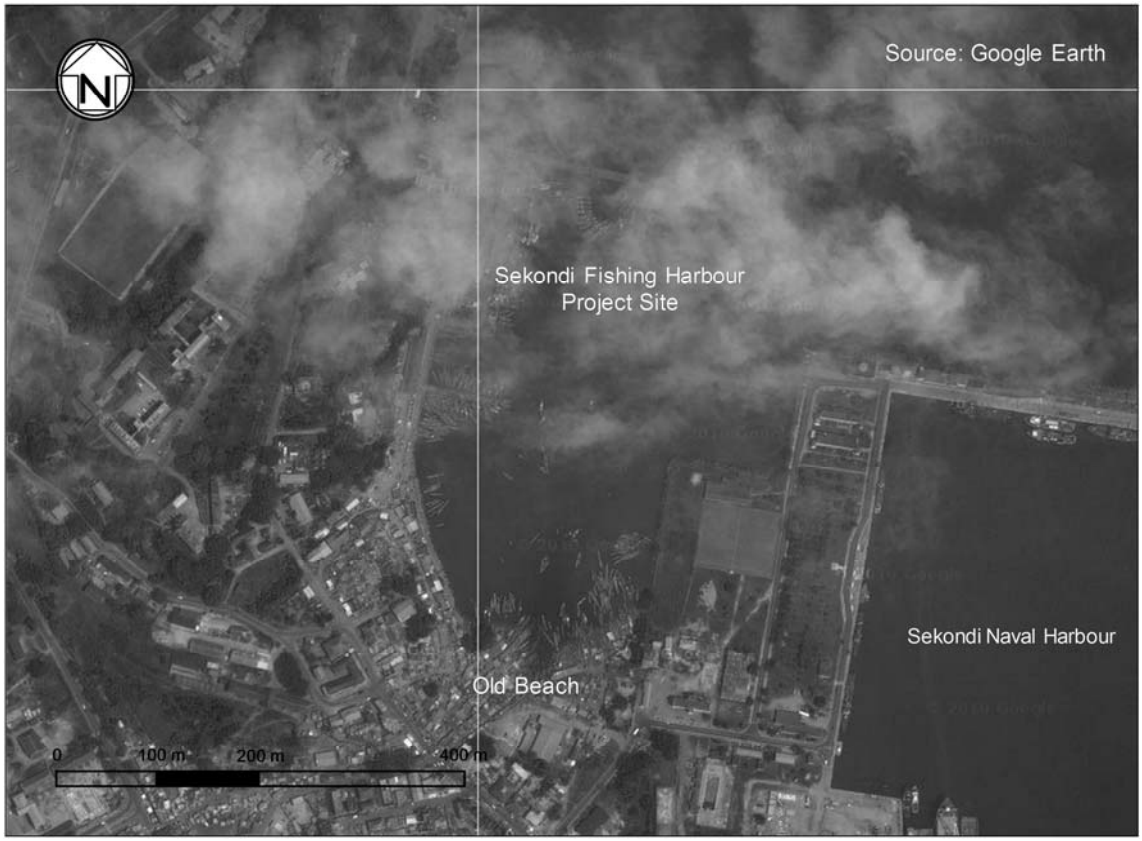
Location Map of Ghana



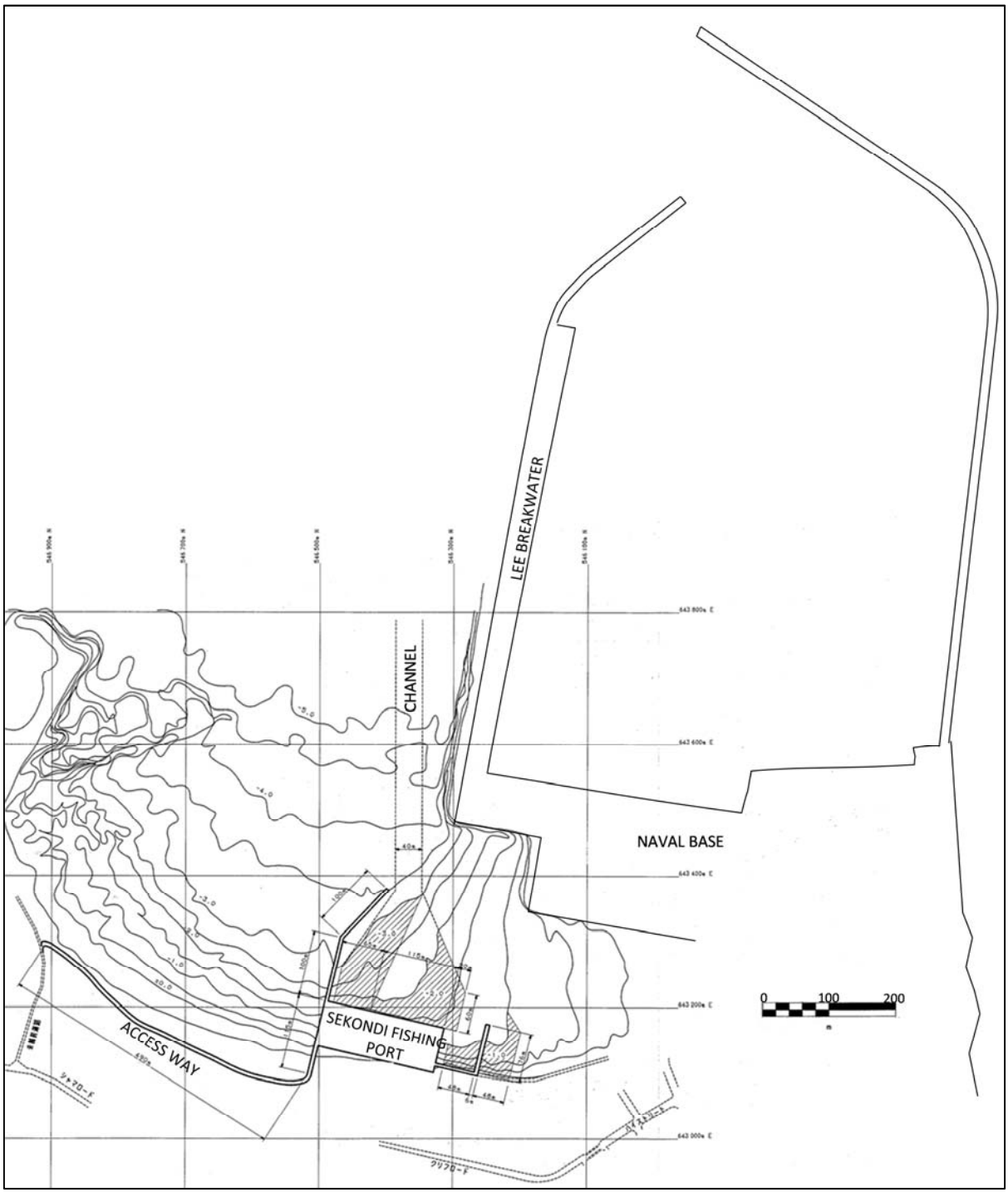
Location Map of Sekondi Fishing Harbour



Location Map of Sekondi Fishing Harbour

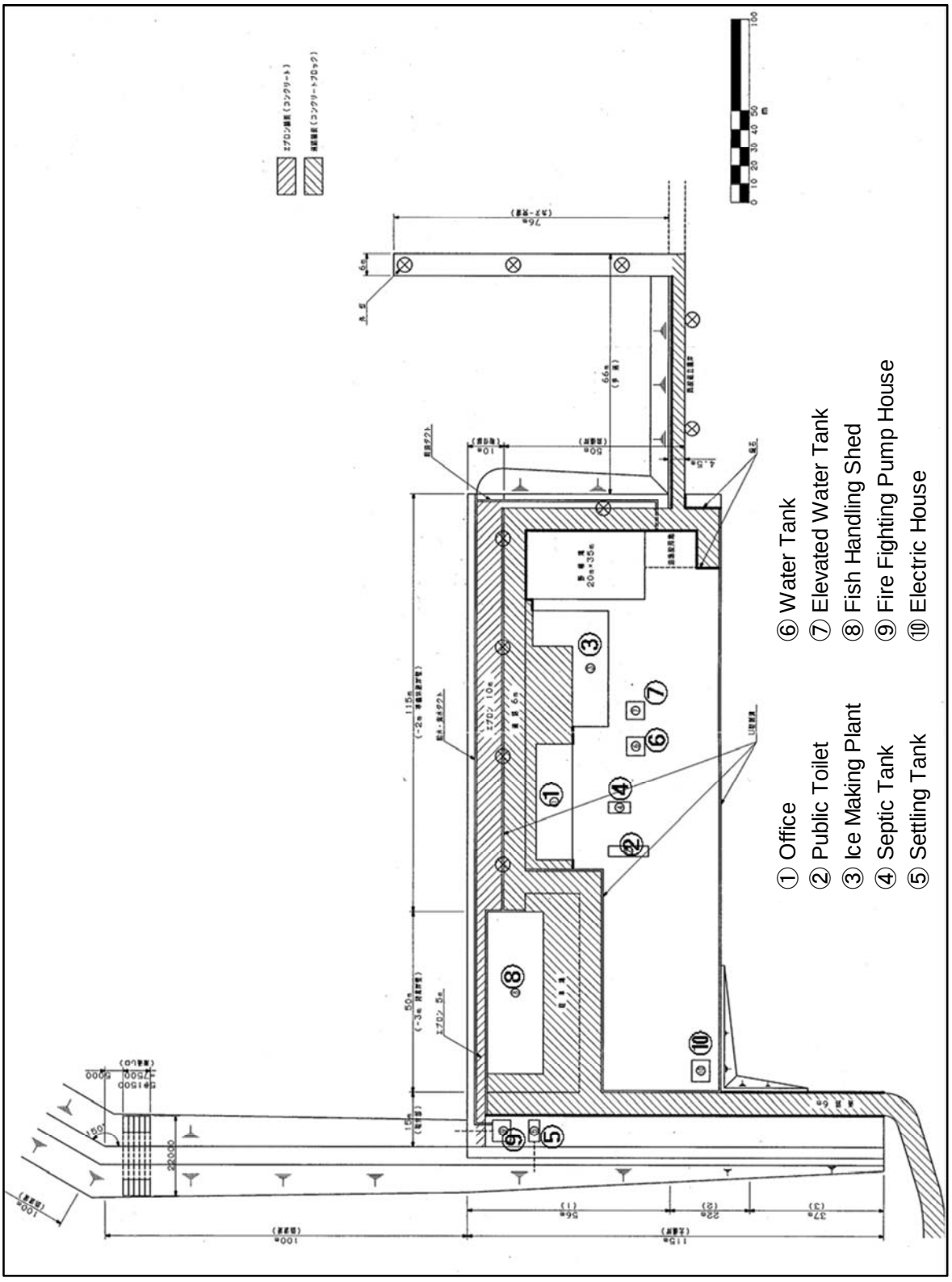


Aerial View of Sekondi Fishing Harbour



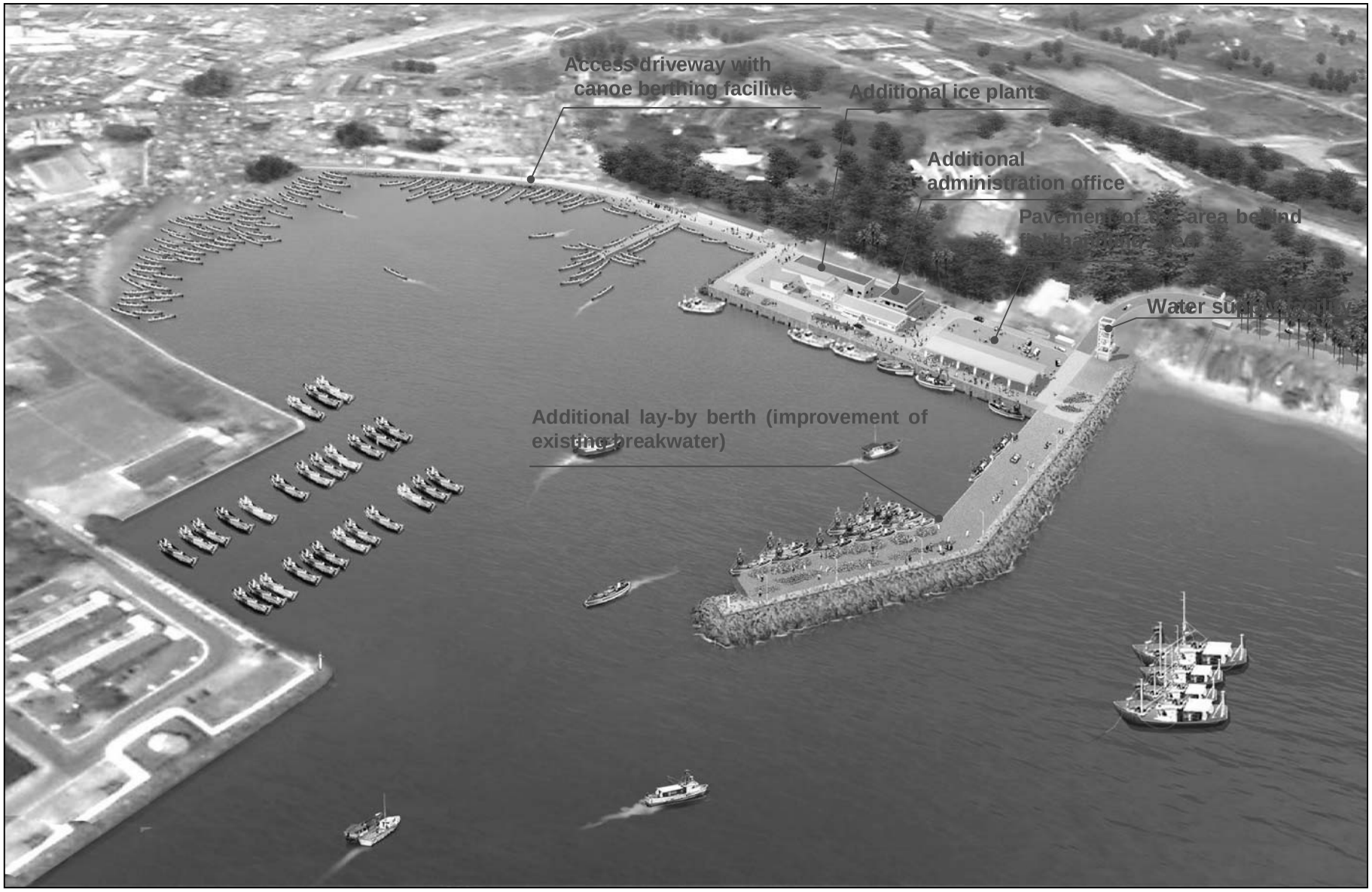
Facility Layout of Sekondi Fishing Harbour

(Source: Basic Design Study Report on the Project for the Construction of Sekondi Fishing Port, 1996)



On land Facility Layout of Sekondi Fishing Harbour

(Source: Basic Design Study Report on the Project for the Construction of Sekondi Fishing Port, 1996)


Access driveway with
canoe berthing facilities
Additional ice plants
Additional
administration office
Additional lay-by berth (improvement of
existing breakwater)

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ABBREVIATION

A	AP	Authorization to Pay
B	BA	Banking Arrangement
	BD	Basic Design (Outline Design or Preparatory Survey Design)
C	CDL	Chart Datum Level
	CPUE	Catch per Unit Effort
	CRC	Coastal Resources Centre
D	DACF	District Assembly Common Found
	DFC	District Fisheries Committee
	DFMC	District Fisheries Management Committee
	DSA	Development Bank of Southern Africa
	DD	Detailed Design
E	EIA	Environmental Impact Assessment
	EIS	Environmental Impact Statement
	EN	Exchange of Notes
	EPA	Environmental Protection Agency
	EU	European Union
F	FAO	Food and Agriculture Organization of the United Nations
	FC	Forestry Commission
G	GA	Grant Agreement
	GDP	Gross Domestic Product
	GHS	Ghanaian Cedi
	GIFA	Ghana Inshore Fishery Association
	GMP	Good Manufacturing Practice
	GoG	Government of Ghana
	GPHA	Ghana Ports and Harbours Authority
	GSGDA	Ghana Shared Growth and Development Agenda
I	ICCAT	The International Commission for the Conservation of Atlantic Tunas
	IEE	Initial Environmental Examination
	IMF	International Monetary Fund

J	JICA	Japan International Cooperation Agency
M	MCS	Monitoring, Control and Surveillance
	MFRD	Marine Fisheries Research Division
	MOF	Ministry of Finance
	MOFA	Ministry of Food and Agriculture
	MOFAD	Ministry of Fisheries and Aquaculture Development
	MOT	Ministry of Transport
	MOSE	Ministry of Science and Environment
N	NGO	Non-Governmental Organization
O	ODA	Official Development Assistance
S	SIF	Social Investment Fund
	SSOP	Sanitary Standard Operating Procedure
	STMA	Sekondi-Takoradi Metropolitan Assembly
U	UN	United Nations
W	WB	The World Bank
	WFP	World Food Programme

Chapter 1　Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

1-1-1 Current Situation and Harbour Capacity

(1) Current Situation

The Project for the Construction of Sekondi Fishing Port Development through Japanese grant aid cooperation was planned in 1996 and was completed in 1998 named as Phase I of the project. The current project will be implemented as Phase II Project, which is 15 years on from the previous harbour development.

Initially, constructed facilities of Phase I was planned to cater for up to about 50 inshore purse seiners. Currently, 106 vessels are registered and up to 123 vessels use the harbour during high season, equivalent to more than twice of initial planned utilization. In addition to the number of the vessels, the size of vessels is also getting significantly bigger. Namely, average vessel length is increased from 10 m to 15 m, and average breadth is from 2.5 m to 4.1 m. Further, annual fish landing volume only by inshore purse seiners was initially planned of 1,600 tons in Phase I Project. Currently, totals fish landing volume have increased to nearly 2,800 tons, equivalent to 1.6 times the planned volume.

Thus, currently the most significant problem of Sekondi Fishing Harbour is that the functions of all harbour facilities are not sufficient due to the congestions in the harbour basin, berths and all on-land facilities.

There are a number of issues with the berthing facilities in particular, where a landing berth of 50 m extension and a lay-by berth of 115 m extension were developed in Phase I. The landing berth is now occupied exclusively by large trawlers, and inshore purse seiners of increased number and larger size are moored in the lay-by berth where fishermen are weaving in between for landing their fish catch and preparing fishing operation. This issue reduces berth functionality in terms of fish landing and preparation works, with vessels berth waiting. The shortage of the berth extension causes that inshore purse seiners take over the canoe jetty as a mooring area, resulting in leaving fishing canoes nowhere to moor themselves.

Furthermore, not only the increased number of fishing vessels use the berth but also the berth apron has become a net storage area, which causes overcrowded situation with fish landing and preparation works and a number of fishmongers are using the area to sell fresh fish to consumers on the berth apron, leading to extreme congestion.

(2) Capacity of Phase I Facilities

Figure 1-1-1(1) shows the berth utilization plan from the Phase I Project comparing to the current utilization for the berths and the canoe jetty. Current situation shows that the fishing vessels are using the canoe jetty using the berth, breakwater front and harbour water basin due to shortage of mooring berth.

To improve fish landing and preparation works more efficiently, vessels should not be

moored disorderly in the landing and preparation berths so that vessels can always share the wharf fairly. Especially during handling fresh fish in the landing berths, landing operation must be efficient, considering the importance of freshness and hygiene control when dealing with fish product.

The wharf constructed in Phase I Project is 165 m (50 m for landing and 115m for preparation) in total extension with space for 46 landing vessels. Based on the above as well as accounting for the larger vessel sizes, however, the appropriate capacity of landing berth facilities should be about 25 vessels as shown in Figure 1-1-1(2).

(3) Basic Concepts of the Project

Considering the circumstances above, Phase II Project will control through the Phase II Project the current traffic of the increased number fishing vessels as well as growing in size, taking full advantage of the Phase I facilities. As shown in Figure 1-1-1(3), the basic concepts of the Project are to secure the function of fish landing and preparation works. Less active vessels will be moored offshore to ensure functionality with this phase.

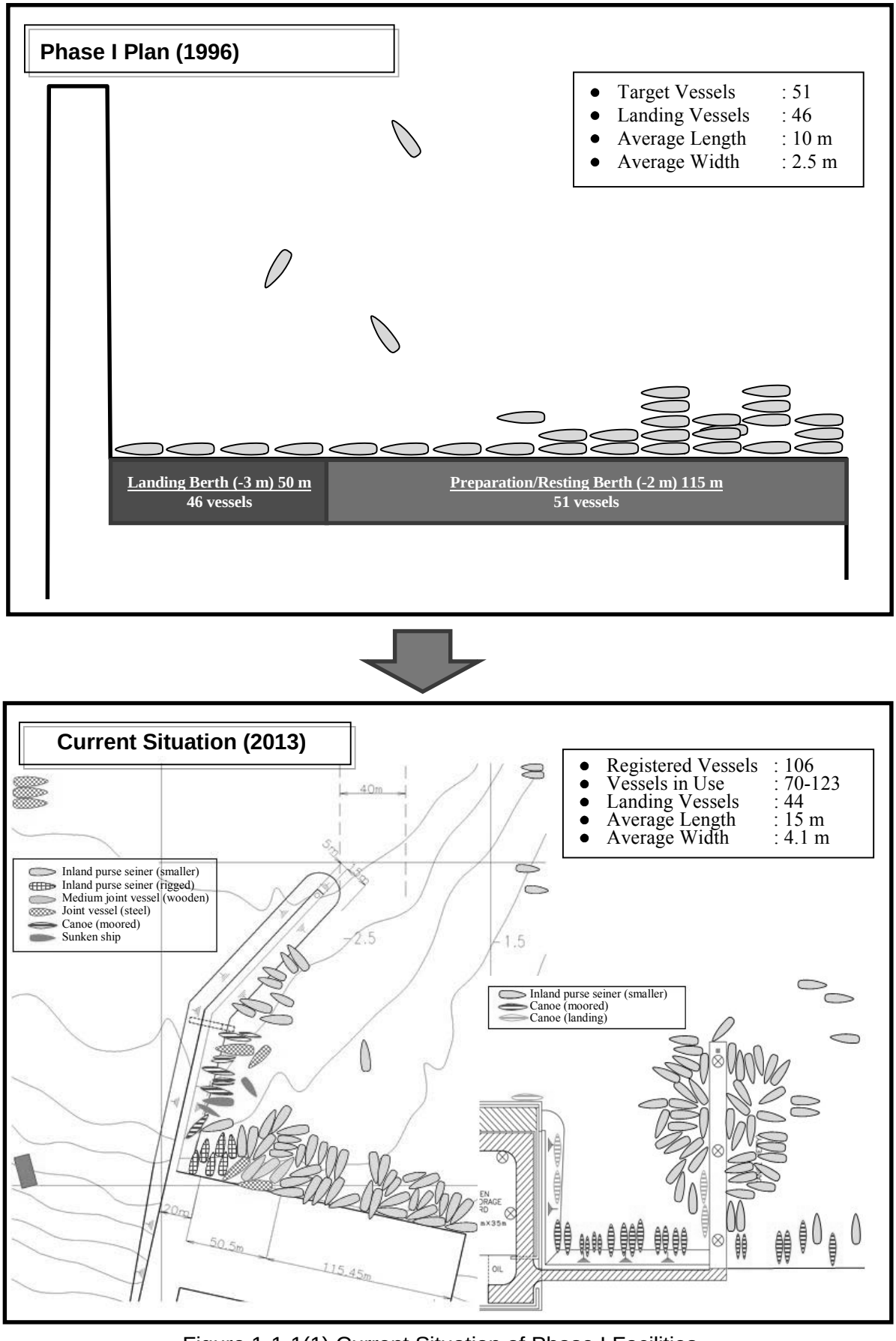


Figure 1-1-1(1) Current Situation of Phase I Facilities

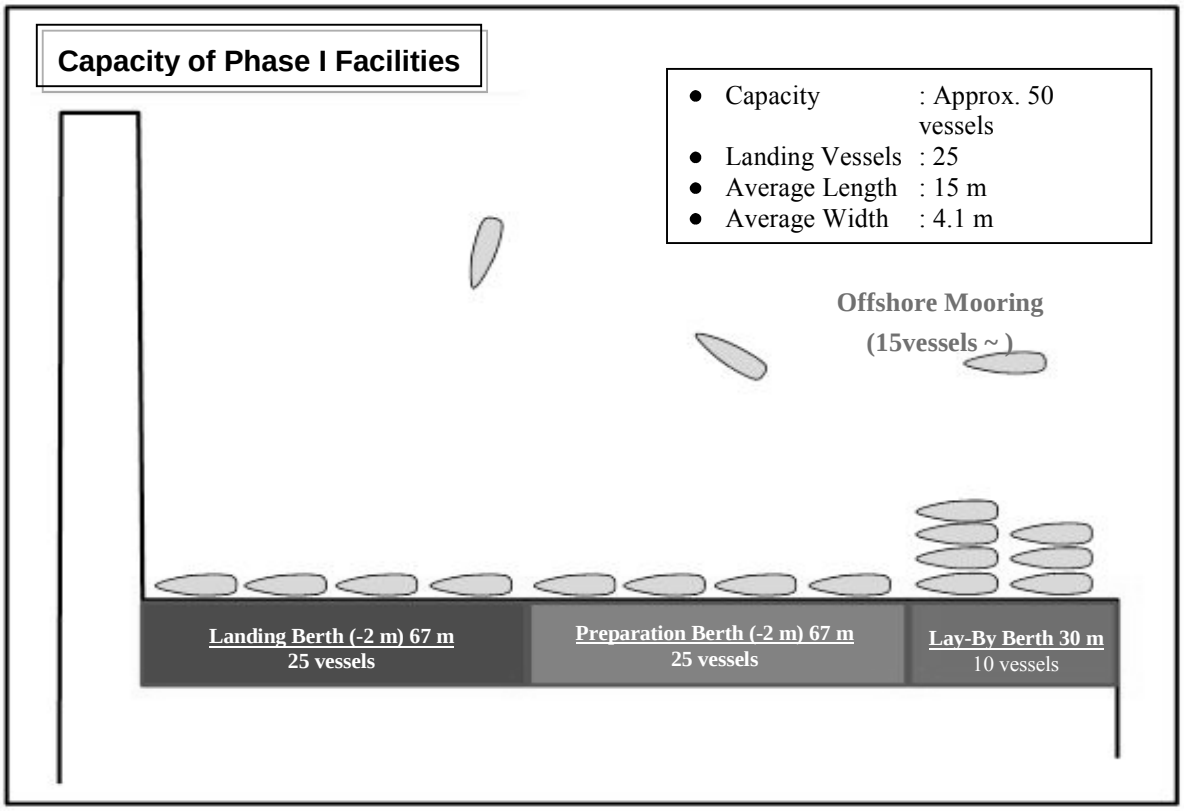


Figure 1-1-1(2) Capacity of Phase I Facilities

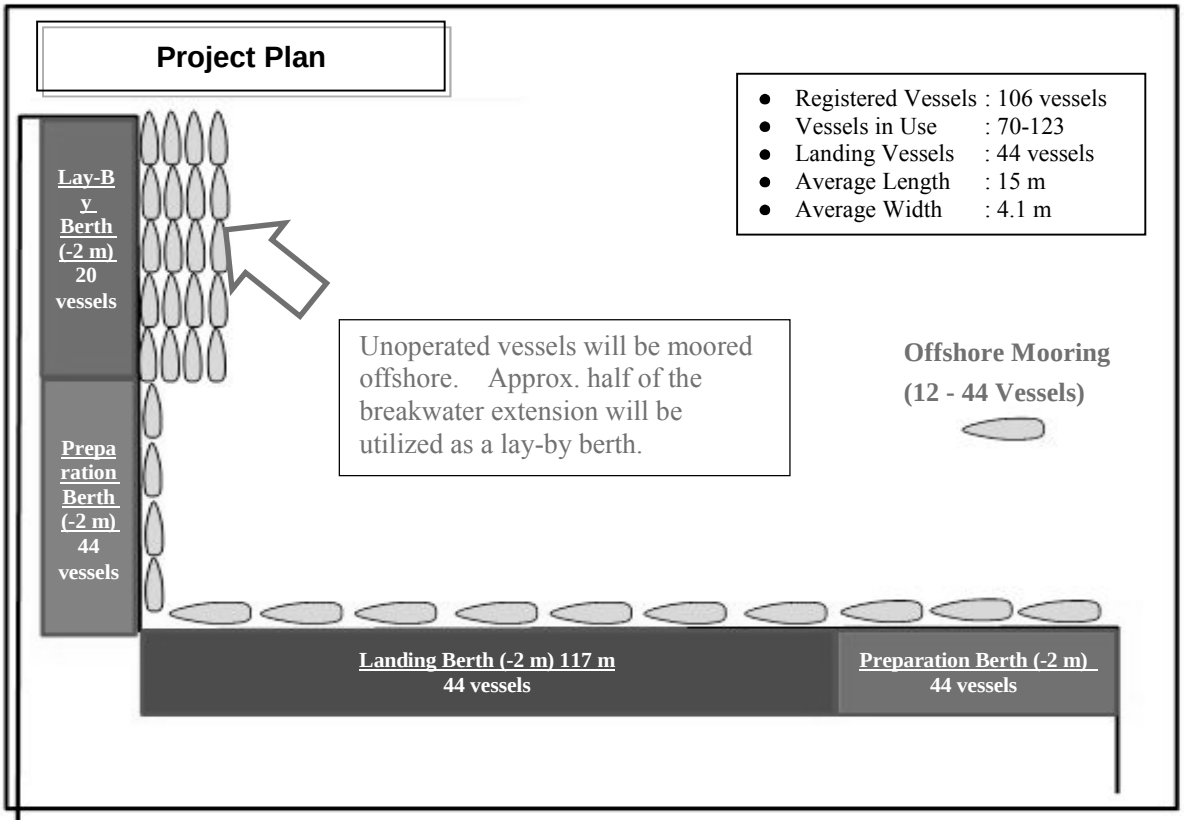


Figure 1-1-1(3) Basic Project Concept

1-1-2 Problems and Actions

(1) Problems and Actions in the Fisheries Sector

1) More Fish Catch Efforts and Rules for Illegal Fishing Operation

(a) More Fishing Effort

The Ghanaians have increased their fishing efforts, such as using larger inshore vessels in greater numbers and enlarging size of their purse seines. Yet still, their catch volume has plateaued and catch per unit effort (CPUE) has dropped with shrinking profitability for fishing. These are problems facing the entire Ghanaian fishing industry.

(b) Rules for Illegal Fishing Operation

Illegal fishing operation and other dishonest practices attributes to reduction of fish catches in size and risk the chance of eating away at limited fishery resources. There are frequent cases of fishermen catching young fish and seed fish or using prohibited chemicals and fishing methods. There are also frequent fights over fishing grounds between any combination of inshore fishing vessels and canoes. Further exacerbating the issue, offshore commercial trawlers and tuna fishing vessels will often illegally enter the inshore areas to move in on these territorial fights.

2) Restructuring of Co-Management System

The Fisheries Regulations is reorganized in 2010 by adding new needed regulations to those already in force, including the following: the fishing vessel registration system; compulsory operation licensing for vessels and canoes; regulations on improper fishing gear, nets and stitching; operating regulations; illegal fishing prohibitions; and obligations to consent to a fisheries monitoring system and inspectors. While the new fisheries regulations make fishery regulations more accessible, fishery management is quite slow to implement in terms of operational effectiveness.

Considering above situations, the Ministry of Fisheries and Aquaculture Development (MOFAD) plans to resume a co-management system. This system is MOFAD strategy for achieving its policy goals, looking to get voluntary participation from fishermen and the regional authorities to share in fishery management responsibilities with central authorities. Since the 2009 establishment of 21 District Fisheries Management Committees (DFMCs) in Sekondi, Takoradi and other communities, these DFMCs are able to enforce local regulations independently defined by local fishermen and authorities alongside national fishery regulations, with coordination of surveillance organizations.

3) Added Value and Improvement of Fishermen's Household Economy

With fishing currently requiring more effort, life improvement targets for fishing households cannot be achieved. The only way to achieve these targets from the fishing sector end is to make improvements in all stages, from fishing operation in the seas through to the ultimate beneficiaries of the consumer. Operation works must be made more efficient, value added and

industry profitability increased.

(a) Fishing Vessel Improvements for Promotion of Efficient Fishing

To catch more fish despite facing diminishing catch volumes, Ghanaian fishermen are expending more effort on fishing by using larger but fishing vessels with enhanced engines operating at reduced efficiency. Still, fish catch volume has not increased, which affects CPUE down and coaxing fishing profitability ever lower. With fishery resources already approaching the level of overfishing, MOFAD is advising on the introduction of downsizing and more efficient fishing vessels.

In the interest of preserving fishery resources, in February 2012 MOFAD has deferred all fishing license for fishing vessel renewal, new vessel building and imported vessels until fishery resources recovery.

(b) Promotion of Ice Use and Icing Ratio

One of the most important measures in adding value to fish products is to keep them fresh with temperature control. Temperature control needs to be spread throughout all steps in the process from fishing operation to product distribution. This includes urging rational use of ice, timeliness in cold storage and refrigerated trucks.

With a large number of landing sites mainly for canoe fishing, one policy put forth for adding value to fish is to select highly influential sites to develop ice making plants as a part of the social infrastructure. These areas could then promote the use of ice in fishing operation throughout all districts, helping to improve on-board fish storage.

(c) Environmental Improvements and Sanitary Handling Process for Fish Products

Another policy being pushed is to establish a more hygiene and sanitary environment across all process from fishing, landing, sorting, processing and transport of fish products. This will add a value by ensuring that the fisheries product that makes its way to market is hygienic, safe and high quality.

(2) Problems and Actions in Sekondi Fishing Harbour

1) Structural and Operational Problems

(a) Congestion by Insufficient Berth Extension

The increase in size and number of fishing vessels from the initial Phase I plan is degrading harbour functionality. The port area is extremely congested, with the existing berths and canoe jetty being used as a mooring area for inshore purse seiners and many fishing vessels moored in front of the berths. In addition, large trawlers are taking up the landing berths, which, in addition to violating fair use of the public facilities, make congestion even worse in the limited berth area. Considering all above, the absolute berth extension becomes insufficient.

(b) Landing and Preparation Functional Recovery

Ideally, landing and preparation berths should normally be available for vessels to use on their demands and for their aim. Currently, however, vessels are landing and preparing amidst any number of moored vessels not in operation. Thus, the problem is that the harbour is overcrowded, with the same berth being used for resting, landing and preparations. Separate zones for the important landing and preparation functions are essential for their aims.

(c) Net Mending Functionality

The open net yard planned in Phase I has been installed a light pavement by GPHA and is utilized mainly as net mending and storage areas. With double number of the fishing vessels, however, this area is vastly undersized as a required net yard. Net mending is also a very important operation in fishing preparations; more than a few net menders use the berth apron and vacant lots in the fishing harbour. Net mending space will be allocated in the utilization zones for net mending and storage areas.

(d) Increasing Ice Demands

Ice supply is an essential factor to maintaining the freshness quality of fish products. With fishing vessels and fish catch volumes in the harbour doubling since the initial Phase I Project, there is strong demands from fishermen to increase ice production for fishing operation.

Meanwhile, the existing ice making plant is at increasing risk of machine trouble. It was built 15 years ago and is forced to operate at full capacity every day.

(e) Safety of Vessels using the Harbour

Water depth in harbour basin becomes shallow by 50 cm in the 15 years since Phase I Project. Meanwhile, larger vessels with deeper drafts require more water depth. Fully loaded inshore purse seiners in particular are already at danger for entering the harbour. There are also abandoned and sunken vessels in the area behind the breakwater connecting the port entrance and existing landing berths that become fully submerged and is difficult to recognize during high tide, resulting in treacherous water area to navigate through.

(f) Safety of Harbour Work

On the west end of Sekondi Fishing Harbour, there is a fuel supply station for fishing vessels operated by a number of private companies. Fuel tanks are spreading into the narrow and limited harbour area. There is no fencing or enclosure for the harbour, making for a dangerous situation where anyone may enter the grounds.

(g) Integrated Environmental Improvements from Sekondi Fishing Harbour to Old Beach

The area from Sekondi Fishing Harbour to Old Beach is in need of integrated environmental improvements. GPHA handled the request to operate Sekondi Fishing Harbour and manages

both the Phase I facilities, where inshore purse seiners gather and Old Beach where the traditional fishing canoes gather. The current access driveway connecting the two sites is narrow where vehicles cannot drive through. Thus, canoe fishermen handle all their preparation works manually. There is a gate behind the access driveway with many fishing industry workers coming and going between fish smoking areas and other small shops scattered along. Waste water from this back area flows over the access driveway, and discarded items are scattered about. Further, inshore fishing vessels currently occupy the canoe jetty, forcing many canoes to moor along the access driveway.

(h) Necessity of Slipway

Hull maintenance and repairs for inshore purse seiners, including simple bottom cleaning and painting, are taken place on the beach at the north end of Sekondi Fishing Harbour. Currently, For vessels repairs on land, docking facilities at either the naval base near Sekondi and at Takoradi Harbour are used. These docking facilities are expensive for fishermen to use. Sekondi Fishing Harbour therefore needs to have a slipway installed for fishing vessel repairing.

2) Operation and Maintenance

(a) Relief of Operation Deficit

The GPHA Director General has stated that Sekondi Fishing Harbour is situated as a place which contributes to the community and plans to continue covering the financial deficits, but would like to cut down the deficit even just a little. Considering that the fishing harbour is a public facility of social infrastructure, it will not the facility to seek revenue, but a system to collect appropriate charges fairly and equally from users is needed as a source of income to keep the facilities up and running.

(b) Control of Increasing Vessel Numbers

Sekondi Fishing Harbour is currently running well above capacity with registered vessels alone more than twice the Phase I planned capacity. Meanwhile, the Ghana fisheries sector is increasingly facing the issue of dwindling fishery resources due to overfishing from more fishing vessels, larger vessels and illegal fishing. Thus, MOFAD is taking a policy of not allowing further increase of the number of registered vessels.

(c) Promotion of Highly Public, Fair and Equal Facility Utilization

Doubled numbers and larger sizes of fishing vessels have made berths congested and affect vessels hindering from entering and departing, landing nets and preparing for departure. The existing berths for inshore purse seiners are not sufficient, resulting in leaving vessels to occupy the canoe jetty. There are also large trawlers occupying some portion of the landing berths, preventing other fishing vessels from their appropriate access to the berths for fish landing.

In terms of harbour operation, landing and preparation berths must be managed so that

fishing vessel can fairly access them at any time. For Sekondi Fishing Harbour, due to the shortage of berthing facility capacity, vessels not in use are recommended to be moored offshore for taking to ease mooring congestion for example.

(d) Improvement on Collection of Wharfage

Currently, berthing fees are only imposed on large steel trawlers. Reportedly, wooden inshore purse seiners and canoes do not pay berthing fees, because the large trawlers have taken over the landing berth, leaving the berths allocated to wooden vessels constantly crowded.

Sekondi Fishing Harbour office did propose lower berthing fees for wooden vessels at the stakeholder meeting. However, the berthing fees has not been regulated or collected from the fishermen or association for the above reasons.

(e) Recovery of Fishing Harbour Function in On-land Facilities

i) Mitigation for Degrading of Berth Function

The open storage yard of 700 m^2 was constructed in Phase I. Most of fishermen use the berth apron. Furthermore, the apron is being used for fish landing and vessel preparation works, as well as fish sorting and fishmonger deals, stretching back to the road behind the apron. This activity makes the harbour even more crowded and inhibits the apron from fulfilling its original purpose. Temporary preparation works such as loading nets onto the vessel would be allowable, but nets are being left here even during low season. Harbour management must restrict the apron use to fish landing and vessel preparation works and secure a space for a net mending and net storage.

ii) Mitigation for Degrading in Fish Handling Shed

In Phase I Project, a roofed fish handling shed of 720 m^2 (45 m x 16 m) was constructed behind the berthing facilities. In actuality, however, most of the fish handling shed is being occupied as a net storage area with part as space for selling fresh fish, and fish sorting is done on board vessels and on the apron. With landing amounts twice those initially planned for, the fish handling shed is not utilized for fish processing and sorting, but it currently is not being used for its original purpose at all.

Also, the road adjacent to the fish handling shed and the wharf area are used as vessel rigging and repair areas, with usage fees also set, which indicated that the harbour office allow an unappropriated use of the harbour facility.

Behind the existing fish handling shed stretching back to the public toilets is an unpaved space of about 1,000 m^2 (50 by 20 meters). Harbour Office could have an alternative to advise users to use this space along with the open net yard constructed in Phase I. They should be recommended that advising users to use facilities for their originally planned purposes.

iii) Securement of Public Nature for Berth Use

Joint companies own the large trawlers have fenced off the landing berths and back of the apron as their own exclusive fish handling area. The users are from China-Ghana joint ventures, and unlike with inshore purse seiners, canoes and other wooden vessels, harbour management can collect berthing fees and facility usage fees from them according to their landing amounts. Thus, management has effectively recognized their takeover of the berth.

Harbour management needs to consider how to grant users fair access to the public facilities for their intended purposes for the utilization of highly public fishing harbour facilities. .

(f) Clarification and Thoroughness of Zoning for Land Area

Besides water area in the Sekondi Fishing Harbour and berths, the narrow land area are also crowded during the high season and other busy periods. The problem here is that the berths are simultaneously being used for landing, preparations and resting, and regularly as the net storage area and net mending area. The berth apron is overcrowded with all the fish landing, sorting and selling fish, fueling and water supply and ice transportation. Particularly, the fish handling shed has been taken over as a net storage and mending area, unable to fulfil its original functions as a fish handling facility.

Harbour Office must clearly define utilization zones of the land area, ensure facilities are used for their intended purpose and make this familiarize to all stakeholders using Sekondi Fishing Harbour.

(g) Improvement on Operation, Safety and Hygiene of Fuel Supply Facility

i) Improvement on Operation

In Phase I, the trench for fuel piping was installed from the harbour onshore area along the south revetment, and commissioned oil distributors were supposed to install fuel storage tanks, dispensers and other fuelling facilities. While there were not many fishing vessels to use the services when Phase I was completed, demand has increased over the past 15 years. With more vessels, multiple oil distributors have been taken on, as a result installing fuel tanks and dispensers for multiple fuel companies.

The Sekondi Fishing Harbour Administration Office collects land rental fees from the private fuel companies, leaving fuel sales up to the companies. With multiple fuel distributors now involved, the trench for fuel piping installed in Phase I is not being used. Fishing vessels purchase the fuel from the fuel companies, by pushing large plastic tanks to their vessels with wheel barrows to refuel.

Considering the above, the improvement is required on effective fuel supply operation for fishing vessels. .

ii) Improvement on Safety

The Sekondi Administration Office has a staff of 14 assigned to fire safety and harbour

security. Still, 39 fuel storage tanks of 15 oil companies arranged in a large area 100 m long and 15 m wide. And no enclosures whatsoever fencing off the facilities, outsiders can enter free.

From the above, there could be a fire or explosion at any time and the site is at great risks in terms of fire safety management. Therefore, safety improvement such as the installation of fences is necessary.

iii) Improvement on Hygiene and Sanitation

The landing berths for inshore purse seiners have been taken over by large trawlers. Also, the apron of lay-by wharf is overcrowded, being used for handling and selling of fresh fish after landing as well as for fuel supply. Thus, sales work of fuel on the berth apron in terms of hygiene and sanitary control is cross contamination from fuel feeding and fresh foods being handled simultaneously on the apron.

With the above, the firm instruction to use landing berth for landing works and preparation berth for fuel supply operation is necessary as well as the improvement of fuel supply operation in views of hygiene and sanitation so as to supply fuel directly to fishing vessels from the berth.

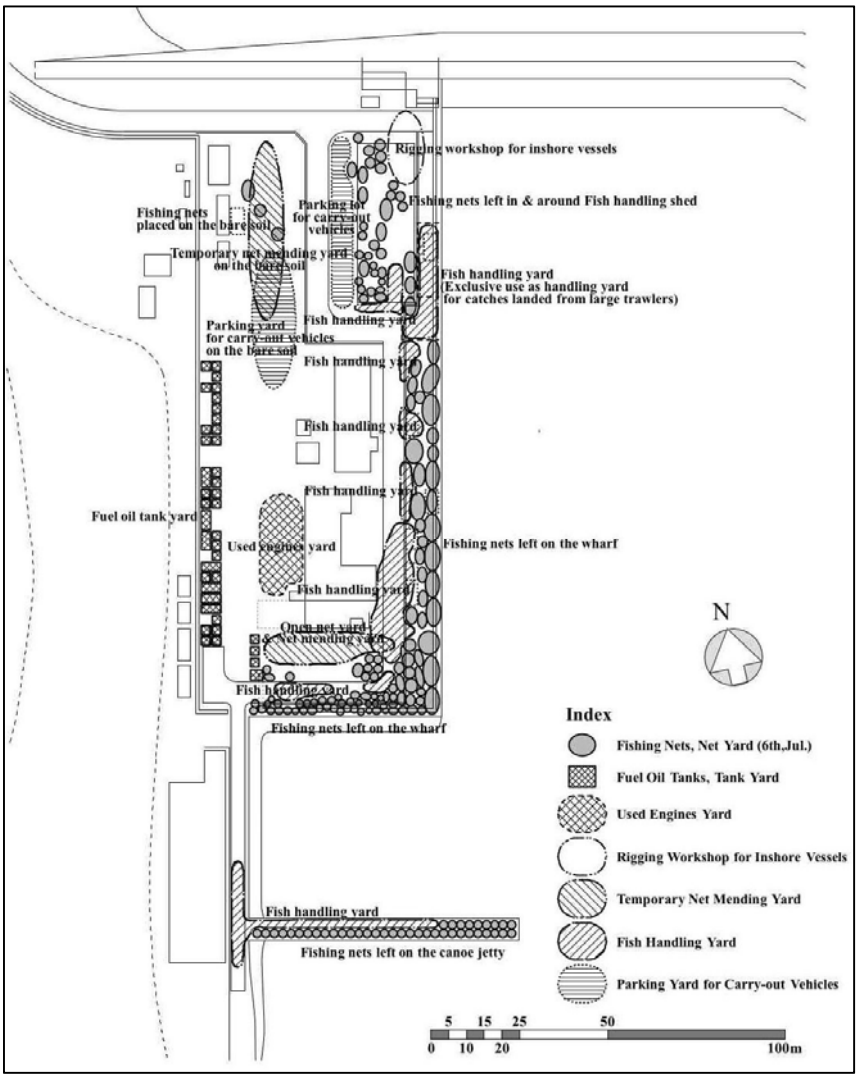


Figure 1-1-2(1) Current Situation of Crowded Onshore Facilities

(h) Securement of Safety in Using Basin by Fishing Vessels

i) Required Water Depth

According to the bathymetric sounding conducted in this study, water depth in the harbour basin has become shallower by 50 cm in the 15 years since Phase I implementation. Further, water depth of the landing berth and lay-by berth are set 3.0 m and 2.0 m below datum level, respectively. Beyond just using the berths, coupled with their recent larger sizing, the vessels currently in use will not be able to meet the required depth for navigation or anchoring. Harbour water basin could become unsafe for vessels to use, resulting in hull bottom touch or worse.

Therefore, Harbour Office should be checking water depth in the basin periodically as needed to secure safety for fishing vessels. Maintenance dredging is necessary as needed, as well as controlling water depth in the water areas such as berth front, waterway and mooring basin.

ii) Removal of Abandoned and Sunken Vessels

During the mooring vessel survey in this study, six vessels within the harbour (five along the breakwater, one at Old Beach) and one outside the harbour were observed as being either abandoned or sunken. Here, vessels were defined as abandoned if they were damaged to the point of being inoperable. The Administration Office advises fishing vessels known to have sunk due to hull damage to be moved to the breakwater while they can still move. Thus, the sunken vessels are not directly in front of the berths, but rather are gathered between the base and center of the breakwater nearby.

The location of the hull and masts of larger vessels are visible after sinking, but sunken canoes and smaller inshore fishing vessels will be completely submerged below the water surface during high tide, making their positions unclear. With sunken vessels near the navigation channel of fishing vessels using the landing berth, this is judged to be extremely dangerous.

Thus, in order to secure safety for the navigation of vessels using mooring berthing water area, waterway, basin and etc. it is necessary to remove obstacles such as abandoned and sunken vessels in route of fishing vessels.

(i) Improvement of Environmental Hygiene in Water Basin

Littering in waters basin of Sekondi Fishing Harbour is prohibited, and any litterers found are fined GHS 30. While the harbour grounds are periodically cleaned and managed by a contractor. In the waters area between the existing breakwater and landing berth of calm waves and current, many pieces of plastics, plastic bottles, pieces of

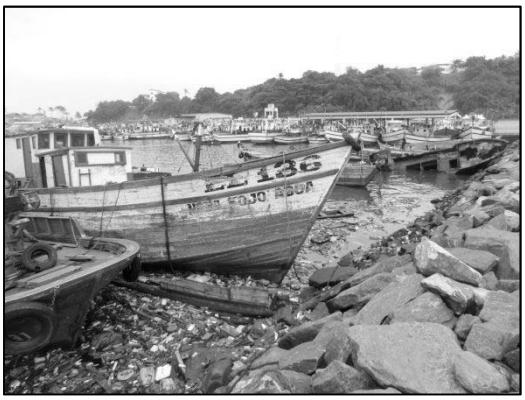


Photo 1-1-2(1) Trash in the Water Basin

wood and other trash were observed as shown in Photo 1-1-2(1).

As this water basin connects to the landing berth, the water areas need more strict enforcement on littering and so forth and periodic removal from environmental conservation is required.

(j) Coordination with MOFAD

In planning stage of Phase I, MOFAD was planned to assign three staff to the Administration Office. Currently, one staff from the Takoradi Field Office of MOFAD is stationed at the fishing harbour to conduct monitoring surveys. However, there is not sufficient coordination with the harbour management office. The Takoradi Field Office is invited to the stakeholder meeting of fishery related people held several time a year by the harbour management office. However, it is a kind of formality and is not functioning as technical transfer of expertise of MOFAD and GPHA. Activities of the MOFAD staff assigned to the major functions such as monitoring, control and surveillance are limited to dispatch and patrol from the Takoradi Field Office, not stationed.

As explained previously, the present Ghana policy in the fisheries sector is not to allow the number of fishing license nationally against increase of the fishing vessels in order to preserve fishery resources. In Sekondi Fishing Harbour, however, number of registered vessels keeps increasing. The reasons for this are explained as being that Sekondi and Elmina are merely the sites equipped with fishing harbour facility in the western region of Ghana.

From the above, GPHA and MOFAD are recommended to coordinate better on the management of Sekondi Fishing Harbour to take substantial measures for effective harbour operation considering the issues and plan of the fishing harbour.

(k) Establishment of Coordination Organization with Management and Fisheries Parties

There are many parties working in the fishery sector in Sekondi Fishing Harbour, other than the fishermen manning the inshore purse seiners, fishing canoes and large trawlers, there are also fishmongers, smoke fish processing workers, small store workers and more. Ghana has taken cracking down on some among these for illegal fishing operations using fishing lights and dynamite as issues in the fishery sector. Also, with inshore purse seiners and fishing canoes co-existing, Sekondi Fishing Harbour reported several instances of conflicts among fishermen. Illegal fishing operations are also a problem in Sekondi-Takoradi District. This problem reportedly leads to reduced fish landing volume, fish quality and fish prices, also impacting income levels for fishmongers, dealers and other selling vendors.

Under the circumstances, although setting facility usage fees is decided through a stakeholders meeting with management and fisheries sector parties, but merely exchange of opinion is done there, considerable number of fishermen do not pay such facility usage fees.

Therefore, it is required to establish the coordination organization consisted of management, fisheries sector parties, local community and etc. between management and users of harbour.

1-1-3 Planning Concepts of the Project

Considering the above listed issues, planning concepts that Sekondi Fishing Harbour currently needs are as follows,

	Issues and Problems	Expected Actions
1)	Proper operation of harbour facilities and zoning of fishing harbour activities	→Clear usage zoning, enhancements of facility management and operation, technical assistance (soft-component)
2)	Proper fishing harbour management by MOFAD and GPHA	→Administrative enhancements, MCRS enhancements, Administration Office expansion
3)	More efficient fish landing and preparation works	→Secure space for offshore mooring, expansion of berthing facility
4)	Installation of facilities to mitigate harbour congestion	→Expansion of berthing facility, secure space for net mending and storage
5)	Reinforcement of ice making function to ensure fishing product quality	→Expansion of ice making plant
6)	Safety in Sekondi Fishing Harbour	→Maintenance dredging, safety ensuring of fuel tank, removal of sunken vessels
7)	Environmental consideration for coexistence of canoes fishing and inshore purse seiner fishing	→Improvement of access driveway, introduction of a third party organization
8)	Crack down on illegal fishing methods and practices	→Enhancement of administrative function, increase of administrative staff
9)	Improvement of fishing vessel repair function to fill fishermen needs	→Introduction of slipway
10)	Establishment of fair and equitable use for public facilities	→Strengthen harbour management, revision of tariff and reasonable fees of harbour use
11)	Hygiene control for harbour water basins	→Periodical trash clean up in water basins

1-1-4 Project Justification and Relevant Upper Plans

(1) Project Justification

Tema Fishing Harbour and Sekondi Fishing Harbour, other than Elmina Fishing Harbour, are the only developed fishing harbour in Ghana. GPHA is in charge of Tema and Sekondi Fishing Harbour and their facilities.

"Tema Fishing Harbour" is located in the hinterland of the national capital city, Accra, and has a large commercial fishing industry of deep-sea fishing, targeting the large markets in Accra and Tema. Some of fishing product landed at the harbour is exported. In contrast, "Sekondi Fishing Harbour" is positioned as a co-managed harbour with local stakeholder involvement as their management policy, according to the management policy as dictated to GPHA.

Meanwhile, fish landing sites excluding above two harbours are controlled by MOFAD, where the Ghanaian fishery sectors have total issues, mentioned as followings:

i) Insufficient data on fishery management,

ii) Monitoring for stable management of fishery resources and building a monitoring system,

iii) Co-management of fishery resources with the local community and etc.

MOFAD is developing major 11 fish landing beaches to solve the above issues.

Because of vulnerable organization and workforce of MOFAD, co-management system with the local community is essential to control the rural fish landing beaches. Considering the above undergrounds, this project installed in Sekondi Fishing Harbour is expected to be a model case of community-based fishing harbour.

(2) Consistency with Upper Plans

Upper level plans for this project include the Ghana Shared Growth and Development Agenda (GSGDA), Sekondi-Takoradi District MediumTerm Development Plan (DMTDP) and Ghana National Aquaculture Development Plan (GNADP). This project is justified with the upper level plans and should contribute to them on the following points.

1) Ghana Shared Growth and Development Agenda

<Objective>

Promote growth in the fishery industry for food security and income.

<Strategy> (Project Contributions)

(a) To promote data collection for fishery management

(b) To establish a systems for compliance with fishery resource regulations and monitoring and surveillance

(c) To develop and enhance co-management system for fishery resource management with the fishing community

(d) To promote intra-sector cooperation in fishery management

(e) To improve regulatory measures and legal framework for sustainable management of fishery resources and enforce relevant provisions

2) Sekondi-Takoradi District Medium Term Development Plan

<Basic Objectives for Fisheries Industry> (Project Contributions)

(a) Poverty reduction

(b) Food security

(c) Sustainable fishery management

(d) Conservation of habitats and biodiversity

3) Fishery Development Plan (Ghana National Aquaculture Development Plan (2010-2015))

<Development Objectives> (Project Contributions)

(a) Preserve fishery management, fishery resources and fishery resource environment

(b) Add value in the fisheries sector and life improvements for fishing community

(c) Increase support for MOFAD and other supporting agencies

1-1-5 Summary of the Project

(1) Project Objective

The project objective is to "promote the capacity and functions of Sekondi Fishing Harbour through improvement and expansion of harbour facilities, thus contributing to advancement in efficient coastal fishery."

(2) Project Site

Sekondi Fishing Harbour, Secondi-Takoradi, Western Region, Ghana

(3) Project Components

1) Japan Side:

(a) Additional lay-by berth (improvement of existing breakwater)

(b) Access driveway from canoe jetty to old Beach with canoe berthing facilities

(c) Additional ice making plants

(d) Additional administration office

(e) Pavement of the area behind the fish handling shed (including inner road, parking lot/net mending area and street lights)

(f) Utilities (water supply, reservoir, high tank tower, trench for fuel and water supply, etc.)

(g) Technical assistance (soft-component)

2) Ghana Side:

(a) Environmental Impact Assessment (EIA)

(b) Relocation of small shops

(c) Disposal of wastes in project water basins (abandoned and sunken vessels, etc.)

(d) Disposal of waste in project sites (used engines, etc.)

(e) Fencing around existing fuel supply station

(f) 2 personnel for technical assistance (soft-component)

(g) Commission payment for Banking Arrangement (B/A) and Authorization to Pay (A/P)

(4) Responsible and Implementing Organizations

Responsible Agencies:	Ministry of Transport (MOT)
	Ministry of Fisheries and Aquaculture Development (MOFAD)
	overall responsibilities for the project, jointly
Implementing Agency:	Ghana Ports and Harbours Authority (GPHA)
Operating Agency:	Ghana Ports and Harbours Authority (GPHA)

Chapter 2　Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Project Components

In 2010, the government of Ghana requested grant aid on Sekondi Fishing Harbour for promotion of streamlining and efficiency of harbour operation and management as well as fishery activity, submitting request again in July 2013. Table 2-1-1(1) shows a list of the requested components and confirmed result in the Minutes of Meeting as follows.

Table 2-1-1(1) Confirmation of Requested Components

Requested Components	Re-requested Components (2013)	Components Confirmed in Minutes of Discussion
(1) Additional lay-by berths (160m)	(1) Additional lay-by berths (200m)	(1) Additional lay-by berths
(2) Additional breakwater (100m)	(2) Additional breakwater (150m)	
(3) Slipway (350m^2)	(3) Slipway for canoes (350m^2)	(2) Slipway for inshore vessels
	(4) Extension of fish handling shed	
(4) Construction of ice plants (15 t/day)	(5) Construction of ice plants (30 t/day)	(3) Construction of ice plants (block ice)
(5) Cold storage (50-100m^2)	(6) Cold storage (50-100m^2)	
	(7) Ancillary facilities	(4) Ancillary facilities
	• Sanitary facilities	
	• Utilities	• Supporting facilities (water supply facilities etc.)
	• Net mending area	• Pavement of the area behind the fish handling shed
	• Access driveway	• Access driveway with canoe berthing facilities
		• Site for fuel supply facilities
		(5) Additional administration office
		(6) Technical assistance (soft component)

Table 2-1-1(2) Project Components in the Study

Category	Component
1. Civil facilities	(1) Additional lay-by berths
	(2) Access driveway with canoe berthing facilities
2. Building facilities	(3) Additional ice plants (block ice)
	(4) Additional administration office
	(5) Pavement of the area behind the fish handling shed (including in-port road and street lights)
	(6) Supporting facilities (water supply facilities etc.)
	(7) Site for fuel supply facilities
3.Technical assistance (Soft component)	(8) Technical assistance (soft component)

2-1-2 Examination on the Project Components

(1) Civil Facilities

1) Additional Lay-by Berths

Almost 2.5 times of the registered vessels planned for last time in Phase I Project are using Sekondi Fishing Harbour, and average vessel sizes for inshore purse seiners have increased from 10.0 m to 14.5 m. Furthermore, the landing berths originally meant exclusively for fish landing are not being used as landing berths by inshore purse seiners, but rather are occupied as mooring water basins for fitting works of vessels and exclusive berths for large trawlers.

Thus, the majority of fishing vessels is doing their fish landing work in the lay-by wharf, with some working at the canoe jetty and Old Beach. Also in the lay-by wharf, vessels weave around all the vessels preparing and laid up to do their landing work, causing vessels to queue for berths to land or make preparations.

This all means that due to insufficient berth extension for inshore purse seiners to lay up and prepare, they are using the canoe jetty and relatively calm waters behind the breakwater, and even mooring offshore in harbour waters. Also, with almost 90% of the canoe jetty now overtaken by inshore purse seiners, the fishing canoes have lost their mooring facilities.

Note here that in Phase I, an apron of 10 m width and a road of 6 m width were constructed behind the lay-by wharf. However, now almost the entire area of the apron is being used as net storage area during the low season. During high season, the roads are congested with fishmongers and consumers to the areas that vehicles cannot pass through. Fish landing and preparation works all take place amidst all this confusion. With fishing nets also strewn at the back of the berths, the areas are extremely overcrowded with fresh fish transport, sales and vessels preparing for departure.

From the above, additional lay-by berths are considered as a highly necessary and urgent component.

2) Access Driveway with Canoe Berthing Function

There is an access driveway of 48 m extension paved with interlocking blocks connecting the main harbour grounds and the canoe jetty constructed in Phase I. However, the pedestrian walk is constructed but the portion from the canoe jetty to old slipway toward Old Beach is unpaved and narrow and a number of kiosks have also set up their shops along the walking portion, dividing the lanes of traffic.

The area behind the walking road from the canoe jetty to the old slipway is heavily trafficked by fishing industry workers. Gates to be the entrances to Fishing Harbour and Old Beach, are located along this portion, which is the closest to the smokehouses.

Front face of the walking road is composed of a rubble stone revetment, where mooring nearly half of the fishing canoes. As explained above, inshore purse seiners have overtaken the canoe jetty, and fishing canoes do their fish landing and preparation works in the beach of Old Beach where has reached the point of saturation as a mooring area, and so many fishing canoes are laid up on the revetment for their resting in front of walking rad from canoe jetty to Old Beach. .

From the above, improvement of the access driveway connecting Sekondi Fishing Harbour and Old Beach will contribute to foster a strong sense of unity of the harbour and Old Beach in addition to the improvement of accessibility. As this will also add mooring capabilities, the facilities will be both convenient to the fishermen and a highly necessary component to operation and maintenance of the fishing harbour as a whole.

Also, waste water flows in several spots behind the smokehouse, discharging into the water basin via the road and revetment, hindering foot traffic in several areas. Thus, installation of drainage and making other improvements along the access driveway would also be better in terms of environmental sanitation.

3) Slipway for Inshore Vessels

For inshore purse seiner repairs, vessel owners are using the slipways in the naval base adjacent to the fishing harbour and at Takoradi Harbour despite high usage fees. In case that a slipway for inshore vessels is developed in Sekondi Fishing Harbour, it would both be economically superior to these existing facilities and hold the promise of income from usage fees. Thus, it would contribute to harbour management and finances, being meaningful to both fishermen and the Harbour Office management.

From the baseline study, repair items for inshore purse seiners include hull painting, hull leak repairs, hull bottom reinforcements and engine repairs. Hull painting is a three-day job that is carried out on the shore north of the project area, and is performed once every 4.59 months.

Meanwhile, hull leak repairs, hull bottom reinforcement and engine repairs are done once every 1.5 years and take about one week. Calculating the number of vessels and frequency of slipway usage based on docked repairs for inshore purse seiners yields a daily average of 0.96 vessels. Thus, one-lane slipway would be needed for the vessel repairs targeted by the Project.

Due to restrictions on usage of harbour water basins, an area of the slipway plan for facing the open sea north of the existing breakwater is thought to be available and reasonable. Given the impact of waves from the open sea, however, this area was investigated based on wave calmness simulation.

Evaluating from the wave calmness simulation results, an annual effective working rate for the slipway is 40% for a critical wave height of 30 cm, and reached only 59% even for 40 cm. Due to the increased dangers associated with the ship body movement, fishing vessels are normally docked in calm waters surrounded by a breakwater. A slipway would require a breakwater to be constructed alongside it to keep the water basin calm where the slipway is to be built, which would balloon project costs. Assuming a breakwater is not developed, the robust slipway structure required to withstand intruding severe waves would mean higher project costs than the standard slipway.

Therefore, construction of a slipway on the open sea waters north of the existing slipway appears fraught with problems in terms of project costs and operational management. Further, waters at the plan location cause intense deformation and sedimentation on the southern beach, which could cause issues with slipway operation and maintenance.

As given above, from the perspectives of cost-effectiveness and facility operation and maintenance, the slipway has been excluded from the project components.

(2) Land Facilities and Equipment

1) Additional Ice Plants

The existing ice making plant installed in Phase I Project have a daily ice making capacity of 15 t/day, which is mainly supplied for fishery industry. Since the fishing harbour started its service, the number of fishing vessels using the harbour has increased by 2.5 times. Harbour fishermen have thus asked GPHA to increase ice production and improve quality of ice for the following reasons:

- During high season, when many inshore vessels and canoes need ice, much ice is supplied from outside the harbour due to insufficient ice production in Sekondi Fishing Harbour. However, even this does not fill the demands, thus, many vessels are unable to obtain ice and will depart without enough. Therefore, without enough ice, vessels thus often have to come back to harbour within the same day of departure regardless of their

catch amount, not allowing them to cover fishing costs.

- During high season, ice exceeding the capacity of the harbour ice plant is supplied from a wide region. The fishermen have to purchase this ice themselves, requiring a great deal of effort to arrange.
- To secure their own fishing ice, some fishermen have their own reefer trucks, purchasing excess ice from ice plants in various locations. This is a large cost to bear for procurement of ice.
- There are quality issues with much of the ice delivered from outside the harbour. Some are sent out unfinished and hollowed due to rushed ice making.
- Unable to obtain fishing ice, fishermen are forced to use more expensive small cylindrical ice, produced by small-scale facilities for distribution applications.
- Transportation costs are added to ice price coming from far outside the harbour, from places such as Tema, Elmina, Agora and Axim, greatly affects the livelihood of fishing households.

In the first half of a baseline study on ice delivered from outside the harbour, the daily average was 9.6 t/day in low season, when inshore vessels are almost entirely inactive. Figures are 22.0 t/day in the latter half of the study for high season, when fishing was more active. All of this ice is confirmed as being used in fishing activity by inshore vessels and canoes. (See appendices for more detail)

The existing ice making equipment has already been in operation for 15 years now at nearly full capacity, with short time for routine maintenance or overhauls. This tempts the fate of failure, which could result in downtime for repairs in which no ice could be supplied. GPHA is aware of the need of maintenance to halt operation and service the ice equipment more frequently in the future.

Seeing the ice making equipment as part of the harbour social infrastructure and based on the above, GPHA determines increase of ice making capacity in the harbour as essential to supplying enough quality ice so that the fishermen are not burdened. They have requested that the ice plant be newly expanded in this project.

In the baseline study, it was confirmed that harbour ice making equipment has continued to run at nearly full production since going into service, high volumes of ice are being delivered from outside the harbour in far off locations such as Tema and Elmina. Based on the field study, expansion of the ice plant is deemed a highly necessary and urgent component.

2) Additional Administration Office

In-port activity has greatly exceeded expectations from planning of Phase I Project, with the number of vessels using the fishing harbour doubling and the associated increases in fish product

volume handled. As a result, there is a shortage of berths for fishing vessels to land their fish catches, make preparations and lay-by, as well as ice plants, places for handling and transporting landed catches and other facilities. Given the site limitations in the harbour today, however, simply expanding the facilities and equipment is not likely to solve the current harbour congestion and deficiencies. It is necessary to control in-harbour activity properly by improving operation of facility and equipment and to promote efficient use.

To address these issues, GPHA plans to reorganize its current operational management structure, enhancing it with proper increases in staff numbers in the proper positions. They expect to effectively restore order by introducing a community-based operational management approach, establishing a "Multi-Stakeholder Advisory Committee" (MSAC) to advise the GPHA-led operational management structure. GPHA also plans to involve harbour users along with the local Fisheries Commission (under MOFAD jurisdiction), which controls fisheries monitoring, control, surveillance and research, and regional environmental protection authorities.

Operational management of the fishing harbour was also planned to be based on cooperation between the Fisheries Commission and fishermen's cooperatives in Phase I, and space was originally set aside in the administration office plans. This did not materialize, however, as the space was prioritized for departments for security management, disaster prevention, immigration control and customs, which were planned to have external operational management support. Management operation by collaboration between MSAC and Fishermen's cooperatives has not been realized

As the administration office constructed in Phase I Project was planned to accommodate 23 operational management staff, including the Fisheries Commission and fishermen's cooperatives, it is already cramped, with many staff not having office space. Therefore, it is entirely unequipped for the staff increases GPHA is planning for improving its operational management structure.

From the above, together with expanding facilities and securing space, an additional administration office is an essential and urgent component to improving the operational management structure in order to make fishing harbour operation more efficient.

3) Pavement of the Area behind the Fish Handling Shed

(a) Expanding Paved Area behind the Fish Handling Shed (Including Parking Lot)

In Phase I Project, the open ground storage yard has constructed at neighboring place to the access driveway, inner road behind the wharf and ice making plant. The open ground storage yard has put in light traffic pavement by GPHA.

Of the paved areas, parking lot for a total of 23 vehicles was installed in front of the ice plant and behind the fish handling shed. The area behind the fish handling shed is used as parking for

fisheries industry workers, and the lot in front of the ice plant is used as parking for Administration Office visitors, etc. Both observe frequent use and rarely have empty spaces.

As such, almost all vehicles transporting fish products landed and handled at the fishing harbour park between the road behind the fish handling shed and the power station and public toilets, an area with no specific use designated. This location is unpaved because it is not originally planned for use as a parking lot, and loading work is carried out while the dust goes up. This environment is not suited to handle fresh food products. And the grounds become muddy in the rainy day and impede loading and unloading works.

That being said, paving this location is highly necessary and urgent to facilitate fish product loading work and provide a hygiene and sanitary workplace that minimizes cross-contamination risks for handling fresh fish products.

Net mending is an essential task in fishing. However, the number of fishing vessels to use the fishing harbour at present being doubled from the planning stage of Phase I, no particular net mending area was designated, with the assumption being that fishermen would mend nets in their free time in the spacious wharf and other open areas. Nets are strewn all throughout the wharf, and fishermen mend their nets in the openings between the nets in the berths and the open net yard, in addition to the aforementioned unpaved area behind the fish handling shed and elsewhere. None of these places has enough space, making them inconvenient and detrimental to efficient mending work.

Fishermen will mend nets sometimes between fishing operation, but demands for net mending will increase on non-fishing days in preparation for harbour departures when fishing resumes. Meanwhile, as a parking lot would see hardly any use on non-fishing days and have plenty of space, it would be suitable for net mending if paved. Given these points, development of the open lot behind the fish handling shed is deemed highly necessary.

(b) Expansion of Paved Area behind the Fish Handling Shed (Including Inner Road) and Connection to the Access Driveway

Sekondi Fishing Harbour has an inner road leading from the main entrance going through the inshore fishing vessel wharf to the canoe jetty, but there is no access driveway to Old Beach. As per the components mentioned in “Civil Facilities” section, developing an access driveway between the canoe jetty and Old Beach is a high necessity component.

According to landing statistics of MOFAD for 2010, the fishing canoes, which are active mainly in Old Beach, reaped twice the landing volume of inshore vessels. Even discounting the fact that these statistics are estimated samples and may not accurately reflect reality, vehicle traffic on the inner road will increase if an access driveway to Old Beach is developed. If the access driveway to Old Beach is connected to the existing inner road, vehicles using Old Beach

will continuously be passing through the inshore vessel wharf. And with the inshore vessel wharf already overcrowded with landing and handling work from inshore vessels, increased vehicle traffic would only serve to exacerbate the situation. This would not only get in the way of work in the wharf, but also slow traffic to Old Beach. Thus, traffic flow to Old Beach from Sekondi Fishing Harbour and to the inshore vessel wharf should be separated.

From mentioned above on the access driveway, the existing inner road will be moved towards the power sub-station and public toilets when the parking lot behind the fish handling shed is paved. Extending the relocated road south would pass west of the administration office and ice plant, offering a direct connection to the Old Beach access driveway. Meanwhile, the route bound for the inshore vessel wharf can be preserved by developing a connecting road between the road relocated and the existing road between the fish handling shed and the administration office.

The connecting roads would allow traffic flow to the inshore vessel wharf and Old Beach to be split, which in turn would avoid the increased congestion of the inshore vessel wharf that through traffic to Old Beach would be expected to bring. Both of these connecting roads are seen as urgent and necessary components for the Project.

4) Utilities (Electrical Equipment, Water Supply/Drainage, etc.)

(a) Electrical Equipment

i) Emergency Generator

GPHA currently has a 185-KVA emergency generator installed at the fishing harbour. With this generator, the ice plant and the Administration Office both work through power outages without problem. While, due to deficiencies in power generation capacity in Sekondi-Takoradi District and frequent outages, this generator has been used a total of 1,050 hours in the past six years since its installation. While power is out 175 hours annually on average, each outage does not last that long. Thus, installing an emergency generator was highly effective means of handling the frequent outages.

That being said, as mentioned in the section on local infrastructure, supply capacity for the Takoradi Power Station has been increased, and thus power supply to the harbour will improve in the near future. A new emergency generator will thus not be a high necessity and has been excluded from the Project.

ii) Street Lighting

In this project, the lay-by wharf along the breakwater and access driveways to Old Beach with roads connecting to these two will be improved. Street lighting is absolutely essential for keeping the berths, roads and surrounding areas safe at night.

(b) Water Supply and Drainage Facilities

i) Reservoir and Elevated Tanks

The reservoir of the harbour has a capacity of 60 m^3. The existing ice machinery use 30 m^3 of the capacity, and there are large water supply demands for fishing vessels during high season, not to mention the large volumes of water used by the fishermen showers that GPHA installed after completion of Phase I. Given this, the existing reservoir tank is likely quite close to its capacity. The expansion work of reservoir tank absolutely must thus be expanded to handle the new demand from the ice plant and the administration office additions from this project.

With elevated high tank capacity required to be between one tenth and fifteenth that of the reservoir tank, high elevated tank expansion is also an essential component with reservoir expansion.

Note here that installation height for the existing high tank has a hydraulic head of 8 m. Given the land area limitations for project additions to the administration office, the building is likely to be two-story. Hydraulic head will be insufficient requiring the elevated high tank to be mounted higher.

ii) Sewage Tank

The Phase I plans had wastewater from site facilities treated in an anaerobic septic tank, and then passed through a settlement tank before surface infiltration. The settlement tank has since lost its infiltration capacity, but there are large public wastewater treatment plants near the harbour, including a sewage plant. Wastewater is currently pumped for transport to the public sewage plant and purified there, not through the harbour septic tank and settlement tank.

The existing septic tank is being used as a sewage tank, but due to the limited capacity requires frequent pumping. This is costly in terms of operation and maintenance. Thus, in order to improve this situation and prepare for the increased wastewater from newly added facilities, a sewage tank addition is considered to be a highly necessary and urgent component.

iii) Rainwater Drainage

Street gutters will be needed on the relocated in-port road and new connecting roads developed in the Project to drain rainwater from the paved surfaces.

5) Location of Fuel and Water Supply Facilities

On the south end of the harbour grounds near the berths, a fuel piping trench was installed at the time of Phase I, going from inland to the sea. This trench has not been used, so far. Instead, GPHA has leased the entire area in west of the ice plant to private companies, who have installed

39 fuel tanks and 13 dispensers on the site. This fuel is pushed by hand cart to the berth for inshore vessels and canoes.

All the fuel tanks are steel, but are left out in the open and not enclosed with any kind of fencing, making them a large fire hazard. Loading fuel onto hand carts to carry them to the inshore vessels and canoes also has its issues. In addition to the fire hazards during transport, the fuel must pass through the wharf and other areas where fresh fish products are being sorted and dealt, increasing the risks of cross contamination. This situation needs to be improved.

Given these points, GPHA has future plans to consolidate these fuel tanks into an inshore vessel location and canoe location. They are currently coordinating with the owners for the existing facilities and installation crews on the methods and procedure for the consolidation while continuing to supply the vessels and canoes with fuel.

In this project, it will be highly necessary and urgent to review overall site zoning and relation to other facilities, as well as to set locations for the fuel tank yard and refueling areas in preparation for future implementation of the plan. For the refueling transition to take place without halting refueling activity for inshore vessels or canoes, pre-installing pipe trenches is also deemed necessary so that the future piping work to both fuel dispensing areas goes quickly.

(3) Technical Assistance (Soft Component)

Approximately 15 years have passed since the Phase I facilities were constructed, and the number of fishing vessels and fish landing volumes have greatly exceeded the original plan. Although GPHA is good at managing commercial port with high financial capacity and keep facilities very well maintained, that does not mean to control fishing harbour properly. GPHA has positioned Sekondi Fishing Harbour as a place of social contribution and has been accepting many fishing vessels and others from the fishing industry. Still, there are limitations on land and water within the fishing harbour, which cannot handle the doubling of fishing vessels and fish landing volume. This has led to unclear berth and back end zoning, and disorganized facility usage and congestion resulting in confusion, which management is no longer able to control.

In addition to facility usage management, quite a few fishing industry workers are not paying fees for using the facilities. Furthermore, the management based on the policy and thoughts of Ghanaian Fishery Industry is not done and it is the state that the proper management as fishing harbour is not operated. Therefore, in order to re-construct proper management for operation and maintenance as fishing harbour, confirmation of establishment of MSAC consisted of each representative from MOFAD and stakeholders is necessary and it is considered to be ideal that training cooperation through technical assistance (soft component) including review of usage rules of fishing harbour and confirmation of thoroughness to users.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policies

(1) Basic Policies for Civil Facilities

1) Basic Planning Policies

The project objective is as follows:

"The capacity and functions of Sekondi Fishing Harbour are promoted through improvement and expansion of harbour facilities, thus contributing to advancement in efficient coastal fishery".

For the success of the Project, the implementation of the civil facilities will improve the fishing harbour functionality of the resting, preparation and landings works congested with resting vessels. This is all due to the increasing number and size of fishing vessels which have overcrowded the harbour. There are also already a number of fishing vessels that cannot use the lay-by wharf and are obliged to moor offshore. If more fishing vessels are to be based out of the harbour, more will be forced to moor offshore, making it unsafe to navigate in the harbour basin. Meanwhile, while the size of fishing vessels is increasing, the water depth in the harbour is becoming shallower than the water depth set at Phase I Project. This may also cause problems with safety and operations in the future.

Therefore, it is essential to direct traffic for easy operational management and to restrict the fishing vessels that can currently use the berths and water basins.

(a) Target Fishing Vessels

i) Conditions of Vessel Use for Landing Berths

Phase I sets landing berths (water depth: 3.0 m), and preparation and resting berths (water depth: 2.0 m) while the current water depth is -2.5 m for landing berths and -2.0 m for preparation and resting berths. In this project, the lay-by wharf from Phase I will be used to supplement the already insufficient landing berths. The landing berths in this plan are considered rather dangerous unless safety dredging is conducted, and the existing berths should be reset to -2.0 m.

In case of a critical wave height as 30 cm, fishing vessels able to use waters with a depth of -2.0 m will be less than -1.7 m at full draft. However, there are some fishing vessels that call at the harbour seasonally but are not registered with Sekondi Fishing Harbour. Thus, all the drafts of vessels calling to Sekondi Fishing Harbour not necessary be known.

In terms of berth management operations, it is important for GPHA to recognize that fishing vessels that are less than - 1.7 m at full draft are safe even in case that vessels with the draft of -1.7m or more are calling to the harbour, and that fishing vessels with less than -3.0 m at full draft are also able to call on the harbour in cases when tidal level is more than MSL (Mean Sea level).

Meanwhile, it is problematic that joint venture vessels (large trawlers) occupy the existing

landing berths, therefore forcing other vessels to use the lay-by wharf. The cause of the exclusive use of the berth by large scaled trawlers is that they do sorting even after landing and they occupy the berth even for preparations and resting.

Based on the issues above, this plan will organize usage of landing berths as follows:

< Usage Policies >

- In case the required extension is not sufficient for landing berths, reconfigure some of the preparation and resting berths organized in Phase I to the landing berths.
- Water depth for landing berths shall be modified from -3.0 m to -2.0 m.
- As long as they satisfy the draft conditions above, fishing vessels that are not registered with Sekondi Fishing Harbour is allowed to use the landing berths.
- Fishing vessels that use the landing berths shall have a draft of less than -1.7 m at full load condition under critical wave height 30 cm.
- During water level above Mean Sea Level, the draft of fishing vessels that use the landing berths shall be less than about -3.0 m (-2.7m) at full load condition.
- Joint venture vessels (large trawlers) shall not take over the landing berths and be treated equally with other inshore purse seiners.

ii) Conditions of Use for Preparations Berths

The lay-by wharf constructed in Phase I allowed for simultaneous use as a preparation berth and resting berth. However, these forces vessels to prepare among crowds of laid up vessels as the number of fishing vessels increases. Furthermore, preparation berths are also being used as landing berths and congested with landing works and preparation and resting works. This complication negates the ability to manage berth operation. Meanwhile, the ice plant and the open storage yard were constructed in Phase I at the back of the wharf. Therefore, it is more convenient location as the preparation berths.

The water depth for the preparation berths as set in Phase I, -2.0 m, has mostly been maintained to this time.

Based on the issues above, this plan will organize usage of preparation berths as follows:

<Usage Policies>

- The lay-by wharf developed in Phase I Project has been used for a landing berth, but it is used as preparation berth in this project.
- Insufficient extension for preparation berths allocates to preparation work area to a convenient breakwater base by widening and improving the existing breakwater.
- Design water depth for preparation berths shall be -2.0 m.

- Fishing vessels that use the preparation berths shall have drafts of less than -1.6 m when empty under critical wave height 40 cm.
- The preparation berths shall primarily be for Sekondi Fishing Harbour based vessels that are currently registered (they shall be given priority).
- Fishing vessels not registered with Sekondi Fishing Harbour are basically to prepare at a harbour where they are registered.
- Joint venture vessels (large trawlers) shall not take over the landing berths and will be treated equally with inshore purse seiners.

iii) Conditions of Use for Lay-by Berths (Resting Berths)

The lay-by berth constructed in Phase I is in principle to be used for fish landing and resting berths in this project. This will emphasize the sequential cycle of fish landing, preparation and operation, and the strong relationship between the fish handling shed, ice plant, and open storage yard located at the back facilities. The convenience factor here also has a strong correlation to preparation functions.

Lay-by berths (resting berths) are out of the sequential cycle of landing, preparation and operation, as they are for non-working and resting fishing vessels. Therefore, non-working fishing vessels currently lay up on the south side of the existing canoe jetty and within port water basins. However, for Sekondi Fishing Harbour based fishing vessels, it is necessary to rest when not working, and considering their convenience, it is desirable to ensure as many berths as possible. Therefore, in this project, the existing breakwater shall be widened to place berths toward the head of the breakwater, next to the preparation berths.

Based on the issues above, these project usage policies for resting berths are set as follows:

<Usage Policies>

- Lay up space for berthing shall in principle be offshore mooring within the harbour, and the existing breakwater will be improved and equip berths for the most effective use as possible.
- Water depth of resting berths shall be -2.0 m.
- Fishing vessels that use the resting berths and moor offshore within harbour water basins shall have drafts of less than -1.6 m when empty under critical wave height 40 cm.
- Lay-by berths shall primarily be for Sekondi Fishing Harbour based fishing vessels that are currently registered with Sekondi Fishing Harbour (they shall be given priority).
- Fishing vessels not registered with Sekondi Fishing Harbour shall basically prepare where they are registered.
- Joint venture vessels (large trawlers) shall not occupy the resting berths due to their size,

and shall in principle be obliged to moor offshore outside of the harbour along with the current usage.

(b) Implementation Policies for Civil Facilities

The implementation policy for this project assumes that functionality will be improved through effective refinement of the existing facilities based on implementation concepts with operating the facilities constructed in Phase I.

The following are the basic policies of implementation on each component.

i) Additional Lay-by Berths

- As the front water area adjacent tothe existing breakwater constructed in Phase I are very calm, they can be effectively used as lay-by berths by improving to berthing structure for the inside of the harbour from the current rubble stone structure.
- Based on a wave tranquillity analysis, only the safe waters shall be improved to berthing structure on the existing breakwater.
- Out of new wharf expanded from breakwater, existing landing berth and resting berths where target vessels are moored, at least fish landing and preparation berths are secured.
- This project shall in principle not allow landing and preparation work to be conducted at the same berth as is currently allowed.
- Based on the sounding survey results, a new water depth of the berth shall be set to include existing berths for safety view.
- Improvement of the existing breakwater to berthing structure shall be designed so that it does not disturb the existing sea water circulation culvert.
- For parts of the existing breakwater to be improved, the necessary width shall be secured based on the current usage conditions and be planned with consideration to the traffic lanes of fishing industry workers and vehicles. For this reason, some of the existing fire pump rooms and shower facilities shall be removed.

ii) Access Driveway with Canoe Berthing Facilities

- The access driveway shall ensure a road for vehicles and pedestrians, and its design shall give a unified concept with the existing access driveway.
- The project scope shall be 250 m from the south revetment of Phase I facilities.
- The existing access driveway revetment shall be exclusively for fishing canoes to berth, and the design plan shall account for accessibility between the access driveway and canoes. The minimum necessary height shall also be maintained so that the construction scale shall not be larger for the crown height from the canoe jetty to Old Beach.

- The design shall be careful not to cut off the drainage channel from the smokehouse area.

2) Policy on Natural Conditions

- Temperature is 27.2°C all through the year and the highest temperature is around 30.5°C, which should not significantly affect the construction.
- Monsoon season in Ghana is from April to July. Average monthly rainfall amount in the past five years is 200 to 300 mm from May to June, with more than 10 mm of rain per day recorded around 30 days annually. Therefore, rain should not have much of an impact to construction.
- There is no observatory that constantly monitors design waves in Ghana or obtainable wave observation data. Therefore, the spectrum wave model database obtained from the US Navy in 1996 during Phase I shall be applied.
- The harbour side of the existing breakwater will be an upright wall and the impact of reflected waves from the harbour shall be evaluated through wave tranquillity analysis.
- The design seismic coefficients for earthquakes K_h = 0.1 (ground) and K_h' = 0.2 (underwater) is applied.

3) Policy on Social Environmental Conditions

- According to IMF data, consumer prices have raised by a factor of approximately 5.6 times in Ghana based on year 2000 prices since Phase I facility development. The latest inflation rate in Ghana has increased to 18.35% in the 24 months since 2011. Therefore, the project will reflect calculations of the inflation rate from the estimated point to the expected month of tender.
- The project area is an active fishery area for both sea and land. The construction plan shall account for impact and safety on the existing fishing activities.
- Canoe jetty use shall remain unrestricted to the extent possible during access driveway construction. Access for fishermen shall be secured by installing a floating bridge of the 50 m length between the south revetment and the canoe jetty constructed in Phase I.

4) Policies on Construction and Procurement Conditions

i) Design Standards

In Ghana, there are no regulations for design standards. Essentially, standards are set by construction agencies, or British Standards are applied. Therefore, to implement this project, the Japanese design standard for fishing harbour structures, “Standard Design Methods for Fishing Port Construction”, shall be used together with “Technical Standards and Commentaries for Port and Harbor Facilities in Japan” as supplemental information. Moreover, JIS standards or their

equivalent shall be applied as the materials standard.

ii) Construction Conditions

Construction companies in Ghana have a limited experience with offshore construction works and they only do revetment work. According to interviews with local construction companies, they are certainly capable of general land work, such as earth works, road works, concrete works and construction works. In this project, therefore, design and construction methods shall be considered so that local construction companies are utilized.

iii) Procurement Conditions

Procurement condition of construction materials and equipment are as followings.

- Basic materials, such as stones, cement, ready mixed concrete, re-bar, and lumber are produced in Ghana and can be procured locally. In particular, there is a re-bar supplier is located in Tema although the price is higher than Japan. Therefore, materials that are cheaper in comparison, including the cost of transportation to Sekondi, will be used.
- Basic construction machinery for civil works, roads and other miscellaneous construction works is available locally. However, as it is difficult to procure large-scale heavy machinery, such as crawler cranes, a reasonably priced machinery will be selected to compare rental fees from Japan.

5) Construction Methods

- The construction plan shall account for impact and safety on the existing fishing activities. A temporary access driveway (unifloat: floating bridge) shall be secured so that the existing canoe jetty can be used without restrictions during construction.
- The temporary yard in the harbour shall be as small as possible.
- Based on local construction conditions, construction works will mainly be on or from land. When the temporary construction roads are required, consideration will be given to utilizing temporary construction roads as a part of the project facility.

(2) Basic Policies for Land Facilities and Equipment

1) Basic Planning Policies

(a) Basic Policy for Additional Ice Plant

Estimates and relevance for expanding the ice plant shall be validated by following the procedure below.

i) Estimate the Current Gap between Ice Supply and Demand

- Ice demand for fishing vessels is calculated in terms of the number of inshore vessels and canoes operating per day, multiplied by the ice loading capacity for each vessel type.
- From hearings with the inshore fishing vessel and canoe cooperatives and the baseline study, the number of larger trawlers and canoe categories operating each day fluctuates very little throughout the year, with average numbers operating during both high and low seasons.
- As inshore vessels mainly use purse seine to capture small pelagic fish, their operating numbers fluctuate greatly by season. The baseline study confirmed this seasonal fluctuation. By comparing the result of the baseline study and the monthly number of operating inshore vessels from the Monitor Fishing Vessels Positional Analysis conducted by the Marine Fisheries Research Division (MFRD), the baseline study periods can be used to estimate seasonal fluctuations throughout the year. Thus, numbers for medium sized trawlers, medium sized purse seiners and large purse seiners operating was calculated for each season and used to estimate ice demand.
- Based on hearings with the inshore fishing vessel and canoe cooperatives, ice sales figures from the existing ice plant are used to analyse ice loading volumes for inshore vessels and canoes.
- Ice is supplied to the harbour from both ice produced in the ice plant of Sekondi Fishing Harbour and ice supplied from outside the harbour. In the baseline study, there were great discrepancies between ice supply figures from outside between the first and second half of the study. Thus, as with the ice demand estimation process, ice supply volumes are calculated based on analysis of the MFRD Monitor Fishing Vessels Positional Analysis.
- Transportation fees are added to the ice price coming from far outside the harbour, from places such as Tema, Elmina, Agora and Axim, greatly affecting the management of fishing households. This ice shall therefore be excluded from the ice supply volume when estimating the gap in ice demand.
- Some of the ice brought in from outside the harbour is hollow and not frozen all the way through. This hollow ice has not been removed from the supply - demand gap calculations, but is of no benefit to fishermen of Sekondi Fishing Harbour. In the future, GPHA plans to enhance their monitoring and consult with the supplier when this kind of ice is observed, instructing them how to improve quality.
- The supply - demand gap shall be calculated during low and high fishing seasons.
- Based on the present situation of supply - demand gap calculated in forgoing paragraph, the size of the additional ice plant sall be derived by the following policies.

- The output gap shall be estimated during low and high fishing seasons to calculate the scale for ice plant expansion.
- The plant shall be expanded without making inshore fishing vessels or canoes lose operating opportunities due to a lack of ice supply or operate without ice, which lowers the freshness of the fish during the high fishing season.
- Plant expansion shall be carefully planned to affect a balance between avoiding a massive amount of excess ice during low fishing season when the operation of ice machinery stops over a long period resulting in revenue and expenditure balance on the harbour.

ii) Ice Plant Installation Area

There may not be enough land in the harbour to include the land for expanding the ice plant. The expansion described above shall be verified from perspective of ice plant installation area.

- The existing ice plant has as an in-port way to its wharf side, the administration office to its north and the open net storage yard to its south side, leaving only the west side available for expansion. As the connecting road to the access driveway that leads to Old Beach will be built on the west side, the room for expanding the ice plant will be limited to approximately 12 m in length and 40 m in width.
- The existing ice making equipment makes block ice using ammonium refrigerant. For operation and maintenance consistent with the existing equipment, additional ice making equipment shall also use ammonium refrigerant to make block ice. Setting existing ice plant area as the standard, the maximum expected scale for ice making equipment to be installed in the expansion area will in principle be 22.5 t/day. If this project is to install equipment that can make the 30 t of ice per day that the Ghan Government has requested, ice making equipment will need to be installed on multiple levels (15 ton machines installed on the ground and first floors of a two story building), or the existing open net storage yard will need to be scrapped to make land for expansion.

(b) Basic Policy on Additional Administration Office

The expansion of the administration office shall be planned with the following policies.

i) The existing administration office is surrounded by an in-port road and the ice plant, and only the west side is available for expansion. The west side has the reservoir tank and high tank tower as the water supply base for the harbour facilities. The electric and drain piping for the administration office and the ice plant on the south side are gathered on the west side. As there is no other appropriate place for Administration Office expansion on the habour area, expansion scale must be appropriate, considering the necessity of relocation, replacement, and

workarounds of equipment due to the expansion of the administration office as well as avoiding interference with expansion work in this limited space.

ii) The existing administration office is adequately maintained and can be utilized well into the future. The existing administration office also needs to continue managing the harbour as smoothly as possible without congestion during project construction. For this reason, the existing administration office shall be reused in its entirety. For consistent use of the extension, the necessary renovation shall be minimized. The necessary period to use the temporary Administration Office will also be minimized to the extent possible.

iii) After the project, the management staff in the administration office will be increased. Therefore, the office will be zoned based on staff roles and activities, and appropriate executive offices and related rooms will be allocated. Fishing harbour management will be arranged as follows.

- For operation and maintenance of the fishing harbour, groups for operation management, technical management, and security management are allocated under the direction of the Harbour Manager. Auditing and accounting will be added to the whole constitution.
- In terms of management system enhancements, GPHA will not only be increasing the number of management staff. Rather, they plan to effectively improve fishing harbour management by closely involving users of the harbour in management. Therefore, the plan is to make a fishing harbour advisory commission including the harbour users. The head fishermen and major associations of the fishing harbour will join this commission as user representatives.
- Furthermore, it is planned that the local fisheries commission, marine police, and the GEPA join the fishing harbour advisory commission.
- As Sekondi Fishing Harbour is used for joint venture projects with other countries and there are many foreign fishermen using the harbour, officials from the immigration and customs departments are also assigned to the commission.

iv) The executive office of the existing administration office is quite small compared to offices of the GPHA in Tema or in Takoradi Harbour, but the standard space for expansion shall be roughly equivalent to the existing administration office and not excessive compared to similar cases in other countries.

(c) Basic Policy for Pavement of the Area behind the Fish Handling Shed

Estimates and relevance of paving the area behind the fish handling shed shall be verified by following procedure.

i) The area behind the fish handling shed will be paved for loading works of vehicles that carry landed and handled fish at the fishing harbour and as a parking area. Therefore, the standard size of vehicles, loading volume, and loading work space shall be verified.

ii) Based on the fish landing volume as researched from the baseline survey, the landing volume and the number of loading vehicles of high and low fishing season, and the required number of parking spaces for the loading zone shall be estimated.

iii) In addition to the loading work of vehicles and parking area described above, the area behind the fish handling shed is also being paved for use as a net mending area on non-fishing days. Therefore, pavement estimations shall consider the space required for a net mending area.

(d) Basic Policies for Additional Utilities

i) Basic Policy on Reservoir and High Tank Expansion

The volumes of the existing reservoir and high elevated tank are 60 m^3 and 5 m^3, respectively. As the water demands for the ice plant and other facilities in this project cannot be met, a new reservoir and high tank must be installed.

The existing reservoir tank needs to be relocated as its current location, which will be used for ice plant expansion. The high tank also needs to be relocated to a higher elevation due to insufficient hydraulic head for supplying water to equipment on the first floor of the administration office. However, both of these tanks are panel type and 15 years has already passed since Phase I development, which is close to the lifeyear of the tanks. Therefore, it will be difficult to avoid leaking water when relocating them due to the degeneration of the packing, even if the bolts are refastened. For this reason, both of these tanks shall be disposed and a new reservoir and high tank shall be installed to supply water to meet existing demand and the additional demand for water supply to the expanded facilities and equipment.

As the water supply system from a high tank is cheap and easy to maintain, it shall continue to be used from Phase I.

ii) Policies for Locating Fuel Tank Sites

As fuel tanks are flammable, the installed location shall be set by the following policies from the perspective of safety.

- As far away as possible from the places where fishermen work.
- Sites of easy access to fill fuel tanks with parking space secured sufficiently for refuelling vehicles.
- Site of no interference from existing facilities and equipment on the trench route of the fuel pipe between the fuel tank site and the fuel dispensing point for fishing vessels and canoes.

2) Policy on Natural Conditions

The design conditions for this project site for natural conditions are listed in Table 2-2-1(1).

Additionally, structural designs shall account for characteristics of the region, such as the strong sunlight that is distinctive of low-latitude regions, and the heavy rain during the monsoon season. As there are no public drainage facilities around the site, the rain that falls on the facilities shall be released outside of the breakwater once all suspended solids are settled out in the existing sedimentation tank on the site.

Table 2-2-1(1) Design Conditions that Affect Natural Conditions

Item	Natural conditions	Design values
Wind velocity	As the maximum wind velocity is 13 m/s, the estimated maximum gust speed would be approx. 25 m/s	Standard wind speed: 25 m/s (applied to wind load calculation)
Wind direction	Southwest for most of the year	Nothing of note
Precipitation	Annual average: 1,168 mm, Month maximum: 408.3 mm, Daily maximum: 124.7 mm, Day: more than 40 mm Frequency: 7.0 times/year, Frequency more than 50 mm/day: 0 times/year	Rainfall intensity: 50 mm/hour (applied to drainpipe design)
Temperature	Daily maximum: 34.1°C, Daily minimum: 15.4°C Average: 27.3°C	Applied to air conditioning, ventilation and refrigerator design

3) Policies for Socio-economic Conditions

To comply with the part of the civil facilities.

4) Policies on Construction and Procurement Conditions

(a) Legal Regulations and Application Procedures

In Ghana, the Town and Planning Department Act and national building regulations exist, which regulates town planning restrictions, application and related procedures, general codes for construction, structures, living environments, ancillary facilities, fire resistant, fire protection and evacuation, and safety rules for specified buildings.

Generally, it is necessary to apply to the local branch of the Town and Country Planning Department to obtain building permission based on the Town and Planning Department Act and building regulations, a procedure that takes 90 days. However, this is unnecessary if the GPHA constructs facilities and equipment on land of their control. Therefore, it is not necessary to obtain building permission for this project based on the national building regulations.

After consulting the GPHA, we confirmed that construction of facilities and equipment is

possible for this project by designs that are complied with the national building regulations in Ghana.

(b) Policies for Technical and Quality Standards

Basic construction standards are defined in the Ghana building regulations and code, but no design standards or specifications are defined that conform to Japanese ministry's proclamations or academic design standards, or quality standards that are equivalent to Japanese Industrial Standards (JIS). For these details, international standards, such as British Standards (BS) (as a former British colony), EN, or ISO are applied.

We confirmed that these design standards will comply with the national building code in Ghana, and also to the standard and specifications defined in BS or EN in consultation with GPHA.

Therefore, locally adapted international standards, regulations, and rules, such as BS, EN, ISO, and ASTEM, shall be applied as individual standards, regulations, and rules concerning the design for facilities and equipment in this project.

In recent years, construction and quality standards in Japan have been revised so that they comply with international standards, such as ISO and EN, and standards for design strength, structure, living space functions, and facilities and electric design are equal to that of developed countries, including the United Kingdom. Moreover, GPHA understands that combining Japanese standards has advantages for effective design and construction, and reduces construction costs as Japanese companies would be the main construction contractors given that construction is being performed as Japanese grant aid.

(c) Policies for Equipment Design and Quality Standards

Japanese design and quality standards (such as JIS, JASS, various academic standards, and electrical wiring standards) will be applied as the technical standard for the design of facilities, such as electric equipment, air conditioning and ventilation facilities, and plumbing equipment. We will confirm that the detailed design conforms to locally adopt international standards and regulations, such as BS, EN and ISO.

(d) Structural Design Standards

The structural design standards of this project are listed in Table 2-2-1(2).

According to the locally conducted plate bearing test, there was an increase in settlement observed at 120 kN/m^2 in terms of allowable ground bearing force. However, as the change is very small and on-going, it was determined that specifying the allowable ground bearing force based on the loading test result would be difficult. The standard will be 50 kN/m^2 to comply

with Phase I for safety.

Table 2-2-1(2) Structural Design Standards

Item		Standard values	Notes
Allowable bearing capacity of subgrade		kN/m^2, kN/m^2, kN/m^2	Continuous footing, foundation base width m, m, m Bed depth GL-1.05 m, lowest N value:
Wind pressure		q: 56.25 N/m^2	$q = V^2/16$, V = 30 m/sec. (NV65)
Live load		11,750 N/m^2 (see notes) Lowest: 2,500 N/m^2	Ice making brine tank floor Administration office (BS EN 1991-1-1-2002) (BS EN 1991-1-1-2002)
Concrete	Slump	15 cm	
	Water-cement ratio	55% or less	
	Strength	24 Nf/mm^2 15 Nf/mm^2	Building frame Blinding concrete
	Salinity content	Target less than 0.004% wt	NaCl conversion
	Cement	Normal portland cement	
	Re-bar covering thickness	On ground: 5 cm Underground: 7 cm	For columns and girders For foundation
Re-bar		Yield point strength: 250 to 425N/mm^2	SD390 (JIS G3112)
Steel frame		JIS G 3101, JIS G 3106, JIS G 3192, JIS G 3350	SS330-205, SS400-245, SM400A, SM400B, SSC400-245

5) Policies Concerning the Utilization of Local Construction Companies and Consultants

To comply with the part of civil facilities.

6) Policies Concerning Operation and Maintenance

To comply with the part of civil facilities.

7) Policies Concerning Grade Setting for Facilities and Equipment

As the facilities maintained by this project are for the expansion of existing facilities and equipment, the specifications of facilities and equipment shall be equivalent to the existing facilities.

8) Policies for Construction Methods and Schedule

As this is a project to expand the functions of a fishing harbour that has been in service for approximately 15 years, the construction methods and schedule shall be set based on the following policies:

- As the project site is the fishing harbour in operation, the construction area and scheduling shall be formulated carefully to avoid any situations in which fisheries and distribution activity through construction period.
- In this project, civil works will be done simultaneously, and hence the construction area and schedule shall be formulated through thorough negotiations with the civil works authorities to avoid situations in which construction will halt fishery activity.
- Drainage facilities, water supply, and electrical piping are all concentrated on the west side of the existing ice plant and administration office that are to be expanded. Also, as both of these facilities will be used continuously through construction stage, these pipes must be relocated and replaced prior to the construction work commencement. As there is also a high possibility that the reservoir tank is located in the ice plant expansion area, it must be relocated before construction. The most reasonable methods shall be used for the facility and pipe relocation and replacement plan after verification during the first and latter half.
- Renovation work of the existing ice plant and administration office is necessary so they are used seamlessly with the expanded sections. The construction schedule of these renovation works shall be established not only from the perspective of the effectiveness of the plan, but also smooth and continuous usage of existing facilities.

2-2-2 Basic Plans (Construction Plan and Equipment Plan)

2-2-2-1 Civil Facilities

(1) Basic Quantities for Planning

1) Dimensions of Fishing Vessel

There are 106 inshore purse seiners and 9 large trawlers (joint venture vessels) that are registered with Sekondi Fishing Harbour. The number of registered canoes is not known, even locally, but it is estimated that around 130 canoes are staying at the harbour based on a mooring survey on a non-fishing day.

According to the same survey, 123 inshore purse seiners were confirmed, including inoperable fishing vessels. Moreover, according to MOFAD statistics for 2012, the number of inshore purse seiners during high season at the harbour was 129 at the most, and the average number over six months was 122. Therefore, 123 vessels from the result of this study can be considered the average number of fishing vessels using the harbour during high season. According to MOFAD statistics, the average number of fishing vessels that used the harbour during low season was approximately 70.

The inshore purse seiners can be categorized into middle and large-sized fishing vessels based on the registration data of vessel length and width, with field survey results, and the average length, width, and drafts of each category listed in Table 2-2-2-1(2). Data for large trawlers (joint venture vessels) and fishing canoes are listed in Table 2-2-2-1(3) and Table 2-2-2-1(4), respectively.

Table 2-2-2-1(1) Comparison of Registered Vessel Numbers

	Inshore purse seiners	Large trawlers (joint vessels)	Fishing canoes
Registered vessels	106	9	—
Mooring survey (high season)	123 (including non-operational vessels)	8	130

Notes:
1: MOFAD statistics (2012): Average for high season was 122 and 70 for low season.
2: 17 vessels among the studied inshore purse seiners were registered with non-SFH locations

Table 2-2-2-1(2) Inshore Purse Seiners (Registered Vessels)

	Average length	Average width	Number of registered vessels	Full draft	Unladen draft	Number of registered vessels
Middle-sized	12.4 m	3.5 m	78	1.4 m	0.8 m	78
Large	20.4 m	5.7 m	9	2.5 m	1.3 m	27
Largest	21.3 m	6.4 m	19	3.0 m	1.5 m	1
Average	**14.5 m**	**4.1 m**	**106**	**1.7 m**	**0.9m**	**106**

Note: 24 fishing vessels were registered with non-SFH locations

Table 2-2-2-1(3) Large Trawler (Joint Venture Vessel)

	Average length	Average width	Full draft	Company name	Number of Registered Vessels
Steel	22.3 m	4.5 m	1.8 m	M.F	5
Wooden	25.0 m	5.3 m	2.1 m	N.F	4
Average	**23.5 m**	**4.8 m**	**1.9 m**		**9**

Table 2-2-2-1(4) Canoe with Outboard Engine

	Average length	Average width	Full draft
Small	13 m	1.1 m	0.3 m
Medium-sized	**17 m**	**1.3 m**	**0.5 m**
Large	20 m	1.6 m	0.7 m

2) Fishing Vessels Intended for Planning

The inshore purse seiners and large trawlers used to set scales shall be determined based on the number of vessels in the mooring survey during high season.

Vessels of scales excluded due to future safety reasons and usage policy should use Outer Tema Fishing Harbour and other harbours for large and commercial fishing vessel use.

Moreover, the current number of canoes, which is approximately 130, is considered the maximum, and they should preferably use other harbours when the number increases in the future.

(a) Landing Berths

Out of the whole registered inshore purse seiners of 106, the number that uses Sekondi Fishing Harbour is fluctuated depending on the fishing season. The six monthly average is 70 vessels during low season and 123 vessels during high season. In contrast, the number of large trawlers using the harbour is 9 vessels throughout the year.

In regards to setting the usage of landing berths, fishing vessels that are registered with other harbours might sometimes land at Sekondi Fishing Harbour, and registered vessels might land at other harbours. Therefore, landing berth usage in terms of fishing vessels targeted shall be set based on the current usage conditions (baseline study) rather than registered vessel numbers. However, for the berth operation, berths depth will be -2.0 m for safety and therefore the draft of fishing vessels that can use the harbour shall be less than 1.7 m at full load.

(b) Preparation Berths

For preparation berth usage, registered fishing vessels at Sekondi Fishing Harbour should be given higher priority in principle, and therefore registered vessels are set as the target vessels.

However, as preparation is a part of the sequential cycle of preparations, operations and fish landing, especially during high season, the target shall be set based on the current usage conditions (baseline study), which is the same as the landing berth.

For the berth operation, the berth depth would be -2.0 m for safety and therefore the draft of target fishing vessels that can use the harbour shall be less than 1.6 m when unladen. All the currently registered fishing vessels can use the preparation berth.

(c) Lay-by Berths (for Resting) and Offshore Mooring

Lay-by function of fishing vessels is basically allocated to offshore mooring area and the excessive area generated from berth extensions by improving the existing breakwater after subtracting the preparation berth maintenance extension shall be utilized as a lay-by berth (for resting).

For the berth operation, the berth depth will be -2.0 m for safety and therefore the draft of fishing vessels which can use the berths shall be less than 1.6 m when unladen.

3) Basic Quantities for Landing Berths

(a) Number of Vessels for Landing Berths

This study researched fishing vessels for fish landing from July 15 to August 18 in 2013 according to the baseline study. Very few left the harbour in July but many started fishing in August. Therefore, the number of fishing vessels was analyzed with July as low season and August as high season according to the baseline study. As the baseline study is a short term survey from the middle of July to the middle of August, the variations of the number of fishing vessels throughout a year shall be verified by comparing the monthly number of departing vessels based on data supplied by MOFAD with the number of fishing vessels obtained from the baseline study.

As a result, the MOFAD monthly average number of fishing vessels during high season was 565 as indicated in Table 2-2-2-1(1), and the number of fishing vessels in high season of August, based on the baseline study was 600 as shown in Table 2-2-2-1(2). In the annual variation in the MOFAD data, this corresponds to the high ranked month of high season. Supposing 20 days as actual working days (Tuesdays are off) and converting it to a daily average, 28.3 vessels are operating per day during high season according to the MOFAD data, and this is almost the same as the data from the baseline study, which are 30.5 vessels per day.

For this reason, it can be concluded that the result of the baseline study correlates with the statistics researched by MOFAD.

The number of fishing vessels shall be established based on the average number of the top

sixth of fishing vessels for two consecutive months in high season according to the Japanese standard described in the "Guidebook for Planning a Fishing Harbor".

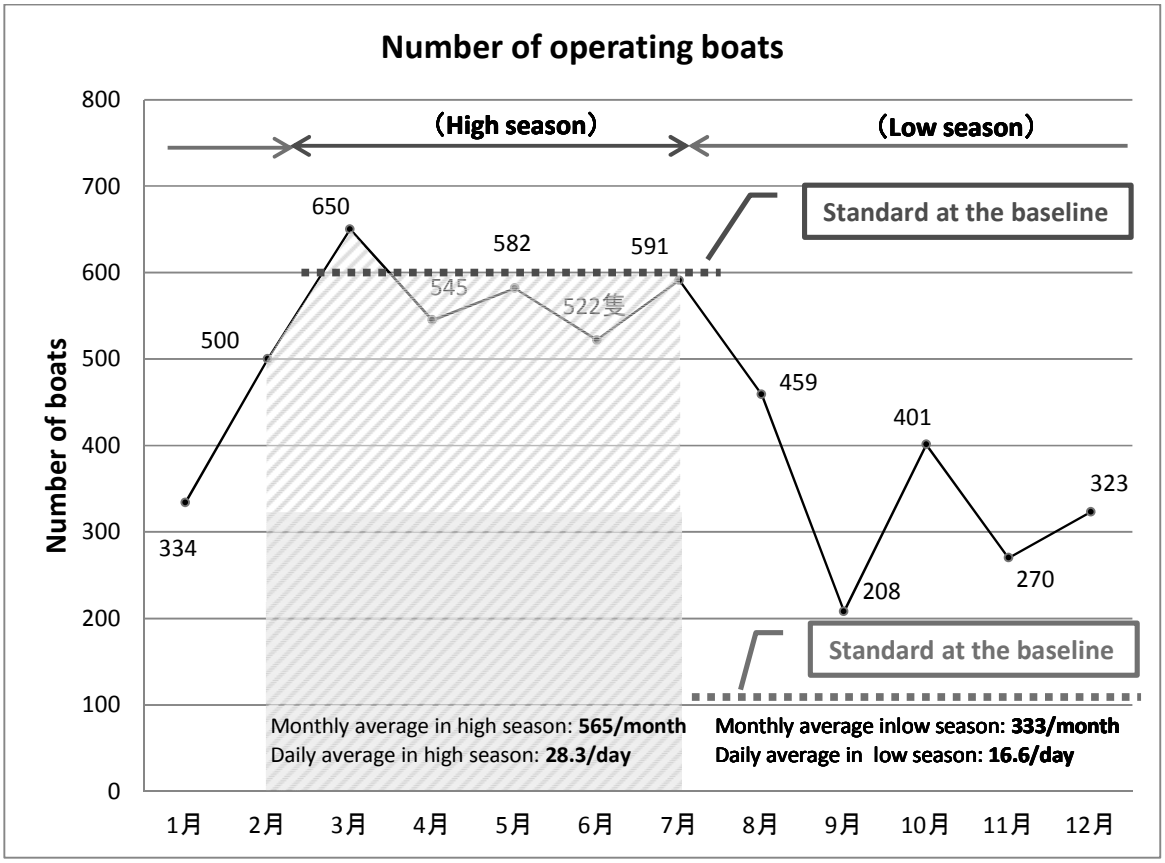
Based on this method, the number of landing inshore purse seiners per day was 6 vessels during low season and 42 vessels during high season according to the baseline study.

Although the number of registered large trawlers (joint venture vessels) is 9 vessels, the actual number that land each day is 1 to 3 vessels regardless of the fishing season. The average number of landing vessels is 2 vessels per day as listed in Table 2-2-2-1(3).

Based on the results stated above, the number of vessels that use the landing berths is 44 vessels per day during high season and 8 vessels per day during low season, shown as follows:

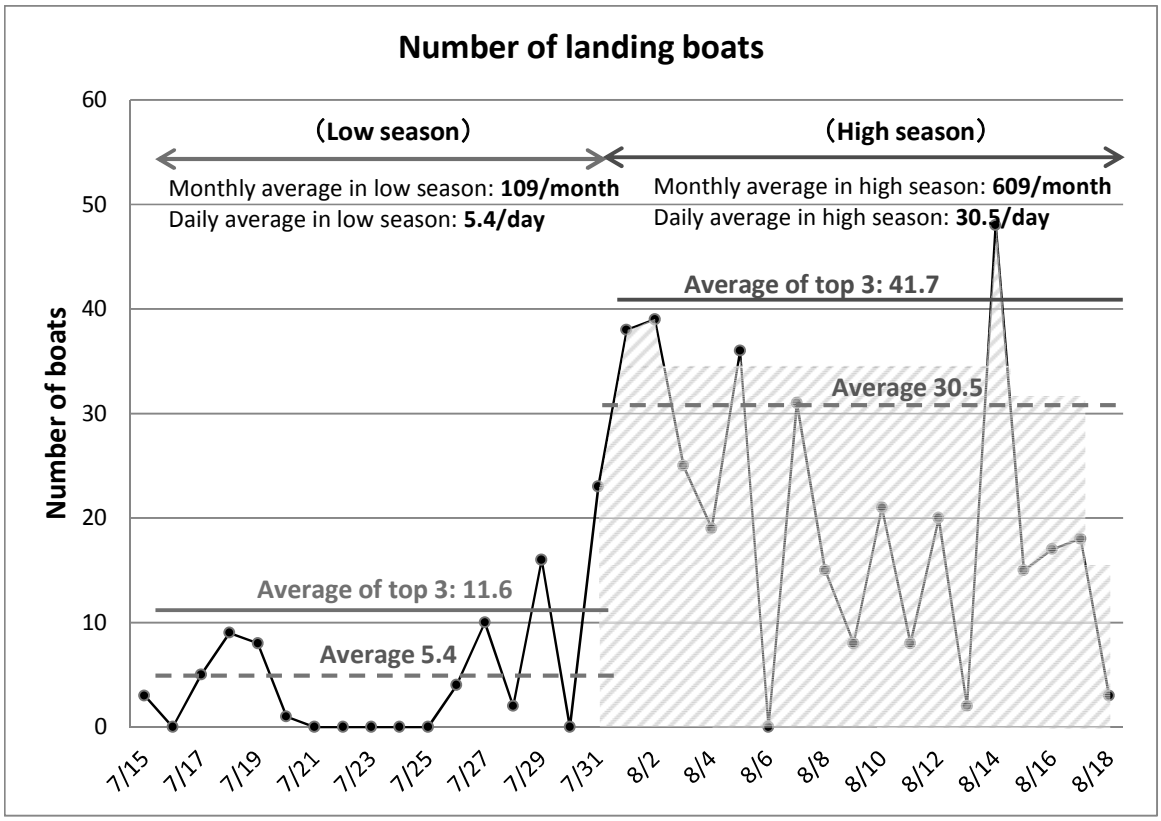
Table 2-2-2-1(5) Vessels for Landing Berths

	High season	Low season
1. Inshore Purse Seiners	42 vessels/day	6 vessels/day
2. Large trawlers	2 vessels/day	2 vessels/day
Total	44 vessels/day	8 vessels/day



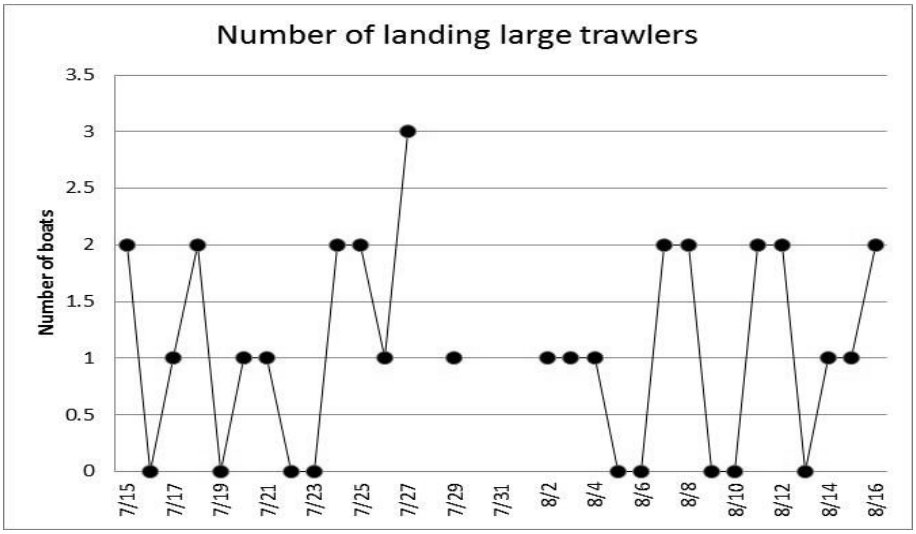
Source: Created based on MOFAD data from 2012

Figure 2-2-2-1(1) Monthly Number of Landing Inshore Purse Seiners (2012)



Source: Created based on MOFAD data from 2012

Figure 2-2-2-1(2) Number of Landing Inshore Purse Seiners (2013)



Source: Created based on data from the baseline study

Figure 2-2-2-1(3) Number of Landing Large Trawlers

(b) Landing Time

The average landing time of inshore purse seiners as estimated from the baseline study data is approximately 50 min. in high season and 55 min. in low season as shown below. Large

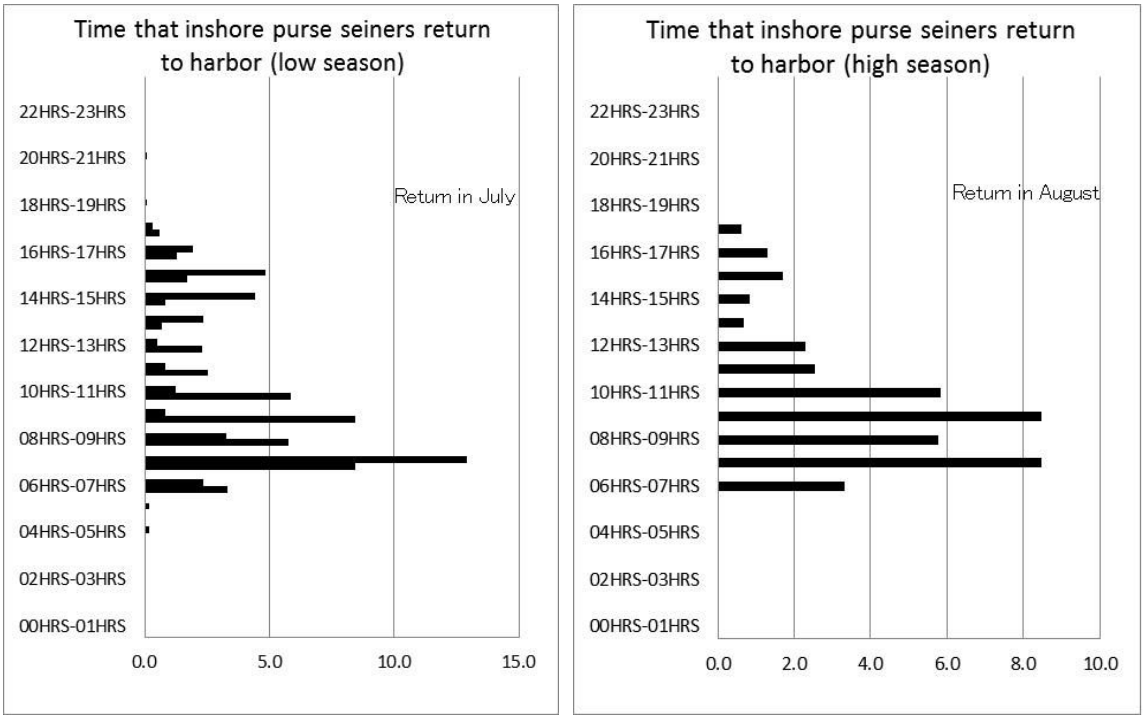
trawlers take from 3 to 4 hours as they are staying in the landing berth while fish are sorted on land. In this project, the landing time for large trawlers is set to a time similar to inshore purse seiners in order to maintain an equivalent operation with them.

The number of inshore purse seiners coming back to the harbour shows that they are active from 6:00 a.m. to 6:00 p.m. regardless of the fishing seasons. The peak landing time is six hours from 7:00 a.m. to 1:00 p.m.

Table 2-2-2-1(6) Landing Times of Inshore Purse Seiners

	July (low season)	August (high season)
Average landing time of inshore purse seiners	0.91 hrs. (54.7min.)	0.82 hrs. (49.4 min.)

Source: Created based on data from the baseline study



Source: Created based on data from the baseline study

Figure 2-2-2-1(4) Port Return Time of Inshore Purse Seiners

4) Basic Quantities for Preparation Berths

(a) Number of Vessels for Preparation Berths

Preparation berths are usually used by fishing vessels that are resuming fishing after time off or non-operation and are loading nets, or vessels of repeated fishing operation are refueling, loading water and ice. Landing and preparation are on-going in the lay-by wharf constructed in Phase I with the basic cycle of operation, landing and preparations in high season.

For this reason, the number of fishing vessels intended to use the preparation berths shall be

set as the same number of available berths in this project.

Table 2-2-2-1(7) Number of Vessels for Preparation Berth

	High season	Low season
1. Inshore purse seiners	42 vessels/day	6 vessels/day
2. Large trawlers	2 vessels/day	2 vessels/day
Total	**44 vessels/day**	**8 vessels/day**

(b) Preparation Time

Currently, the fishing vessels refuel and stock up on water, ice and food as soon as they land and then leave once they are done. In the baseline study, the average preparation time was from 1.5 hours to 2.5 hours according to the logbooks and interviews. Mooring time from landing to completion of preparation measured in the baseline study was approximately 2 hours on average. As the results from the logbooks and interviews were not time description that were actually measured but depended on individual senses, the preparation time was calculated by subtracting the time required for landing from mooring time needed for landing and preparations.

According to the results from the baseline study, the time needed for landing was 49 min. in high season and 55 min. in low season. Therefore, once the preparation and landing berths are clearly segregated, work should become efficient with times shortened by 70 min. (from 2 hours to 50 min.).

Table 2-2-2-1(8) Preparation Times

Baseline study	July (low season)	August (high season)
Average preparation time of inshore purse seiners	70 min./vessel	70 min./vessel

Note: Large trawlers will be treated the same as inshore purse seiners.
Source: Baseline study

5) Required Berth Lengths

Required berths comprising landing berths and preparation berths shall be estimated from the aforementioned specifications. The berthing alignment shall be 4 rows for crosswise berth or 2 rows for lengthwise berth, accounting for current situations.

Large trawlers currently occupy approximately 50 m of the berths, which is a problem in terms of operation. However, they are treated the same as inshore purse seiners in this project. Moreover, as large trawler fish holds are located in the bow, as same as inshore purse seiners, the landing berth and preparation berth for large trawlers shall be aligned crosswise in principle. Furthermore, use for vessel resting shall be set as “mooring offshore outside of the harbour,” the

same as it is now.

(a) Landing Berths

The required landing berth length will be 117 m in high season and 47 m in low season as shown in Table 2-2-2-1(9).

Table 2-2-2-1(9) Required Landing Berth Lengths

Landing berth	Season	Average boat length	Berthing alignment	①Average length of 1 berth (1.15L)	②Number of using vessels /Day	③Usage time for berthage	④Usage time for 1 berthing	⑤Rotation (③/④)	⑥Number of berthages needed (②/⑤)	⑦Required length (①×⑥)
Inshore purse seiner (including trawler)	High season	14.5m	Crosswise	16.7m	44	6.00h	0.82h	7.317	7	117m
	Low season	20.4m	Crosswise	23.5m	8	6.00h	0.91h	6.593	2	47m

Note: As the required number of berth in low season is only two berths, the average vessel length of large fishing vessels was referred.

(b) Preparation Berths

The required preparation berth length will be 117 m in high season and 47 m in low season as shown in Table 2-2-2-1(10).

Table 2-2-2-1(10) Required Preparation Berth Length

Preparation berth	Season	Average boat length	Berthing alignment	①Average length of 1 berth (1.15L)	②Number of using vessels /Day	③Usage time for berthage	④Usage time for 1 berthing	⑤Rotation (③/④)	⑥Number of berthages needed (②/⑤)	⑦Required length (①×⑥)
Inshore purse seiner (including trawler)	High season	14.5m	Crosswise	16.7m	44	8.00h	1.17h	6.857	7	117m
	Low season	20.4m	Crosswise	23.5m	8	8.00h	1.17h	6.857	2	47m

Note: As the required number of berth in low season is only two berths, the average vessel length of large fishing vessels was referred.

(c) Lay-by Berths (Resting Berths)

The number of inshore purse seiners that need lay-by berths is 106 vessels out of registered vessels in high season and 70 vessels in low season, and in principle will mean “offshore mooring in the harbour” for this project. However, much of the harbour water basins are already navigated by many inshore purse seiners and fishing canoes, leading to the current congestion. Effective use of the existing breakwater as the berth may help to mitigate congestion.

The breakwater improvements will add 180 m in berth length as described below, and the space will be used as preparation and lay-by berths. The breakwater length used as preparation berths will be 69 m in high season and 0 meters in low season. Therefore, as shown in Table 2-2-2-1(11), length used as lay-by berths would be 86 m in high season and 155 m in low season.

The possible number of resting vessels would be 12 vessels (3 berths, 4 rows) in high season and 24 vessels (6 berths, 4 rows) in low season. Lay-by berth length ro be used is different in high season and low season for management purposes, with berth length in high season shall be the base of use to avoid user confusion.

Table 2-2-2-1(11) Length Allocated to Lay-by Berths

Lay-by berth	Effective use of the lay-by berth along breakwater					Number of offshore mooring vessels
	Extended berth length	Preparation berth	Corners	Lay-by berth	Number of berthing vessels	
High season	180 m	69 m	25 m	86 m	12	52
Low season	180 m	0 m	25 m	155 m	24	40

(2) Basic Plan for Additional Lay-by Berths along Breakwater

1) Facility Allocation Planning

The required functions for the existing breakwater are preparation and resting, and the preparation berths are given higher priority. The remaining portion of the existing breakwater can be used as resting berths after subtracting the necessary area for preparation berths. In short, the 69 m of improved breakwater in high season can be used as preparation berths (approximately equal to 4 berths) and the rest of the extended area, which is 86 m4 (equal to 4 berths) can be used as resting berths. However, as there is only enough space for 16 inshore purse seiners out of 64 vessels in the harbour, the remaining 48 vessels need to rest in or out of harbour.

As approximately 20 m portion at the head of the existing 200 m breakwater is affected by rough wave due to wave diffractions, 180 m shall be utilized as berths.

(a) Corners between Existing Breakwater and Landing Berths

As the space for new berths to be made through breakwater improvement overlaps with existing landing berths, the space for new berths will be 25 m away from the base of the breakwater as shown in Figure 2-2-2-1(5).

<Allocation Plan for Breakwater Facilities in High Season>

- Preparation berth: 69 m
- Lay-by berths: 86 m
- Corners: 25 m

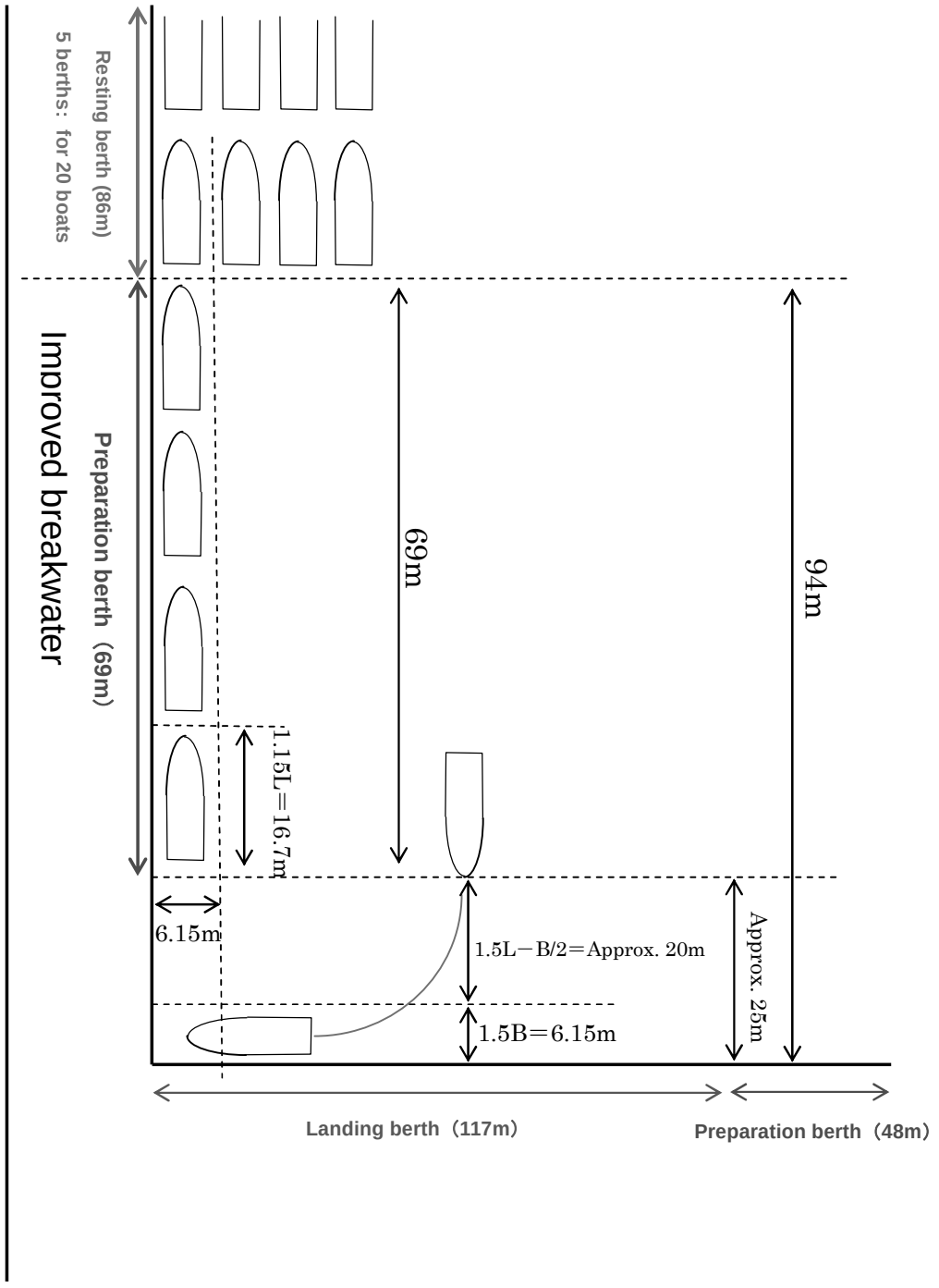


Figure 2-2-2-1(5) Berth Allocation in High Season after Breakwater Improvement

< Allocation Plan for Breakwater Facilities in Low Season >

- Preparation berth: 0 m
- Lay-by berths: 155 m
- Corners: 25 m

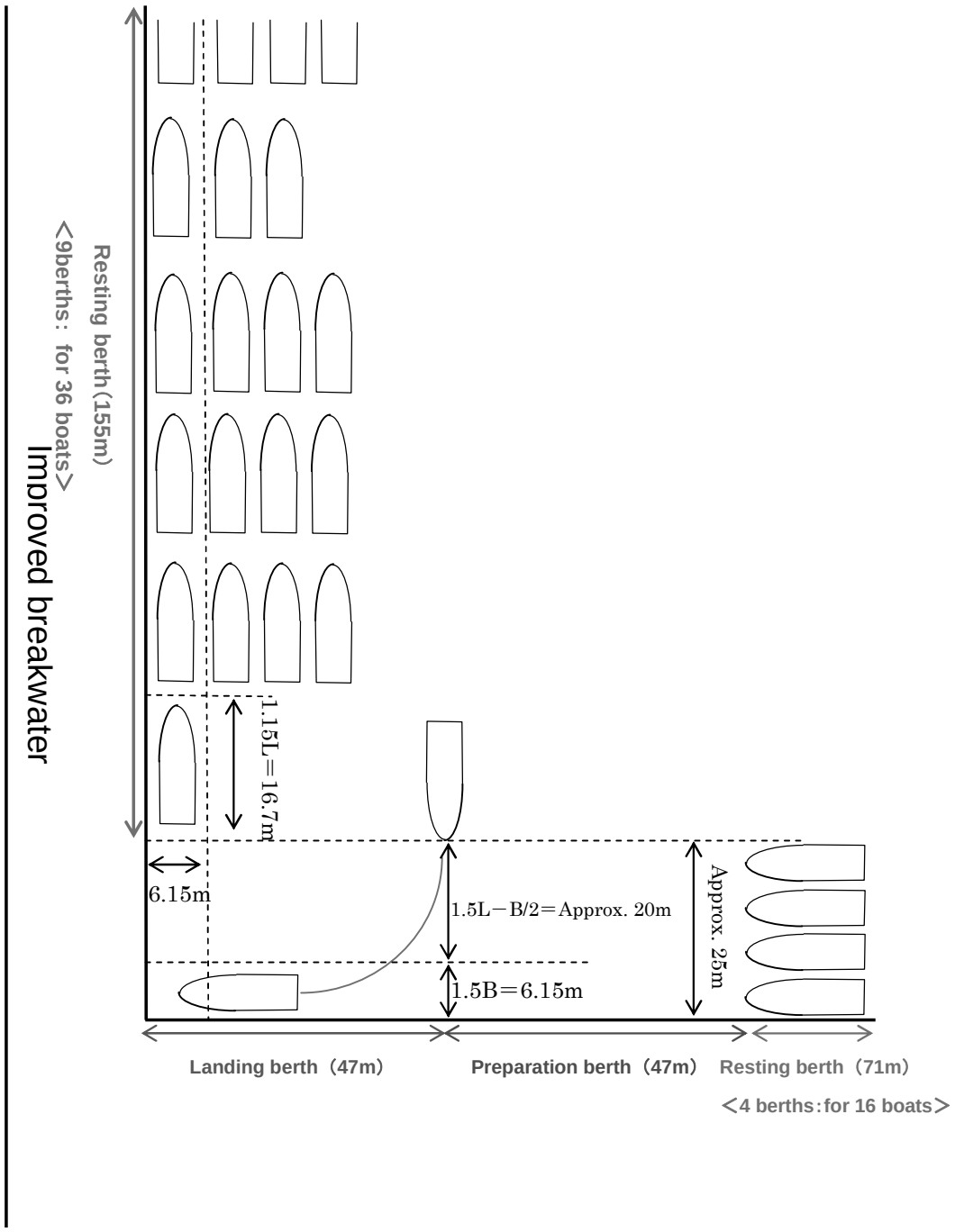


Figure 2-2-2-1(6) Berth Allocation in Low Season after Breakwater Improvement

(b) Breakwater Head

Due to various impacts on the breakwater head from waves of multi-direction including wave diffraction, harbour construction standards recommends that waves of 50% higher for this area are applied than other places. As summarized in the section of "Natural Conditions", results from wave tranquility analysis around the head show the wave height ratio to the incident wave as 1.25 : 1. Furthermore, wave height ratios exceed 1.00 in many places where vessels were damaged due to wave actions around.

Therefore, based on the results from wave tranquility analysis, the 20 m from the breakwater head shall not be used as berths.

(c) Offshore Mooring

Through this project, improving the breakwater will allow 12 inshore purse seiners (registered vessels) in high season and 24 in low season to berth along the breakwater. However, this will leave 52 vessels (=106 - 44 - 12) in high season and 38 vessels (=70 - 8 - 24) in low season anchored either inside or outside of the harbour.

The area shown in Figure 2-2-2-1(7) should ideally be secured as the anchoring area with the following conditions:

- Water depth enabling to secure more than 0.8 m in an unladen draft
- Calm water basin of less than 60 cm of anchorage critical wave height equivalent to wave height ratio lower than 60% based on the tranquillity analysis results
- Current anchorage water basins, such as water basins outside of harbour utilized by mainly large fishing vessels

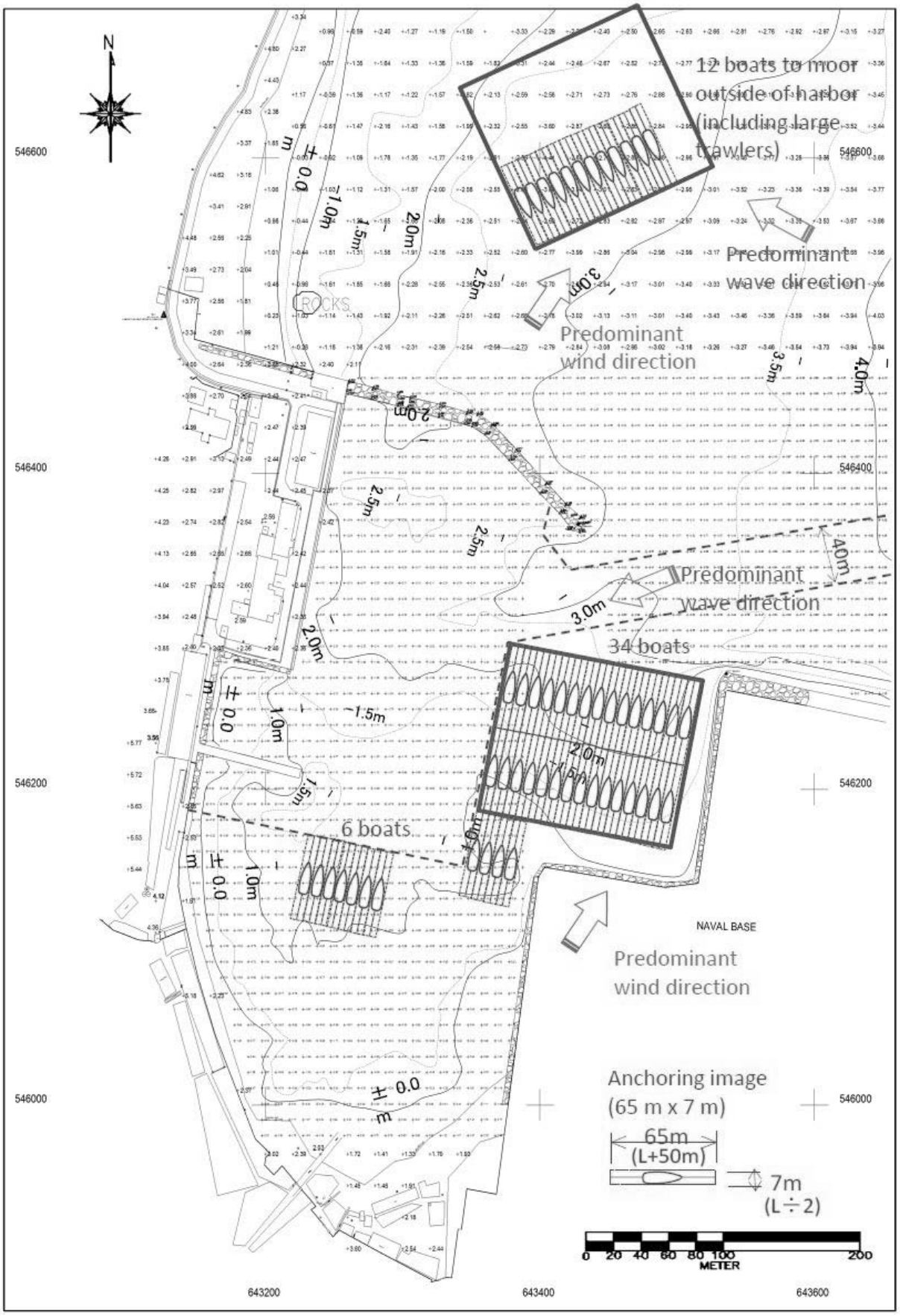
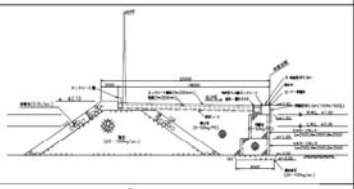
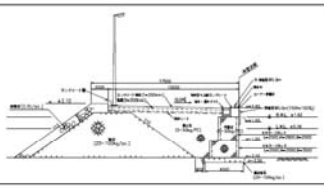
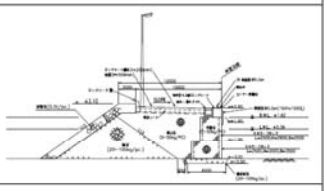
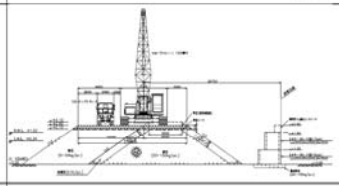
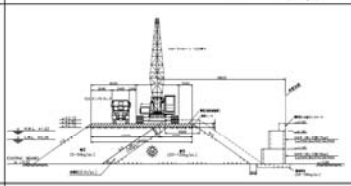
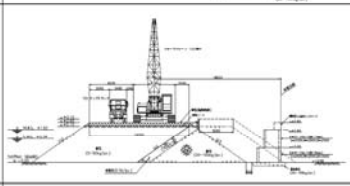


Figure 2-2-2-1(7) Offshore Berth Allocation in High Season

2) Crown Width

Three alternate plans such as Case 1: 18-meter width, Case 2: 15.5-meter width and Case 3: 10-meter width were considered and compared in terms of economic efficiency, workability, and usability for the crown width of the existing breakwater. The alternatives offer two main approaches: to install a berth block at the end of the existing rubble mound breakwater, or to narrow the width and remove the rubble mound breakwater. Although there is no significant difference between Cases 1 and 2 for cost effectiveness, Case 2 was rated highly overall as the cost was slightly lower than Case 1. Case 3 looks cheap as it has the narrowest crown width on the complete cross section, but ends up being the most expensive as the existing breakwater must be removed before making a new breakwater and berth.

Table 2-2-2-1(12) Comparison of Alternate Breakwater Crown Width

Used levee crown Items	Case 1: 18-meter levee crown width	Case 2: 15.5-meter levee crown width	Case 3: 10-meter levee crown width
Standard cross section			
Construction cross section			
Standard quantities	Remove existing coated stones 1,040 m3 Remove existing rubble stones 0 m3 Store rubble stones (temporary roads) <appropriate> 0 m3 Store rubble stones <new materials> 8,160 m3 Remove rubble stones (temporary roads) <appropriate> 7,617 m3 Remove rubble stones (temporary roads) <carryout> 544 m3 Sand prevention sheet (under base course) 2,560 m2 Base course 768 m3 Concrete pavement 512 m3 Rebar 25.6 t	2,509m3 0m3 0m3 8,160m3 6,927m3 1,233m3 2,160m3 648m3 432m3 21.6t	2,540m3 4,456m3 4,456m3 8,192m3 6,706m3 5,942m3 1,280m3 384m3 256m3 12.8t
Delivery time	Standard (5 points)	Almost the same as Case 1 (5 points)	Approx. 2 months more than Case 1 and Case 2 (2 points)
Economic efficiency	1.0 (4 points)	0.9 (5 points)	1.3 (2 points)
Workability	• Crawler cranes and dump trucks for transportation shall work on the construction. • Secure a temporary road outside the existing breakwater. The road can be used for backfill material for the berths after erecting the blocks. • There are few existing coated stones that need to be removed and is no need to remove rubble stones. Therefore, delivery time is shorter by approximately two months compared to the Case 3. (5 points)	• Crawler cranes and dump trucks for transportation shall work on the construction. • Secure a temporary road outside the existing breakwater. The road can be used for backfill material for the berths after erecting the blocks. About 600 m3 has to be carried out compared to Case 1, but this can use for the slipway. • There are few existing coated stones that need to be removed and is no need to remove rubble stones. Therefore, delivery time is shorter by approximately 1.5 months compared to Case 3. • The construction cost is lower than Case 1 because of lower costs for base course and concrete pavement. (5 points)	• Crawler cranes and dump trucks for transportation shall work on the construction. • Remove coated stones and rubble stones from the existing breakwater after securing a temporary road outside of the existing breakwater, and use it as widening material for the temporary road. It will be used as a backfill material after erecting the blocks for the berths. However, the material amount to be carried out is almost six times more than Case 1 and Case 2. • The existing coated and rubble stones can be used for the temporary road. However, it takes time to appropriate them and carry them out. For this reason, delivery time is approximately two months longer than Case 1. • The cost of materials is lower than Case 1 and Case 2. However, the comprehensive cost is expensive as the crawler cranes usage period is long. (3 points)
Usability	• As the berth line matches the line of the existing road that is next to the fish handling shed, the accessibility from the back end is smooth. • Case 1 secures the upmost levee crown width and therefore there would be sufficient room for net mending and storage at the back end of the berths. • The safety for vehicles can be guaranteed the most with sufficient road width. (5 points)	• The berth line does not match the line of the existing road that is next to the fish handling shed. However, accessibility from the back end is relatively smooth compared to Case 3. • The crown width is narrower than Case 1. However, the land used for fishery behind the berth is almost equal to Case 1. • It is possible to guarantee almost the same width as Case 1 by defining the width for the preparation and net-mending area. (5 points)	• As the berth line does not match the line of the existing road that is next to the fish handling shed, the accessibility to the back end is ineffective and the worst among these three cases. • This is the narrowes terown width , with 10 meters at the apron, and only four to five meters can be secured when vehicles enter the net mending area. (3 points)
Overall evaluation	(19 points)	(20 points)	(10 points)

Note: Each item is rated on a 5-point scale. More points earn a higher evaluation.

Based on the comparison results above, Case 2 of t15.5 m crown width is selected.

The back end of a berth is usually configured as an apron, and a width of 10 m is recommended according to Japanese Standards ("Guidebook on Planning for Fishing Harbor") as a place for landing and preparation. At the existing lay-by wharf, nets and small boats are placed on the 10 m apron and the nets are repaired in low season. Furthermore, there is a 6 m wide road behind the apron used to carry ice and fishing gears necessary for preparation. Taking these facts into account, the 10 m crown width for preparation works is considered appropriate.

This project, with consideration to the current usage situation, plans to utilize the back side of the lay-by berth as a net storage area during high season. The preparation berth apron will only allow preparation work and will not be permitted for use as a storage place for fishing nets or other fishing gear.

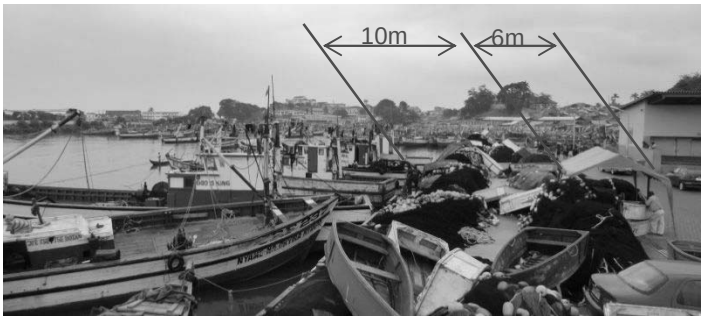


Figure 2-2-2-1(8) Situation of Existing Preparation Berths

3) Berth Crown Height

The crown height of the preparation and resting berth shall be established based on vessel freeboard height. Not all fishing vessels were surveyed for freeboard height, but the freeboard of a 20 m inshore purse seiner that was preparing and resting was about 1.6 m at the centre. Combining this freeboard heights with the relationship of tide level shown in Figure 2-2-2-1 (9), the crown height utilized on the tide level at MSL shall be determined at +2.6 m above Datum Level with the increasing vessel sizes.

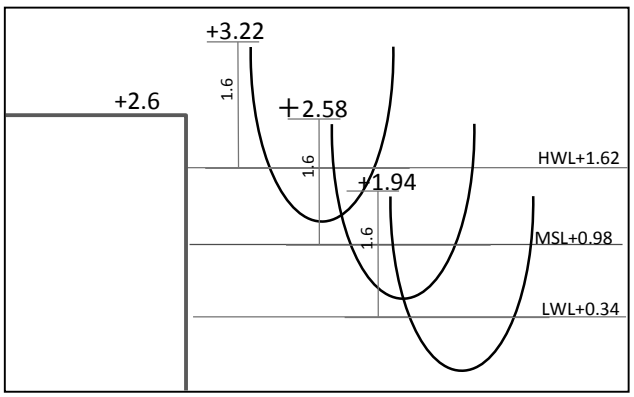


Figure 2-2-2-1(9) Crown Height of Berth

4) Water Depth

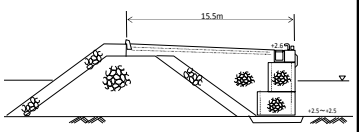
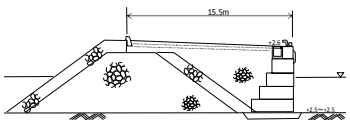
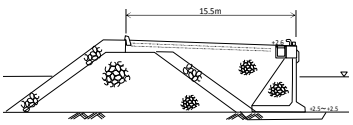
The water depth shall be set as -2.0 m based on the sounding survey and drafts of target vessels.

5) Sectional Structure

Sub-soil geological surveys showed that there is a layer of strong weathered sandstone that is N value of more than 50 from 2 to 4 m underneath the sea bottom. As it is difficult to drive piles or sheet piles into the ground, the berth structure will be a gravity type. For land-based construction, large crawler cranes are needed to install the concrete blocks that are the foundations for the berths from the existing breakwater as the first stage of the construction work.

Three structure types are compared for workability, economic efficiency and construction period as shown in Table 2-2-2-1(13). It was determined that the cellular concrete block system was the cheapest and as effective as the other two systems. The cellular concrete block system shall therefore be adapted for the cross-sectional structure.

Table 2-2-2-1(13) Comparison of Breakwater Berth Alternatives

Structure / Items	Cellular block piling system	Concrete block system	L-shaped block system
Standard cross section			
Gross outline of quantity	Concrete precast (M3) 968 Making and installing blocks (No) 145 Standard block weight max. (T) 17	2,219 362 18	788 46 50
Construction method and major construction equipment	・The concrete volume and number of blocks required are around 40% of the block piling system. There is no difference in concrete volume compared to the L-shaped block system. ・Compared to the concrete block system, it takes longer to make blocks but the number is less than half. ・It is cheaper than the concrete block system as low price stones can be used as packing material. ・A crawl crane (100 t) is necessary.	・Requires the largest concrete volume and number of blocks. (fresh concrete and cement are expensive) ・Does not take long to make blocks, but the number of required blocks is large and hence more to install. ・A crawl crane (100 t) is necessary.	・The least volume of concrete and number of blocks required, but the weight of blocks would be heavy. ・A crawl crane (300 t) is necessary. A 50t crane would be required even if surface construction (salvage barge) was chosen.
Economic efficiency	1.0	1.3	1.3
Construction Period	1	1.2	1.1
Evaluation	◎	○	×

(3) Basic Plan for Access Driveway with Canoe Berthing Function

1) Usage Plan

The access driveway to the project site developed in Phase I (South Revetment) and to the canoe jetty was developed as a pedestrian road with a length of 66 m. Moreover, the pavement is interlocking block type.

This project plans to extend the access driveway from Sekondi Fishing Harbour to as close as possible to Old Beach, expand it for vehicle use and add space for fishing canoes to lay up. The end of the access driveway (existing rubble stone revetment road) up to the old slipway was confirmed with GPHA in the baseline survey and the extended length from the canoe jetty will be approximately 250 m.

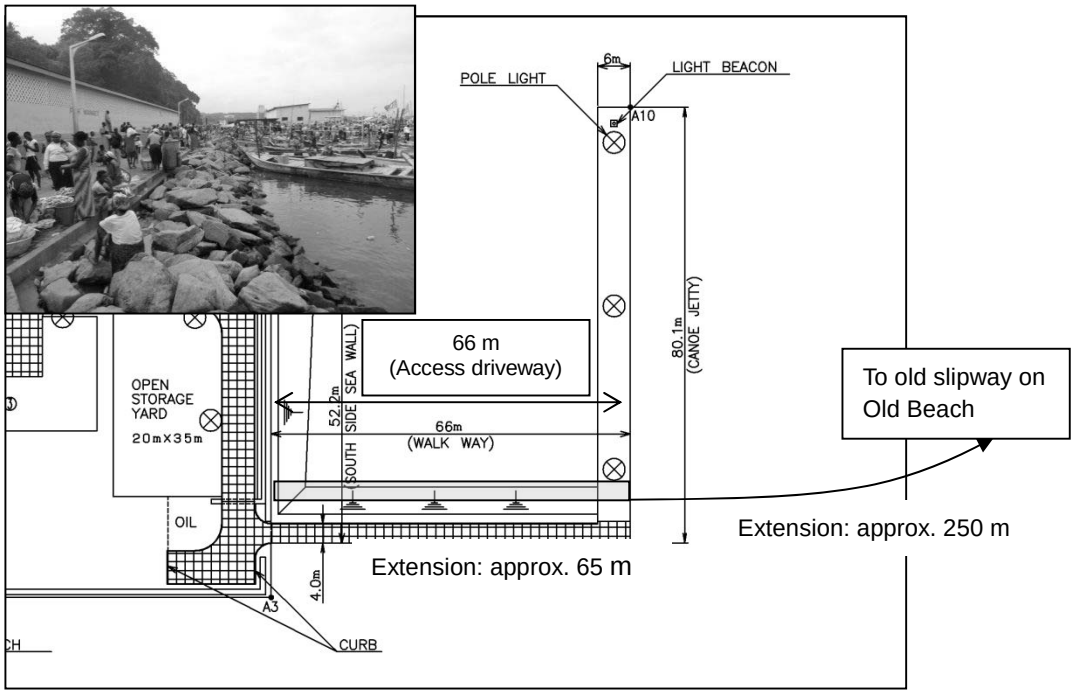


Figure 2-2-2-1(10) Access Driveway behind Canoe Jetty Constructed in Phase I

2) Driveway Width

The access driveway to the project site developed in Phase I (South Revetment) and to the canoe jetty was developed as a 4 m wide pedestrian road. The image shown in Figure 2-2-2-1(10) was taken on a non-fishing day during high season in August. Once fishing operation starts, many fishermen, fishmongers, and consumers gather to buy, sell, and transport the fish as well as make preparations for the next departure. This congests the road, making the width of the access driveway too narrow in high season.

This project will expand the driveway not only for pedestrians but also for vehicles. Considering workability and economic efficiency, left-in-place of the existing seawalls is the cheapest and fastest construction methodology. The total width of existing road and the covering crown width is 7 m. A width of at 5 m is necessary for the backhoes, crawler cranes

and dump trucks used in the construction, and a 2 m buffer width would be required considering the work area and the stable ground slope during construction works. Based on this, the expansion width for this project shall be set to 7 m. After construction, the expanded 7 m width shall be allocated as follows:

Vehicle Width: 5 m
Pedestrian Width: 2 m Total Driveway Width: 7 m

3) Crown Height

The crown height of the existing access driveways has been set to the same +2.6 m height of the landing berths and the preparation berths. The existing rubble stone revetment driveways (unpaved) lead to Old Beach from the installation area height of +2.6 m, with the crown height gradually dropping to a height of +1.8 m in the vicinity of the old slipway.

In terms of use, pedestrian and vehicle traffic lines should be kept the same height as existing roads whenever possible. Additionally, the aprons height of lay-by berths for fishing canoes should be lowered at the crown whenever possible for the sake of work efficiency. On the other hand, the fishing harbour has a high water level of +1.62 m and low water level of +0.34 m, with a highest high tide of approx. 1.80 m. This means that a crown height of +1.8 m could potentially lead to the flooding of driveways in the vicinity of the old slipway. Thus, crown height has been set at +2.00 m in this project.

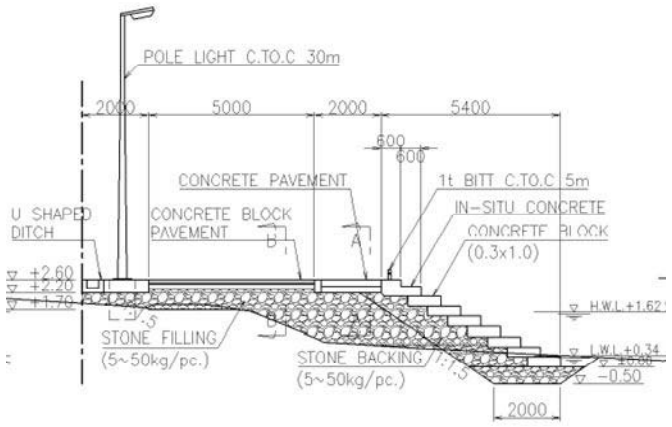
4) Sectional Structure

As shown in Figure 2-2-2-1(11), the sectional structure for the access driveway has been divided into three sections: (a) near the canoe jetty, (b) centre, and (c) near the old slipway.

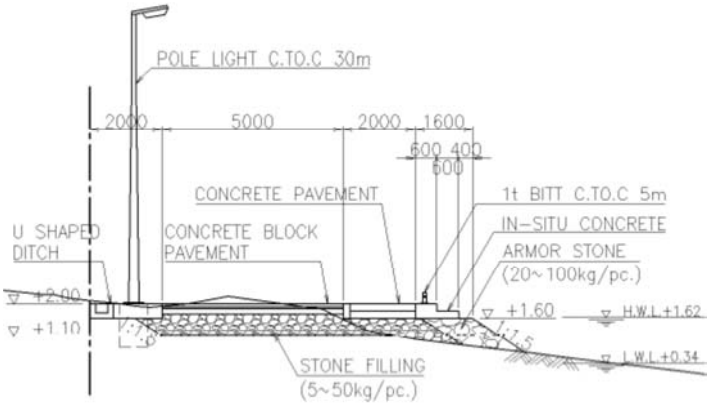
Interlocking pavement will be used on the driveway in order to establish a sense of unity between them and existing harbour pavement.

Further, as fishing canoe berthing facilities are to be added to the front of the driveway in the area where the water depth required for fishing canoe mooring can be secured. Stepped revetments and bollards to allow for easy access to fishing canoes will be equipped along. Rubble stone revetments will applied for shallow water areas, but bollards are also planned for installation as fishing canoes can moor during high tide levels.

(a) Access Drivewav near Canoe Jettv



(b) Access Driveway Centre



(c) Access Driveway near Old Slipway

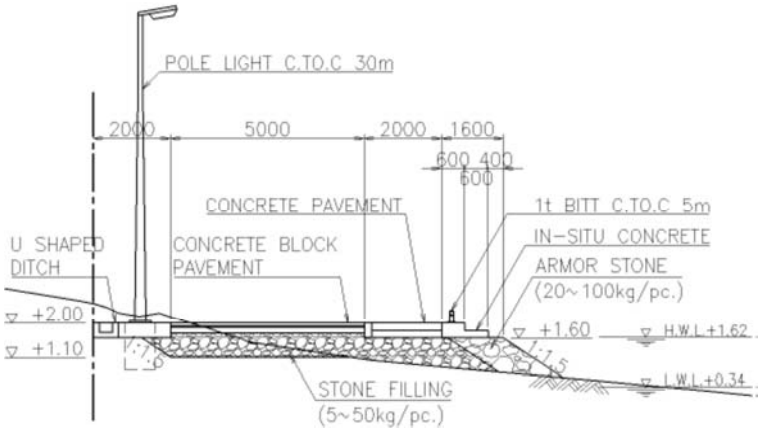


Figure 2-2-2-1(11) Standard Cross-Section of Access Driveways
(w/ Fishing Canoe Berthing Function)

5) Number of Fishing Canoes to Be Moored (for Reference)

If fishing canoes with outboard engine are berthed nose in along the access driveway extension of approx. 200 m, with an assumed average width for medium-sized fishing canoes being 1.3 m, 1.5 vessels would occupy approx. 2 m of width, allowing up to approx. 100 fishing canoes (=200 m / 2 m) to be moored. The use of the berths are intended as resting berths.

2-2-2-2 Land Facilities and Equipment

(1) Layout of Land Facilities and Equipment

1) Layout Plan Concepts

In Phase I Project, land area was reclaimed on rocky sea area in front of a cliff behind the land portion of Sekondi Fishing Harbour. The southern end of the berth for inshore vessels extends approx.. 185 m to the breakwater crown in the north, and the eastern landing and lay-by whaf extend approx. 70 m to the drainage installed at the foot of the mountain cliff, forming an almost rectangular shape. Facing the berths to the east, the fish handling shed, the administration office and the ice plant are located in order from north to south, with the area south of the ice plant used as open net yard.

In this project, the paved area behind the fish handling shed will be expanded to add parking for carrying out vehicles. Plans also call for expansions to the areas west of the administration office and ice plant.

A lack of space and suitable locations leaves no choice but to place them as planned. Ancillary facilities will generally be located on the unoccupied grounds west of the main facilities.

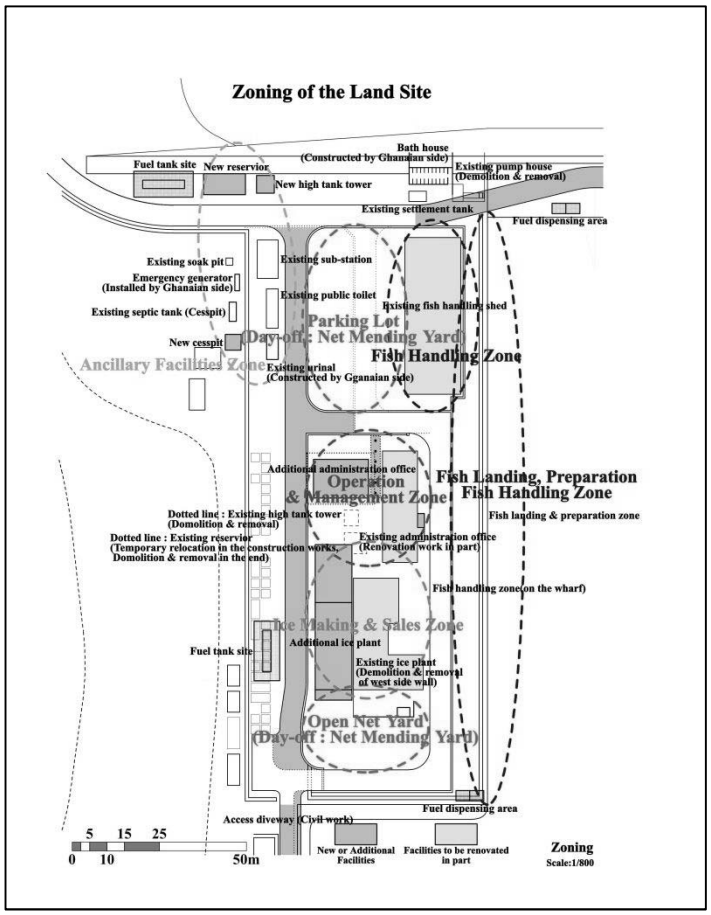


Figure 2-2-2-2(1) Zoning of Land Facilities and Equipment

The fuel tank site for the inshore vessels will be placed at the base of the breakwater near the entrance. The trench for fuel piping will be installed between the sites planned for fuel dispensing area on the new lay-by wharf along the breakwater extension. An area below the west cliff where many fuel tanks are currently located has been designated as fishing canoe fuel tank site. New trenches will be installed between existing trench to connect the new to the old.

Thus, the layout of the land facilities and equipment is divided into the following zones: the fish landing, preparation and fish handling zone on the berth side; the central facility zone which includes the fish handling shed, administration office, ice plant, open net yard and parking lot (net mending area); and the zone closest to the mountain, which serves as the location for ancillary facilities.

2) Layout Plan for Pavement behind Fish Handling Shed and Connecting Roads

(a) Scale of Expanded Paved Area behind Fish Handling Shed (Parking Lot)

The paved expansion behind the fish handling shed will be made into a parking lot for vehicles that will carry out fish products landed and sorted at the harbour and will be outfitted for loading work.

Vehicles used to carry out fish products will include taxies, pickup vans, and small trucks. In each of these cases, the transport container will be the same type of aluminium pan (tub-shaped object) that is used for fish landing and sorting. Taxies, the vehicles most commonly used for carry out, are normally loaded with four large pans, though some can occasionally load five to six pans. A single large pan can accommodate approx. 90 kg of fish product, meaning that a single taxi load (transported amount) comes to approx. 360 kg.

The average daily landing volume of inshore vessels during the latter half of the baseline survey corresponding to high fishing season came to 30.4 t, while MFRD statistics (2008-2010) on the average daily landing volume of fishing canoes came to 20.5 t. This means that a total of 50.9 t a day is carried out from the harbour. If everything are to be carried out of the harbour by taxi, 141.3 taxis would be required to accommodate a load of 50.9 t in a day.

As given in Figure 2-2-2-2(2), however, the extensible space on the west side of the existing fish handling shed will allow for an additional 31 parking spaces. This comes to enough space for 47 vehicles when combined with the existing parking lot. Furthermore, the layout for this parking lot provides 3.0 m space for each adjacently parked vehicle, with each parking spot spaced 3.3 m apart to allow for the loading works of fish products. The amount of space provided for loading comes to approx. 5 m^2 per vehicle.

Among the 47 total parking spaces, the existing 16 spaces will continue to be used for ordinary vehicles, including those of fishing vessels crews. Assuming that carrying out vehicles use the two-row expansion of 31 spaces, 141.3 vehicle loads can be handled in approx. 4.5 turns a day. As described in the chapter of the basic plan on civil facilities, most inshore vessels return to harbour over a 6:00 am in the morning. It is concluded that this is more than enough time to achieve the 4.5 turns required.

Thus, as shown in Figure 2-2-2-2(2), this project will pave all available space west of the existing fish handling shed. The area of this expansion comes to approx. 700 m^2.

(b) Pavement Plan behind Fish Handling Shed and Layout Plan of Connecting Roads

The inner road in the harbour enters from the northwest and moves along the west side of the fish handling shed toward the inshore vessel's wharf. In this project, the area west of the fish handling shed will be paved to expand parking lot. Thus, the road that falls within the dotted line portion will be relocated toward the existing sub-station and public toilet on the west side and travel around the expanded parking area on its way to the wharf for inshore vessels. The areas of road shaded in gray in the figure indicate inner road additions and changes in this project.

The existing road to the west of the fish handling shed (outlined with dotted lines) will be used as is a part of the parking lot. The inner road that will be relocated from the dotted line portion toward the existing sub-station will proceed due south along the west side of the additional administration office and connect with the access driveway to Old Beach, which will be developed as civil facilities for the project.

The width of the new road and access driveway will be 6 m, the same as the existing inner road, and will have gutters installed on one side to prevent drainage.

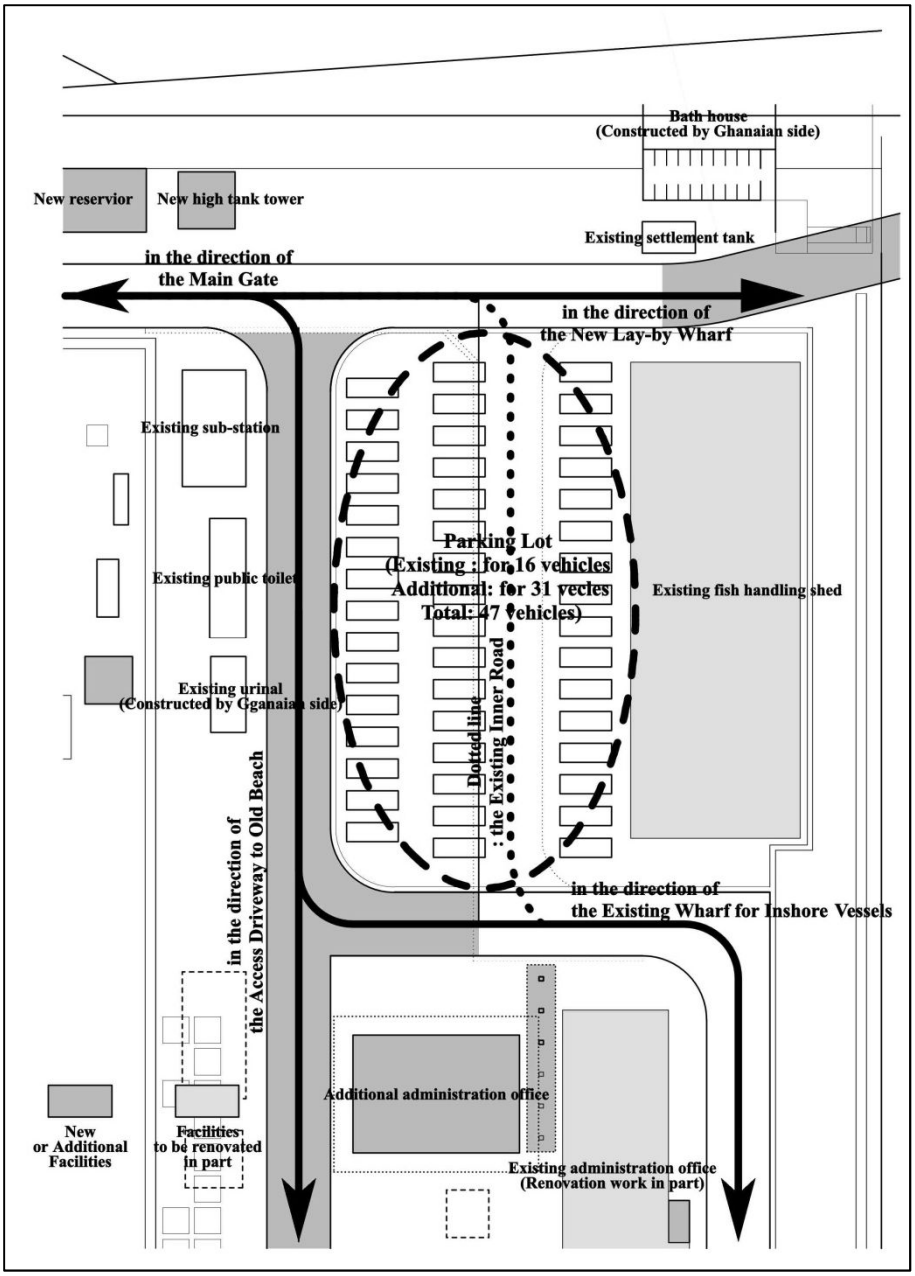


Figure 2-2-2-2(2) Layout Plan of Parking Lot, Pavement and Detour Roads

(2) Plan of Additional Ice Plant

1) Scale of Ice Plant Expansion

This project is set to enhance existing facilities and equipment, so the supply-demand gap

and scale of enhancement requirement are calculated based on how the facilities and equipment are used and on the actual values available whenever possible. The following estimates are made in accordance with the basic policies described previously.

(a) Ice Demands of Inshore Vessels and Canoes

(i) Ice Loading Amount of Fishing Vessels and Canoes

The ice loading amount for inshore fishing vessels and canoes using Sekondi Fishing Harbour are set as followings.

First, ice sales records from the existing ice plant are classified by sales volume to inshore vessels or sales to fishing canoes and aggregated. Estimations of the volume of ice sold to each type of vessel are then made based on interviews with the cooperatives of inshore vessel and canoe. During high fishing seasons, many inshore vessels and canoes use ice brought in from outside the harbour. However, the amount of said ice provided to each type of vessel remains unknown, so the ice loading amount of each type of vessel is set at an average sales volume of approx. 90% to avoid exceeding the maximum estimate. The result of these estimates is shown in Table 2-2-2-2(1).

Table 2-2-2-2(1) Sales Amount of Ice to Inshore Vessels and Canoes

	25 kg block ice sales volume	Number of vessels	Average block ice sales/vessel	Vessel type (assumed)	Average number of block ice
Canoe A	1,317	26	46.8	Hook & line canoes	42.1
Canoe B	169	10	16.9	Purce seine canoes	15.2
Canoe C	77	9	12.8	Gillnet canoes	11.5
Inshore Vessel A	36	2	18.0	Medium-sized inshore trawlers, medium-sized purse seiners	16.2
Inshore Vessel B	3,007	36	83.5	Large-sized purse seiners	75.2
Inshore Vessel C	2,150	5	430	Large trawlers	387.0
Others	158	36	4.3		
Total	6,812	Averaged daily sales volume: 757 ice blocks (18.9 tons)			

Notes:

1) Based on ice sales records (July 28 to August 5) from the Sekondi Fishing Harbour ice plant
2) There was one non-fishing day between July 28 and August 5, so the actual study period comes to 8 days.
3) Though the production capacity of the ice plant is 600 pieces of 25 kg blocks/day, average daily sales of 757 blocks/day are achieved by combining the ice produced on a given day with ice stocked in the ice storage.

(ii) Number of Inshore Vessels and Canoes Operating by Fishing Season

i) Estimation of the number of operating inshore vessels and canoes

According to the baseline survey, each half of the survey revealed remarkablly different results in terms of the number of operating inshore vessels with the only exception being large trawlers, which remained stable between halves. The reason for this is supposed to be because vessels are adjusting their operations in response to the catch of inshore vessels, which can fluctuate greatly from season to season.

On the other hand, no major difference is observed in the number of operating vessels among large trawlers and canoes that focused exclusively on demarsal fish. In the case of canoes, the number of operating canoes fluctuates very little between seasons compared to that of inshore vessels, and even the high and low seasons differ from those of the inshore vessels. Based on the above, the ice demand of large trawlers and canoes based on the number of vessels operating throughout the fishing seasons is selected for estimation. The number of inshore vessels besides large trawlers operating during each respective fishing season will be examined.

Table 2-2-2-2(2) Numbers of Inshore Vessels and Canoes in Operation

	Baseline survey period	Total number of operating vessels	Total number converted to 20 days per month	Daily average number of operating vessels	Number of vessels for ice demand estimation
Fishing canoes	7/15-7/30	329	658.0	32.9	37.3 vessels per day
	7/31-8/15	516	814.7	40.7	
Inshore vessels	7/15-7/30	58	116.0	5.8	Examined hereafter
	7/31-8/15	386	609.5	30.5	
Large trawlers	7/15-7/30	14	28.0	1.4	1.4 vessels per day
	7/31-8/15	17	26.8	1.3	

ii) Number of Inshore Vessels in Operation by Fishing Season

MFRD of MOFAD has been monitoring the number of inshore vessels operating out of the harbour and has aggregated the results by month. Table 2-2-2-2(3) below shows the number of operating vessels observed in 2012 from the month with the highest total to the month with the lowest. As indicated in Table 2-2-2-2(2), there were 30.5 vessels operating each day when the harbour is at its busiest during the second half of the baseline survey, while there are only 5.8 vessels per day operating during the more stagnant first half. From this, it is concluded that the results of the baseline study and MFRD monitoring are in accord and reflect the actual state of the fishing activities.

Therefore, the results of MFRD monitoring is employed to estimate the ice demands of operating vessels for each of the seasons. Based on the results of MFRD monitoring, the average monthly operating vessels are set as 28.5 vessels during fishing season and 16.5 vessels during low season, for an annual average of 22.5 vessels.

Table 2-2-2-2(3) Monthly Number of Inshore Vessels in Operation (2012)

March	July	May	April	June	Feb.	Aug.	Oct.	Jan.	Dec.	Nov.	Sept.
650	591	582	545	522	500	459	401	334	323	270	208
32.5	29.6	29.1	27.3	26.1	25.0	23.0	20.1	16.7	16.2	13.5	10.4
Number of vessels operating during high season average: 565/month (28.3/day)						Number of vessels operating during low season average: 332.5/month (16.6/ day)					
Number of vessels operating annual average: 448.8/month (22.4/day)											

Note: Monitor Fishing Vessels Positional Analysis 2012, MRDF
The upper section shows converted operating vessels/month, and the lower section shows operating vessels/day. However, interviews to GIFA suggest that average operation days of inshore vessels is typically about 20 days/month.

iii) Summary of Number of Inshore Vessels and Canoes in Operation by Season

The total number of inshore vessels and canoes, the number of days each type is in operation, and the number of operating vessels per day for (i) and (ii) has allowed to convert the number and type of inshore vessels and canoes operating in each season as follows.

< Fishing Canoes >

- Annually: fishing canoes: 3.3 per day, purse sein canoes: 13.0 per day, gillnetting canoes: 21.0 per day total: 37.3 per day.

< Inshore Vessels >

- High Season: Medium-sized inshore trawlers: 2.0 per day, medium-sized purse seine vessels: 12.0 per day, large purse seine vessels: 14.5 per day
  total: 28.5/day.
- Low Season: Medium-sized inshore trawlers: 1.5 per day, medium-sized purse seine vessels: 8.0 per day, large purse seine: 7.0 per day
  total: 16.5/day.
- Annual Average: Medium-sized inshore trawlers: 1.5 per day, medium-sized purse seine: 10.5 per day, large purse seine: 10.5 per day
  total: 22.5 per day.

< Large Trawlers >

- Annually: 1.4 per day

(iii) Ice Use Rate for Fishing Operation by Inshore Vessel and Canoe

The ratio of ice usage for fishing operation by inshore vessel and canoe type are set based on interviews with GIFA and the cooperatives for each type of fishing canoe as followings.

- Hand line canoes: 100%
- Purse seine canoes: 20%
- Gill net canoes: 20%
- Medium-sized inshore trawlers: 100%

・Medium-sized purse seine vessels: 25%　・Large purse seine vessels: 100%
・Large trawlers: 100%

(iv) Estimation of Ice Demands by Season in SFH

Ice loading capacity of inshore vessels and canoes by type, Number of operating inshore vessels and canoes by season, and Rate of ice usage for each type of inshore vessels and canoe are multiplied together, with the results of estimation on ice demands by season as shown in Table 2-2-2-2(4).

Table 2-2-2-2(4) Ice Demand by Season

Season	Ice Demands
High Season	48.5 t/day
Low season	33.8 t/day
Annual Average	40.6 t/day

(v) Ice Supply Amount by Fishing Season

The production capacity of the existing ice plant of the harbour is 15 t per day.

As mentioned above, the baseline survey determined that 22.1 t of ice per day during high season and 9.6 t of ice per day during low season are brought in from outside the harbour. Based on the basic policy of estimation of supply-demand of ice, acceptable ice brought from outside the harbour comes to 5.4 t a day during high season of the baseline survey and 2.6 t a day during low season. These figures exclude ice from afar with high transportation costs.

This ice supply capacity is in direct proportion to the number of operating inshore vessels, with the estimated results by season shown in Table 2-2-2-2(5).

Table 2-2-2-2(5) Acceptable Ice Supply Capacity from Outside the Harbour

	Number of operating inshore vessels	Total volume of ice brought in from outside the harbour	Volume of ice with transportation costs	Acceptable ice brought in from outside the harbour
		(A)	(B)	(A-B)
Baseline survey high season	30.5 vessels/day	22.1 t/day	12.1 t/day	10.0 t/day
Baseline survey low season	5.8 vessels/day	9.6 t/day	3.5 t/day	6.1 t/day
High Season average	28.3 vessels/day	21.0 t/day	11.3 t/day	9.7 t/day
Low season average	16.6 vessels/day	15.1 t/day	7.3 t/day	7.8 t/day
Annual Average	22.4 vessels/day	18.0 t/day	9.3 t/day	8.7 tons/day

Note: In response to fluctuations in the number of operating inshore vessels, the high season average, low season average, and annual daily average of ice brought in from outside the harbour are estimated based on the actual amount of ice brought in during both halves of the baseline survey.

(vi) Estimation of Supply-demand Gap by Season

Based on the results above, the current seasonal supply-demand gap of ice is estimated as follows.

Table 2-2-2-2(6) Current Supply-Demand Gap of Ice by Season

Season	Ice Demand	Ice Supply (Existing ice machinery)	Ice Supply (Outside Ice)	Ice Supply-Demand Gap
High season	48.5 t/day	15.0 t/day	9.7 t/day	23.8 t/day shortage
Low season	33.8 t/day	15.0 t/day	7.8 t/day	11.0 t/day shortage
Annual Average	40.6 t/day	15.0 t/day	8.7 t/day	16.9 t/day shortage

(b) Scale of Additional Ice Machinery

Daily ice demand shortage by fishing seasons are calculated as approx. 23.8 t during high season and 11.0 t during low season. And annual average ice shortage is calculated as 16.9 t.

Based on the premises below, the ice plant expansion for this project will be scaled to 15 t a day to cover the average annual shortages.

- Scale the additional ice plant carefully, in order to avoid that large surpluses will occur in low season and the facilities will be idled, by scaling in line with high season.
- Avoid scaling in line with low season as it will result in large ice shortages in high season.
- Take an ice can arrangements and other ice making equipment details into account.

The high season supply-demand gap for ice is approx. 23.8 t a day. This would require another 8.8 t of ice a day or so of supply on top of ice brought in from outside the harbour. However, the capacity for ice supply is not believed to be insufficient, as new ice plants are currently being constructed and planned near the harbour in Shama and Essipong, and these facilities are expected to supply ice to Sekondi Fishing Harbour after this project is implemented.

As observed during the supply-demand gap calculation process, many inshore vessels and canoes suspend their operations during spring and neap tides. Fishing operation is thus set as 20 days a month, meaning that surplus ice production capacity at Sekondi Fishing Harbour will exceed the above estimates. Based on the above, the operating ratio of harbour ice machinery is calculated to be roughly 80% after the expansion.

Calculations for the scale of additional ice making machinery are only for fishing ice demand and exclude ice demand for distribution. Still, as landing volume is not expected to increase in the future, value must be added by ensuring temperature control for all fish products caught to increase profitability in the fisheries sector. Accordingly, distributors must be encouraged to use ice for temperature control. If ice demand for distribution increases as a

result, the utilization rate for ice making machinery can be raised.

The existing ice machinery has continued working at nearly full capacity for 15 years following their installation. Thus, their machine trouble rate is expected to increase going forward, meaning regular maintenance will need to be increased. The low season where fishing ice demand is reduced needs to be accurately determined in order to reduce the adverse affects of this maintenance on utilization rates.

If the ice machinery are expanded by 15 t of ice a day, preliminary calculations show that, even with the aforementioned reduction in utilization rate, their earning potential when combined with that of the 15 t of ice a day produced by existing equipment will grow to 1.75 times current production and contribute greatly to total harbour income.

(c) Site Considerations of Expansion and Installation

The additional ice machinery will be installed in a site behind the existing ice machinery limited to a width of approx. 13 m and maximum frontage of 40 m. If the additional ice machinery use ammonia refrigeration like those currently in operation, ice making equipment will be scaled to accommodate a maximum production of 22.5 t of ice a day. As a result, this site is adequate for the project target of 15 tons of daily ice production.

2) Selection of Refrigerant of Refrigeration Unit

Ice can be divided into three types: block ice, flake ice and crushed ice. The ice machinery installed in Phase I have been producing block ice, and the same has been requested for the additional ice machinery in this project.

In the stakeholder meetings and interviews with fishing industry parties conducted during this survey, some vessel owners wanted flake ice. However, the baseline survey confirmed that almost all of the ice was either block ice that had been crushed on a berth or block ice that had been left as-is. Flake ice was used only very rarely. Thus, for the purpose of having ice machinery able to work in unison with existing equipment, the additional ice machinery in this project will also produce block ice. For sake of consistency, block ice size will also be keep at the existing 25 kg.

The selection of refrigerant to use has become an extremely important element for ice making, cold storage and refrigeration facilities in recent years. Traditionally used fluorocarbon refrigerants and the R-404A refrigerant that started being used as a lower temperature alternative have both been cited as contributing to ozone depletion and global warming. In Japan, natural refrigerants like ammonia and carbon dioxide have once again begun to gain traction.

Table 2-2-2-2(7) reveals that ice making staffs in the harbour are extremely able in terms of the operation, maintenance and management of existing ammonia-based ice machinery. This in tandem with the results of our study into the pros and cons of each type of refrigerant led to our choice of the highly evaluated ammonia as the refrigerant for this project.

Table 2-2-2-2(7) Alternate Refrigerant of Ice Making Machinery

	Ammonia	Fluorocarbon 22	R-134a	404A	507A
Ozone-depleting potential	0	0.055	0	0	0
Global warming potential	0	1,500	1,300	3,260	3,300
Safety (toxic/flammable)	△	○	○	○	○
Ease of maintenance and management	○	○	△	△	△
Maintenance and management (refrigeration oil)	△	○	○	○	○
Recent case studies	△	×	×	○	△
Overall evaluation (environmental assessment)	○	×	△	×	×

Note: R-134a cannot be used this time due to the temperate range of the refrigerant.

3) Condensation Method of Refrigeration and Freezing Equipment

The main refrigerant cooling methods are air-cooled and water-cooled. Water-cooled methods are further divided into seawater and fresh water methods, and fresh water methods can be divided even further into cooling tower methods and evaporation-condensation methods.

The choice of an ammonia-based refrigerant prevents use of an air-cooled method. SFH does have access to a stable fresh water supply, however.

From the water-cooled methods mentioned above, the evaporation-condensation method was chosen for this project because of its efficient use of energy.

4) Temporary Ice Storage

The fishing vessels in Sekondi often use more than 50 blocks of 25 kg ice at once and sometimes take as many as 500 blocks. For this reason, the plant must be equipped to be able to remove and transport all of the blocks once the ice making process is complete. Because surpluses in ice production are rare, this plan rejects cold storage in favour of temporary storage that can temporarily store the ice between its removal from the icemaker and its transport out of the plant. Because these temporary storage rooms are only intended to preserve the ice for a short time, refrigeration temperatures will be adjusted as needed to use the smallest possible air-cooled units.

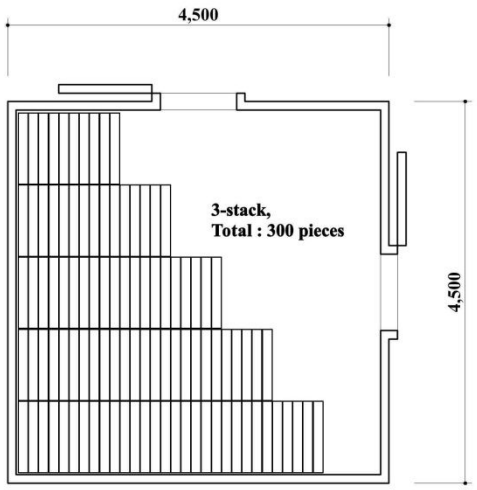


Figure 2-2-2-2(3) Layout Plan of the Temporary Ice Storage

Due to space constraints, the size of the temporary storage rooms will be 4.5m x 4.5m x 2.2m as in the figure and house up to 300 blocks of ice.

(3) Additional Administration Office Plan

1) Spaces Required for Offices and Other Rooms

In accordance with the basic policy on the administration office plan, the space required for offices and others rooms has been set as shown in Table 2-2-2-2 (8). The modular column spacing of the existing administration office organizes office rooms into units that are generally kept to 3 m by 4 m per unit. Because the desks used by the GPHA are quite large, however, two average-sized people would be cramped when using a single unit. Based on this same modular column spacing, unit size for the addition will be 3.15 m x 4.5 m.

The general rule for office allocation was two people per unit, with one person per unit for officers. The harbour manager was allocated two units due to the frequency at which he receives visitors.

Finally, four units are allocated for the conference room. Given that a fishing harbour advisory commission will be established in the future and active participation of harbour users in the operation and management of the harbour is desired, the opportunities for meetings and training sessions are only expected to increase as participation grows.

Table 2-2-2-2(8) Required Area of Administration Office

Offices/Rooms	No. of people	No. of units	Estimate of space required	Floor space	Notes
Harbour manager's office	1	2	15-30 m^2/person	28.35 m^2	Includes washroom
Secretary's office	2	1	5-15 m^2/ person	14.18 m^2	
Audit's office	1	1	10-15 m^2/person	14.18 m^2	
Accountant's office	1	1	10-15 m^2/person	14.18 m^2	
Senior traffic officer's office	1	1	10-15 m^2/person	14.18 m^2	
Traffic supv.'s office	5	2	5-10 m^2/ person	28.35 m^2	Includes traffic officer
Tally clark's office	2	1	5-10 m^2/ person	14.18 m^2	
Project room (used by technical advisors, consultants, and support staff from Takoradi Harbour)		1	10-15 m^2/person	12.00 m^2	One room is currently in use, used by the Study Team during the baseline survey
		1	10-15 m^2/person	12.00 m^2	
Conference room		4	0.8-1.2 m^2/person	86.00 m^2	Used for administrative staff meetings, advisory committee meetings, seminars, workshops, etc.
Security staff's room	8	2	3-5 m^2/ person	24.00 m^2	Includes Security Supv. Direct outdoors access Used as changing/ preparation room
Fire safety staff's room	10	2	3-5 m^2/ person	24.00m^2	Requires direct access to the outside Used as changing/ preparation room
MOFAD staff's office	4	3	5-15 m^2/ person	36.00 m^2	Direct outdoors access
Chief fisherman's office	1	1	10-15 m^2/person	12.00 m^2	
Fishermen's co-op room (A)	2	1	5-15 m^2/ person	12.00 m^2	
Fishermen's co-op room (B)	2	1	5-15 m^2/ person	12.00 m^2	
Fishermen's co-op room (C)	2	1	5-15 m^2/ person	12.00 m^2	
Fishmonger's co-op room (D)	2	1	5-15 m^2/ person	12.00 m^2	
Immigration staff's office	4	2	5-15 m^2/ person	24.00 m^2	Direct outdoors access
Customs staff's office	4	2	5-15 m^2/ person	24.00 m^2	Direct outdoors access

For sake of convenience, the offices for staff that operate and maintain all harbour electrical, mechanical, and other ancillary equipment will be placed in the additional ice plant. The scale required for these offices is as shown in Table 2-2-2-2 (9).

Table 2-2-2-2(9) Required Area of the Ice Plant

Offices/Rooms	No. of people	No. of units	Estimate of space required	Floor space	Notes
Supervisor's office (mechanical)	1	3	5-15 m^2/person	73.58 m^2	Collective office drawing verification, etc.
Mechanical staff's office	4		5-10 m^2/person		
Supervisor's office (electrical)	1		5-15 m^2/person		
Electrical staff's office	4		5-10 m^2/person		
Ice sales staff's room	12	1	1.5-2 m^2/person	21.00 m^2	Serves as changing room

2) Zoning of Administration Office

Behavioural patterns are carefully examined to ensure that the offices of personnel would be zoned according to shared operational management roles. The zonings of the offices are shown in Figure 2-2-2-2 (4).

The offices of harbour operation and management staff face the balcony on the harbour side of the first floor of the additional administration office, allowing them a vantage point from which harbour activity can be observed. From among the operation and management staff, the tally clark office with accountant's office is located next to the ground floor reception desk of the additional administration office to ensure ease of access to harbour users alike. The conference room is located on the ground floor of the additional administration office to ensure ease of access to core harbour operation and management staff on the first floor, the advisory committee offices, and harbour users who will participate in the training sessions and workshops that are expected to increase following the implementation of this project.

The changing and preparation rooms for security guard staffs and fire safety staffs will be located in the existing administration office facing the wharf, enabling them to more easily patrol.

Because the Fisheries Commission has been studying landing volume and number of operating vessels, their offices have been located near the entrance of the existing administration office. The immigration control and customs offices are also located near the other entrance to make them more accessible to harbour users.

Additionally, the offices of technical management staff have been located in the corner of the additional ice plant for the sake of convenience in terms of performing their work.

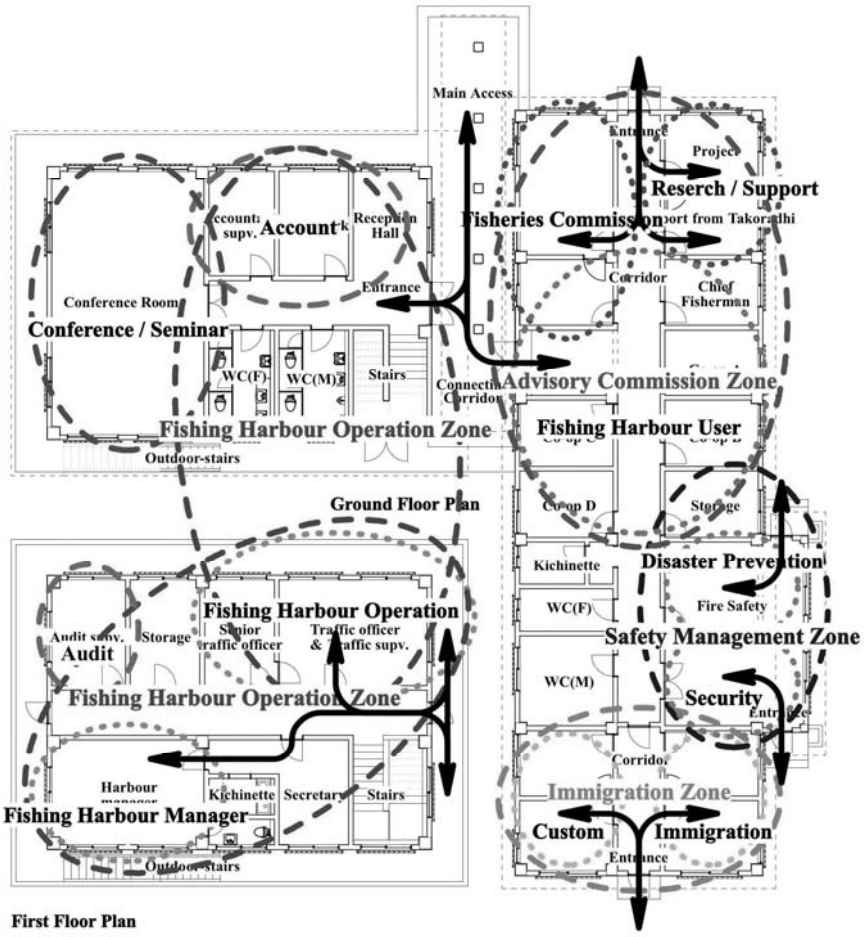


Figure 2-2-2-2(4) Zoning in Administration Office

(4) Pavement Plan for Extension

During Phase I, the wharf, inner roads and parking lot in the harbour grounds were paved. Though the wharfs were paved with concrete, the rest of it utilized interlocking blocks for vehicle's traffic. Maintained and managed extremely well and any defect are not observed there. For that reason, interlocking blocks of the same make for additional pavement in this project are chosen to use.

The sectional structure of the interlocking block pavement starts with a 150 mm thick base course of lean-mix concrete, which is then topped with a 50 mm thick cushion sand and finished with 80 mm thick interlocking blocks. To drain rainwater and prevent damage to inner road, cross slope of 1.5% or greater will be applied, and side ditches will be installed at the bottom of drainage slopes of the road. Slopes adequate for the same ditches used in surrounding areas will also be added to the expanded parking lot.

Those ditches will be concrete with an outer size of 500 mm, inner size of 250 mm, and total depth of 750 mm and will be open conduits like the ones currently in use.

(5) Ancillary Equipment Plan

1) Electrical Equipment

(a) Sub-station

Power for the additional facilities in the project will be supplied by the 500 KVA step-down transformer installed in Phase I.

The power demand after the project including existing facilities is as shown in Table 2-2-2-2(10).

Applying corrections in transformer efficiency, voltage fluctuation, rated value and high temperature to total phase current (510.9 A), voltage (415 V) and required power supply (212.0 kVA) brings to a required transformer capacity of 305.6 kVA. It has been confirmed that the existing step-down transformer can supply the power for the additional facilities in the project in addition to the existing facilities.

Table 2-2-2-2(10) Calculation of Power Demand

Item		Total output (KW)	Input/output conversion	Input load conversion (KVA)	Demand factor	1-phase power load (KVA)	3-phase power load (KVA)
Lighting equipment	Single-phase	29.17	1.25	13.03	0.75	9.77	
3-phase lighting equipment	3-phase	5.40	1.25	6.75	0.75		5.06
Single-phase outlets	3-phase	25.20	1.00	25.20	0.40	10.08	
3-phase outlets	3-phase	23.75	1.25	29.69	0.40		11.88
Hot water/ cookware	3-phase	18.00	1.25	22.50	0.50		11.25
Air conditioners	Single-phase	20.52	1.33	27.29	0.95	25.93	
Exhaust fans	Single-phase	0.57	1.33	0.76	0.95	0.72	
3-phase exhaust fans	3-phase	1.17	1.176	1.38	0.95		1.31
Ice machinery	3-phase	225.00	1.50	337.50	0.80		270.00
Lifting pumps	3-phase	3.70	1.176	4.35	0.50		2.18
Fuel dispensers	3-phase	3.60	1.176	4.23	0.50		2.12
Total power load: (KVA)						63.16	303.79

(b) Main Line Feeder System

The piping and wiring from the step-down transformer installed in the sub-station to the low-voltage main distribution board will be buried, with hand holes installed as necessary. FEP pipes must be used at a depth of 60 cm or more. The piping and wiring from the main distribution board to the control panels of the ice machinery, lifting pumps and other equipment to be added, as well as the piping and wiring from the boards of that equipment to the terminal units, will all be embedded in the walls and floors.

The width of all piping and wiring will be designed in accordance with IEC Standards to prevent malfunctions from overheating, voltage drops, and other issues.

(c) Power Equipment

The power equipment to be used in this project will include block ice machinery, lifting pumps, pressurized exhaust fans. All of this equipment will either be connected directly or by using the main distribution board with the control panels of each device.

Furthermore, alarm panels will be installed in the offices of technical staff in the additional ice plant to simplify both monitoring of the operation status of the reservoir and high elevated tank as well as facility maintenance.

(d) Lighting and Outlets

The width of all piping and wiring will be designed in accordance with IEC Standards to prevent malfunctions from overheating, voltage drops and other issues. In general, all outlets in facilities shall be grounded and use two parallel flat pins with ground pin Type G (UK type) outlets common throughout Ghana. Waterproof outlets will be used for any outlets at risk of water exposure.

(e) Lighting Fixture

Lighting required for the rooms in each of the facilities will observe the practices at both Takoradi Harbour and Tema Harbour, with references made to ISO and International Commission on Illumination (CIE) Standards.

In terms of the selection of lighting equipment, open bottom fluorescent lighting will generally be used. For the administration office rooms, however, louvers will be utilized to prevent glare in accordance with ISO and CIE Standards. Additionally, covers will be employed in rest rooms and other areas where resistance to moisture is thought necessary. In outdoor areas like wharf, access driveways, and connecting inner roads where wide-area lighting is required, ceramic metal halide lamps will be used for their long lifespan and low power consumption.

(f) Communication Equipment

Offices in the additional administration office will generally be equipped with both telephone conduits and outlets. The main distribution board, telephone terminals and wiring will all be under the GPHA scope.

Piping, wiring, and outlets for LAN equipment will all be established as part of this project, while the hub and computers will be under the GPHA scope.

2) Water Supply, Sewage and Sanitation

(a) Water Supply System

The reservoir tank will have the capacity to fulfil demand for one day. For the high tank, given the high likelihood that it will see simultaneous high capacity usage for ice plant and water supplies for vessels, the normal rating of 1/10 to 1/15 will be adapted to 1/10.

Calculations of water demand for the entire harbour shown in Table 2-2-2-2(11) revealed a

demand of approximately 114 m^3 / day. For this reason, capacities for the reservoir tank and high tank will be 120 and 12 m^3, respectively.

Table 2-2-2-2(11) Water (Tap Water) Demand

Use		Calculation	Basic volume	Demand (litres)
Water for ice	Old and new	110% of manufactured ice	Ice capacity: 35 tons/day	38,500
Water for thawing ice and cooling	Old and new	90% of same as above	Same as above	31,500
Water for fishing vessels	Inshore/trawlers	10 litres/person/day, 6 day voyage	Average 1.1 vessels/day, crew of 15	990
Water for fishing vessels	Inshore/medium-sized	3 litres/person/day, 1 day voyage	Average 12.0 vessels/day, crew of 15	540
Water for fishing vessels	Inshore/large-sized	10 litres/person/day, 1.5 day voyage	Average 14.5 vessels/day, crew of 20	4.350
Water for fishing vessels	Canoe/hook & line	10 litres/person/day, 6 day voyage	Average 3.3 vessels/day, crew of 10	1,980
Water for fishing vessels	Canoe/purse seine	3 litres/person/day, 1 day voyage	Average 34.0 vessels/day, crew of 10	1,020
Water for washing fish		1/4 of catch volume x weight ratio 0.8	High season catch 30 tons/day	6,000
Water for washing pans		20 litres/m^2 x 1/2 min./pan	30 tons/90kg/day	3,333
Water for washing the fish handling shed		20 litres/m^2 x 1/3 min./m^2	720 m^2	4,800
Water for washing wharf		20 litres/m^2 x 1/3 min./m^2	110 m x 10 m	7,333
Hot water supply	Existing administration office	13 litres/person	Management staffs 14 + 19	429
	Additional administration office	13 litres/person	Management staffs 12	156
	Additional ice plant	13 litres/person	Management staffs 22	286
Water for the administration office restrooms		18.6 litres/person	Management staffs 48 + 19	1,060
Water for washing hands		4.5 litres/person	Management personnel 48 + 19	257
Water for public toilets	Men	11.16 litres/person	10% of 860 fishermen	960
	Women	36.9 litres/person	5% of 800 fishmongers	1,476
Water for washing hands	Men	3.6 litres/person	10% of 860 fishermen	310
	Women	3.84 litres	5% of 800 fishmongers	154
Shower water for ice making staffs		20 litres x 5 min/person	22 ice making staffs	2,800
Shower water for fishermen	Men	20 litres x 5 min/person	10% of 860 fishermen	8,600
			Total water demand	113,903
			Sewage/gray water total	7,157

(b) Hot Water Supply System

Because the only areas requiring hot water supply equipment will be the kitchenette in the additional ice plant and additional administration office, direct supply system will be adopted. As shown in Table 2-2-2-2(11), these kitchenettes require no more than 350 liters of water, so hot water heaters with 50 liter storage tanks will be used. An electric heat source will be used for the sake of safety and maintenance.

(c) Sanitation Equipment

The existing administration office is equipment with Western toilets, hand wash basins and sinks. The same Western toilets, hand wash basins and sinks will be installed in both the additional ice plant and the additional administration office.

(d) Sewage and Wastewater Treatment System

The same sewage system used in Phase I will be used. Sewage and waste water will both drain into the cesspit while the water discharged from ice machinery and the like will be directed into the drainage ditches along with rain water and discharged into the harbour basin. Water for the fish handling shed and washing the wharf will be discharged into the harbour basin via drainage ditches and drainage basin with basket trap as they are currently used.

The capacity of the anaerobic septic tank that was installed in Phase I and is being used as a cesspit is 12.9 m^3. The volume of sewage and waste water discharged from existing facilities has been estimated at 4.8 m^3, and according to calculations, this sewage and waste water will need to be scooped up once every 2.5 days. Interviews revealed that it is currently done approx. twice a week. Harbour sewage and waste water volume will rise to approx. 7 m^3 upon completion of the planned expansions of this project. Because the cleanup activities will be almost double of what they are now, approx. 30 m^3 of cesspit will be installed as part of this project, expanding the current volume for sewage and waste water to 40 m^3.

3) Air Conditioning and Ventilation Equipment

(a) Air Conditioning

Daytime during dry season is extremely hot. Air conditioning units will be installed in all of the offices of the additional ice plant and the additional administration office just as they are in the offices of the existing the administration office. In terms of air conditioner capacity, however, standard loads of 0.2 KW per m^2 as used in high latitude countries will be used to keep down the increase in maintenance costs that come with the excessive cooling of rooms.

(b) Ventilation

Ventilator will be installed in the vicinity of the cooling equipment of ice machinery, hot water supply equipment, heating equipment and lifting pumps and other devices that will be part of this project's additional ice plant, the additional administration office and expansion of ancillary equipment and facilities.

In addition to windows that can be opened, mechanical ventilator will also be installed. For offices in the administration office, 20 m^3 an hour worth of ventilation capacity is required per person, with calculations made based on the minimum number of staffs to use the room.

In the event that heat remains in the machine rooms, for example, outside air will be pumped into the room in place of the air warmed by the machinery and the required ventilation will be installed to ensure that the room temperature is tolerable.

4) Disaster Prevention Facilities

Southern Ghana, which includes Sekondi and Takoradi, has almost no lightning and for that reason, no lightning protection equipment will be installed same as Phase I.

(a) Automatic Fire Alarms

In accordance with standards for installation of automatic fire alarm systems in the Ghana National Fire Service Act, all of the offices in the administration office will be equipped with automatic fire detectors.

(b) Emergency Lighting Systems

In accordance with Ghana Emergency Lighting Standards, emergency lighting equipment will be installed in the corridors of the additional administration office, which will serve as an evacuation route.

(c) Evacuation Equipment

In accordance with Ghana Evacuation Guidance Standards, sign boards for evacuation route and emergency exit will be installed at all entrances, exits and important parts of stairways in the additional administration office.

5) Fuel Pipe Trenches

The areas in which fuel tanks and fuel dispensing units will be installed by GPHA in the future are specified in advance in this project. For this project, trenches for fuel supply piping are to be installed. These trenches will have concrete ditch covers and an outside measurement of 700 mm, an inside size of 400 mm, and a total depth of 950 mm. Furthermore, there will be culverts at road crossings.

(6) Architectural Planning

1) Floor Plan

(a) Layout Plan of Ice Plant

The additional ice plant expansion will be located to the west of the existing ice plant. In order to optimize work efficiency at each facility, the ice making rooms, handling space and ice making machine rooms will all be placed in the vicinity of the existing plant equivalents.

Because of the increase in volume of ice to be transported due to the expansion, a new ice loading deck will be installed in the area facing the open net yard to the south of the ice making rooms. As this section is positioned near the canoe jetty, ice for inshore vessels will be delivered from the existing loading deck and that for fishing canoes will be loaded from the new loading deck.

Temporary ice storage will be installed in the ice handling space of the ice making rooms.

The front room portion facing the wharf in the existing ice plant is currently being used as an office by the engineering staff but will be converted to a changing room for the ice making staff. Engineering staff offices will be located to the east of the machine room of the additional ice plant.

The toilets and shower rooms installed by the GPHA will be removed for the construction of the additional ice plant and re-installed in a space next to the engineering staff office.

(b) Layout Plan of Administration Office

The additional administration office will be placed to the west of the existing administration office and a connecting corridor will be added between the two buildings. Due to space restrictions on harbour ground, the expanded building will have two floors. As a general rule, offices are to be allocated for GPHA, the main operator of the harbour. The existing building will be made into offices for the organization those who support GPHA operation and management. However, the sections facing the wharf will be made into offices for the security and fire safety staffs in charge of patrolling the premises.

The first floor of the additional office will be made to overlook the whole harbour and house the offices of the harbour manager and traffic operation staffs who are directly in charge of optimizing harbour operations. In the interest of maximizing user-friendliness, the reception, tally clerks and accountant are situated on the ground floor. As this section connects to the existing administration office, it will house the conference room.

In addition to the previously mentioned GPHA security and fire safety staffs in the existing building, the MOFAD Fisheries Commission members comprising the fishing harbour advisory commission, the chief fisherman, fishing vessel cooperatives and fishmonger cooperative will all have places. The offices for immigration control and customs will remain where they are.

Among the individuals and organizations placed on the ground floor of the existing facility, the offices of GPHA security, fire safety, Fisheries Commission investigators, immigration control and customs offices should have external and direct access. As such, each will be placed near an entrance. Among these, the office used by fire safety currently does not have direct access to the outside and is limited for space, so an expansion will be added on the wharf side.

Currently, the harbour manager's room and conference room are in a two-unit room. Likewise, partitions will need to be installed in the cooperative room and the Fisheries Commission room. An entrance from the corridor also needs to be installed.

Furthermore, air conditioner is now standard in Ghana offices, so balconies that allow setting the outdoor units of those and monitoring of the harbour will also be installed. Ghana building regulations mandate that buildings of two floors have two evacuation routes. As such, an emergency staircase will be installed down from the balcony to the ground level.

2) Sectional Plan

(a) Sectional Plan for Additional Ice Plant

For each of the following locations, equipment will be installed at three height levels relative to the ground level of the existing ice plant:

- Machine room for ice making refrigeration unit and anteroom: +200 mm
- Fish handling space, ice storage area, ice loading decks: +900 mm
- Brine tank installation and surrounding workspace: +1,500 mm

The floor levels for the spaces in the additional ice plant will be aligned with the existing floor in the interest of work efficiency.

Eaves height for the ice making and ice handling spaces in the existing ice plant is 6.5 to 7.5 m above the ground level at a 10% roof gradient, sloping down to the west. If the roof for the additional is to have the same gradient, the extension roof would have to be installed to fit under the existing roof. In this case, the extension roof would also have to slope down to the west in order to apply waterproofing properly between the roof of additional and existing buildings. Thus, the whole roof would be much lower than the existing roof, not leaving any space for a crane to install the roof above the ice making space. If the additional plant is given a flat roof with almost no gradient, arranging the parapet crests underneath the eaves of the existing roof, the crane is confirmed to have enough room work above the ice making rooms. As such, the roof of the additional ice plant will be a flat roof structure with reinforced concrete. The ceiling portion of the ice making rooms will be 5.69 to 5.71 m above ground level.

(b) Sectional Plan for Additional Administration Office

The additional administration office must have its ground line aligned with the ground floor of the existing building for seamless connection, and the connecting corridor between the additional and existing buildings must set underneath the first floor balconies of the additional building and the eaves of the existing building. Otherwise, there are no restrictions on the sectional plan.

This being the case, the ceiling height for the corridors for each floor and the conference room will be 2.7 m, and that for general offices will be 2.55 m, the same as the existing building. The sectional design is as follows:

- Ground floor height: +300 mm above ground level
- First floor height: +4,200 mm above ground level
- Eaves height (roof floor beam crown): +7,650 mm above ground level
- Maximum height: +8,190 mm above ground level

3) Structural Plan

(a) Structural Plan for Additional Ice Plant

Upon carefully considering the layout plans, floor plans, waterproofing plan and ice making crane sectional plan, the roof for the additional ice plant will be a flat roof structure made with reinforced concrete.

A reinforced concrete rigid-framed structure will be used for the frame, and a non-bearing concrete block wall will be used for the exterior wall.

Note that the existing ice plant is given a rigid-frame structure for the periphery to support the crane above the ice making workspace, and thus has no interior beams between spans. As the relation between the roofs of the existing and additional buildings will allocate the roof of additional building at the low level of a little gap for the crane to operate, the structural frame of the additional will be given the same external rigid-frame structure.

To adjust the existing ice plant, the foundation type will be a continuous footing (continuous beam foundation). The west side of the existing ice plant has a 2,200 mm continuous footing (pressure plates), which the foundation for the additional building must stay clear of. Thus, an eccentric foundation must be applied to support the east sidewall of the additional building. As the block ice plant must be the building with large live loads such as brine tank, it is necessary to treat carefully.

(b) Structural Plan for Administration Office

As with the existing administration office, reinforced concrete rigid-framed structure with flat roof will be used for the additional administration office, and a non-bearing wall will use concrete blocks.

As with the additional administration office, the foundation type will be a continuous footing (continuous beam foundation).

4) Finishing Plan

The finishing plan for the additional ice plant and administration office for the project is as follows.

Table 2-2-2-2(12) Finishing Table for Ice Plant and Administration Office

Facility	Finishing Details
(1) Ice plant	
Roof	Reinforced concrete slab, cold polymer asphalt waterproofing, asphalt roofing with mineral surface and weather-resistant top coat
Exterior walls	Columns, girders and beams and outside skirting: reinforced concrete, mortar trowelled with AEP finish Exterior non-bearing wall: concrete blocks, mortar trowelled with AEP finish
Exterior openings	Aluminum sash bypass windows, single swing windows, steel flush doors
External floor	Ice loading deck: concrete slab steel trowel finish, wooden drainboard with locally-produced hardwood
Inner floor	General portion: trowelled earthen floor with concrete slab, floor hardener finish Ice making workspace, ice handling space: earthen floor with concrete slab, trowelled waterproof mortar, wooden drainboard with locally-produced hardwood
Interior walls	Columns, girders and beams: reinforced concrete, mortar trowelled with AEP finish Interior non-bearing wall: concrete blocks, mortar trowelled with AEP finish
Ceiling	Reinforced concrete, pinning of glass cloth/glass wool board t=50
Interior openings	Steel flush doors, wood frame doors
(2) Administration office	
Roof	Reinforced concrete slab, cold polymer asphalt waterproofing, asphalt roofing with mineral surface and weather-resistant top coat
Exterior walls	Columns, girders and beams and outside skirting: reinforced concrete, mortar trowelled with AEP finish Exterior non-bearing wall: concrete blocks, mortar trowelled with AEP finish
Exterior openings	Aluminum sash bypass windows, single swing windows, steel flush doors
External floor	Direct trowelled earthen floor with concrete slab
Inner floor	General portion: earthen floor with concrete slab, mortar base, homogenous PVC tiling
Interior walls	Columns, girders and beams: reinforced concrete, mortar trowelled with AEP finish Interior non-bearing wall: concrete blocks, mortar trowelled with AEP finish
Ceiling	Wooden substrate, plasterboard t=12.5 with AEP finish
Interior openings	Wood frame doors (same as existing building)

5) Ancillary Equipment Plan

(a) Refrigeration Equipment Plan

(i) Block Ice Machinery

Refrigerant/ brine: Ammonia (R-717), sodium chloride brine

Compressor: 87 KW capacity (ET-18/CT +40°C), 45 KW motors x 2

Evaporator: Indirect cooling with herringbone evaporator

Condenser: Evaporative condenser x 1, 3.7 KW fan x 2,
1.5 KW cooling water circulation pump x 1,
1.5 KW compressor jacket cooling pump x 1

Ice box: Steel welded tank, 125 mm insulation on outer peripheral surface and floor, 12.1 m x 4.4 m x 1.1 m, grid holds 60 ice making trays

Ice making cans: 25 kg blocks, dimensions (300 mm/285 mm × 130 mm/115 mm × 900 mm), 610 ice cans (including 10 reserves)

Can grid: 10-can grid (total of 61 can grids, including one reserve)

Other: Gantry crane for lifting can grid, flooding tank, thawing tank, tray

dump

(ii) Temporary Ice Storage

Interior dimensions/capacity: 4.5 m x 4.5 m x 2.2 m(h), approx. 40 m^3 (100 25 kg ice blocks)

Insulation:	Floor: wooden drainboard (no insulation), walls/ceiling: 100 mm panel insulation
Refrigeration:	Ceiling-mounted, integrated air-cooled unit (capacity: approx. 2 KW, refrigerant: R-404A)
Holding temperature:	Target 5°C (progressive)
Other:	6 ice loading/unloading chutes (legged)

(b) Electrical Equipment Plan

(i) Main line Feeder System

Power transmission:	3 phase, 4 cable, 50 Hz, 415/240 V
Trunk branch board:	Branches electric wiring to existing and expanded facilities.
Main distribution board:	EM circuit breaker, undervoltage relay, phase failure relay, reverse-phase voltage relay, surge protector, main branch board

(ii) Power Equipment

Power system:	3 phase, 4 cable, 50 Hz, 415/240 V
Wiring system:	Metal pipes or buried pipes

(iii) Alarm Unit

Work overview:	Following alarm unit will be installed in alarm panels of the office of the additional ice plant together with an electromagnetic switch.
Power status displays:	Power indicator, emergency generator malfunction indicator
Reservoir and high tank:	Full/low water alarm relay, one set of alarm device
Thawing water tank:	Full/low water alarm relay, one set of alarm device
Automatic fire alarms:	Heat detector, one set of collective alarm device

(iv) Lighting and Outlet Wiring

Work overview:	Lighting fixtures/switch from each distribution board (light panel), power outlets, wiring to ventilation facilities and equipment, wiring work
Power transmission:	1 phase, 3 cable, 50 Hz, 415/240 V
Floor wiring:	Wiring in synthetic plastic tubing (VE, PF, PFD, CD pipes)
Wall wiring:	Wiring in synthetic plastic tubing (VE, PF, PFD, CD pipes)
Ceiling wiring:	Wiring in synthetic plastic tubing (VE, PF, PFD, CD pipes)
Flashing method:	Manual switch

(v) Telephone Conduit and Outlets

Work overview:	Pipe work from main terminal board to phone receptacle, receptacle outlet work
Installation locations:	Management offices in the additional ice plant and the administration office, conference room, training room, storage (furnished if

converted into offices in the future)

(vi) LAN Conduit and Outlets

Work overview:	LAN wiring pipe and receptacle outlet work
Installation locations:	Management offices in the additional ice plant and the administration office, conference room, training room, storage (furnished if converted into offices in the future)

(c) Plumbing and Sanitation

(i) Water Supply

Water supply locations:	Additional ice plant: ice making rooms, machine rooms, ice loading deck, engineering staffs office, toilet/shower room Additional administration office: ground/first floor toilets, restroom, and kitchenette Outdoor facilities: sill cock around sewage tank
Main water pipe diameter:	250 A (national road portion)
Supply conduct:	150 A (site supply conduct)
Supply system:	Gravity water supply with high tank
High tank:	Local assembly type, FRP insulated tank, 12 m^3 capacity
Reservoir:	Local assembly type, FRP insulated tank, 120 m^3 capacity
Water pumps:	single-suction, multi-stage centrifugal pump 65 x 50, 3 phase, 415 V, 2.2 KW x 2 (automatically alternated), 275 litter/min. x 20mAq
Secondary side supply lines:	PVC piping, underground, underfloor, in-wall piping

(ii) Sanitation Facilities and Equipment Specifications

Toilets:	Porcelain western toilet, SUS-made toilet paper dispenser
Urinals:	Wall-mounted porcelain urinals
Sinks:	Built-in type porcelain basin, approx. 9 litter capacity Vanity mirror, soap dispenser
Slop sink:	Wall-mounted porcelain sink

(iii) Drainage and Ventilation Equipment

Drainage system:	Sewage-waste water confluent system, drain water / rain water split system
Sewage pipes:	PVC main and branch pipes, main pipe 100-150 A, branch pipes 50-100 A
Ventilation system:	Loop ventilation
Drainage capacity:	approx. 7.5 m^3/day (sewage/waste water)
Floor drain grating:	Ice making room, machine room, toilets and shower room
Bowl trap:	Kitchenette sinks, toilet sinks and cleaning sinks
Catch basin:	Concrete basin, 600 mm angled
Sewage pipes:	PVC pipes, 150 A
Treatment:	Cesspit

(iv) Wastewater Facilities (Sewage Tank)

Tank structure: Reinforced concrete, buried (waterproof interior)
Actual capacity: 27.7 m^3

Discharged to: City wastewater treatment plants in the city

(d) Air Conditioning/ Ventilation Equipment

(i) Air Conditioning Equipment

Installation locations: Additional ice plant: office
Additional administration office: offices, conference room
Renovated parts of existing administration office: offices

Air conditioning system: Air conditioning package unit

Cooling capacity standard: approx. 0.2 KW/m^2

(ii) Ventilation Equipment

Installation locations: Additional ice plant: office, toilets and shower room, machine room
Additional administration office: offices, ground/first floor toilets, restroom, kitchenette, conference room
High tank tower: pump room

Ventilation system: 3rd class mechanical ventilation equipment (forced exhaust ventilation fan)

(e) Disaster Prevention Equipment

Automatic fire alarm equipment:
Heat detector positions: offices, toilets, kitchenettes and corridors in additional ice plant and the administration office, 22 spots in total
Collective alarm devices: Ice plant office, 1 location
Automatic fire alarm equipment system: Additional administration office corridor, 1 location

Emergency lighting systems:
Installation locations:
Additional ice plant: Machine room, 1 location
Additional administration office: Ground and first floor corridors, 4 locations; 5 in total

Evacuation equipment:
Sign board of evacuation route:
Additional ice plant: Machine room, 2 locations
the administration office: First floor corridor, 1 location; 3 in total
Sign board of emergency exit:
Additional ice plant: office: 1 location, ice making room: 1 location
Ice plant office: 1 location
Additional administration office ground and 1st floor entrances: 3 locations, conference room: 1 location, training room: 1 location, 5 in total

2-2-3 Outline Design Drawing

2-2-3-1 Facility Outline

An outlines of project facilities are shown in Table 2-2-3-1(1), (2).

Table 2-2-3-1(1) Civil Facilities Outline

Facility name	Scale / plan details
Additional lay-by berth (improvement of existing breakwater)	Length: 180 m, crown width: 15.5 m, crown height: DL +2.6 m Design depth: DL -2.0 m Berth structure: gravity type (cellular concrete block) Outside port structure: rubble mound (armour stone 1.0t/piece) Paving format: concrete pavement Water supply trench: 180 m long, 6 taps Fuel pipe trench: 15 m long (dispensers installed by Ghana side) Fender: 36, ladder: 1, bollard (3t): 36, street light foundation: 7 (street lights included in architectural facility portion)
Access driveway with canoe berthing facilities	Length: 324 m, crown height: DL +2.6 m to +2.0 m Crown widths: 5 m road, 2 m sidewalk Paving type: (road) interlocking block pavement (sidewalk) concrete pavement Revetment structure: stepped type 119 m, rubble stone type 205 m Bollards (1t): 66 Street light foundation: 7 (street lights included in architectural facility portion)

Table 2-2-3-1(2) Architectural Facilities Outline

Facility name	Scale / plan details
Additional ice plants	Reinforced concrete, one-story rigid-framed structure, flat roof Connecting to existing ice plant (west non-bearing wall of existing facility demolished/removed) Floor area of expansion: 444.0 m^2, ice machinery: 15 t/day Relocation of existing ice plant electric, water supply and drainage piping and wiring; relocation of outdoor fire hydrant; ice making staff toilet/shower facilities and cesspit disassembly/removal; fuel sales staff shade disassembly/removal
Additional administration office	Reinforced concrete, two-story rigid-framed structure, flat roof Connected by connecting corridor with existing administration office (one-story building) Floor area of expansion: 384.25 m^2, floor area of access passage: 12.39 m^2 Additions to existing administration office, floor area: 7.84 m^2 Renovation of existing administration office, floor area: 187.84 m^2
Pavement of the area behind fish handling shed (parking lot/net mending area, in-port road)	Paving type: interlocking block pavement (lean concrete: 15 cm, cushion sand: 5 cm, interlocking blocks: 8 cm) Paved areas: parking lot: 695.85 m^2, in-port road: 1,410.62 m^2 Drainage ditch: 340.5 m (open conduit: 310.5 m, culvert: 30.0 m) Demolish/removal of existing sea water pump: 15.00 m^2, paving after removal: 101.54 m^2
Utilities (street lighting, water supply and drainage)	Street lighting: 19 in total (for additional lay-by berths: 7; for access driveway: 7; for in-port road: 5, at 40 m intervals) Water supply and drainage facilities, reservoir (locally assembled FRP insulated tank): 120 m^3 w/ RC girder foundation; high tank (locally assembled FRP insulated tank): 12 m^3 w/ RC tower (tank floor area: 26.01 m^2); pump room (floor area: 26.01 m^2); additional cesspit (added capacity: 27.7 m^3)
Fuel oil tank site construction	Inshore vessel and canoe fuel tank site (1 each) and dispensing areas (1 each), Trenches for piping: 139.7 m (open conduit: 108.7 m, culvert: 31.0 m) Expected fuel tank site area: 128 m^2 (7.4 m x 17 m)

2-2-3-2 Outline Design Drawings

Figure 2-2-3-2 (1) General Layout Plan

Figure 2-2-3-2 (2) Layout Plan of Civil Facilities

Figure 2-2-3-2(3) Typical Cross Section of Breakwater

Figure 2-2-3-2(4) Typical Cross Section of Access Driveway (1)

Figure 2-2-3-2(5) Typical Cross Section of Access Driveway (2)

Figure 2-2-3-2(6) Layout Plan of Land Facilities

Figure 2-2-3-2(7) Layout Plan of Ice Plant

Figure 2-2-3-2(8) Sectional Plan and Elevation of Ice Plant

Figure 2-2-3-2(9) Layout Plan of Administration Office

Figure 2-2-3-2(10) Sectional Plan and Elevation of Administration Office

Figure 2-2-3-2(11) Layout, Sectional Plan and Elevation of High Tank Tower

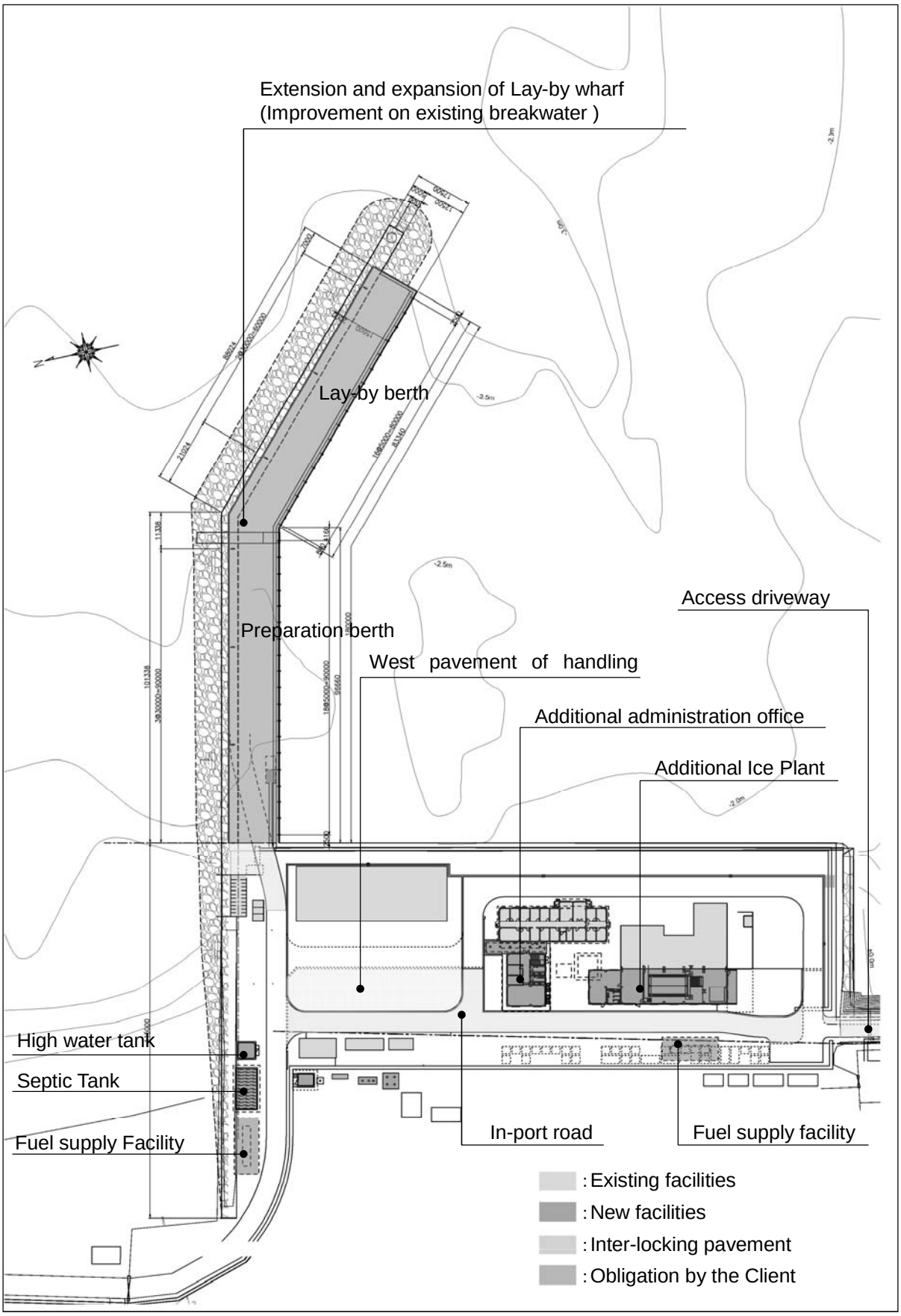


Figure 2-2-3-2(1) General Layout Plan

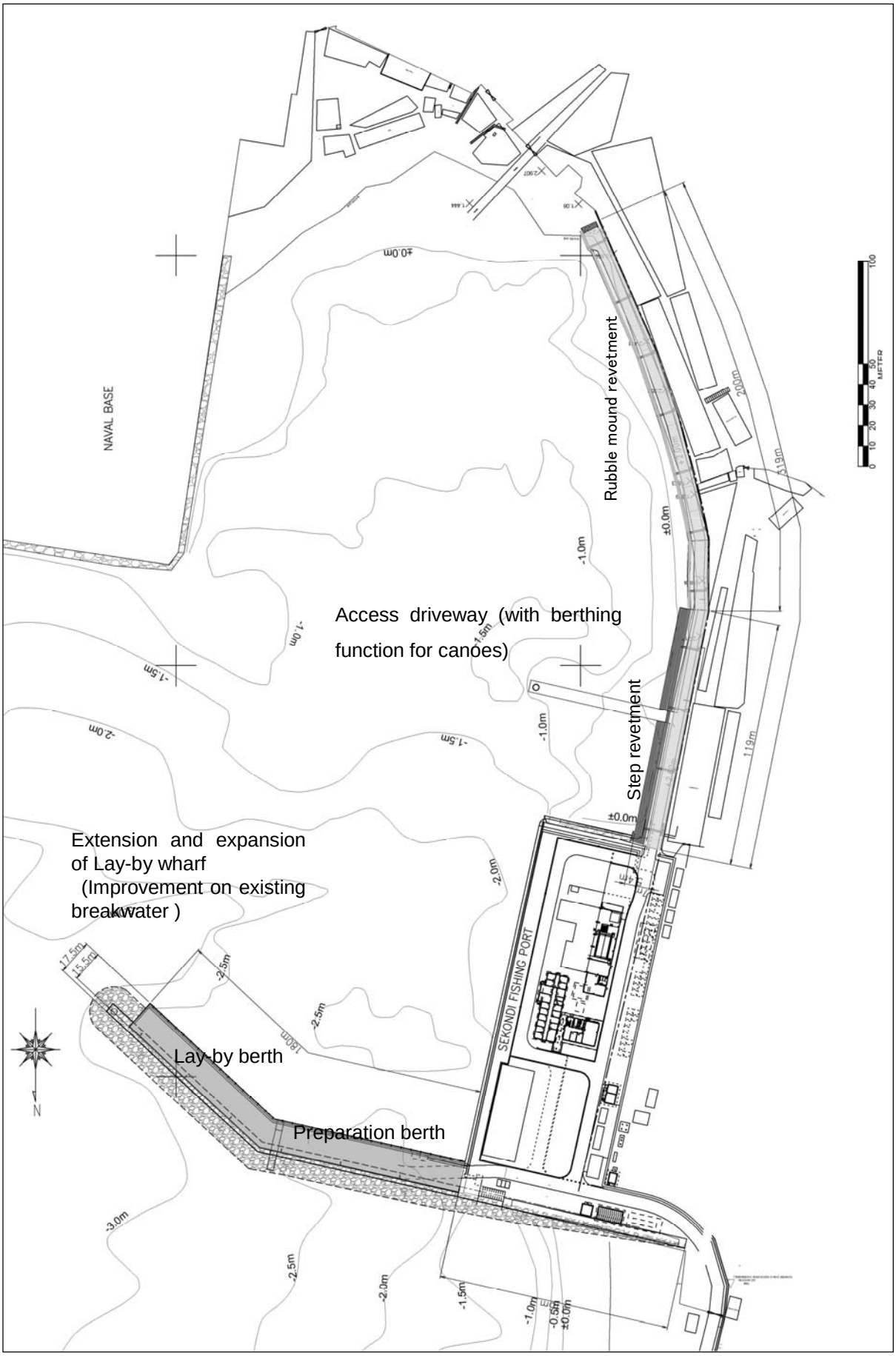
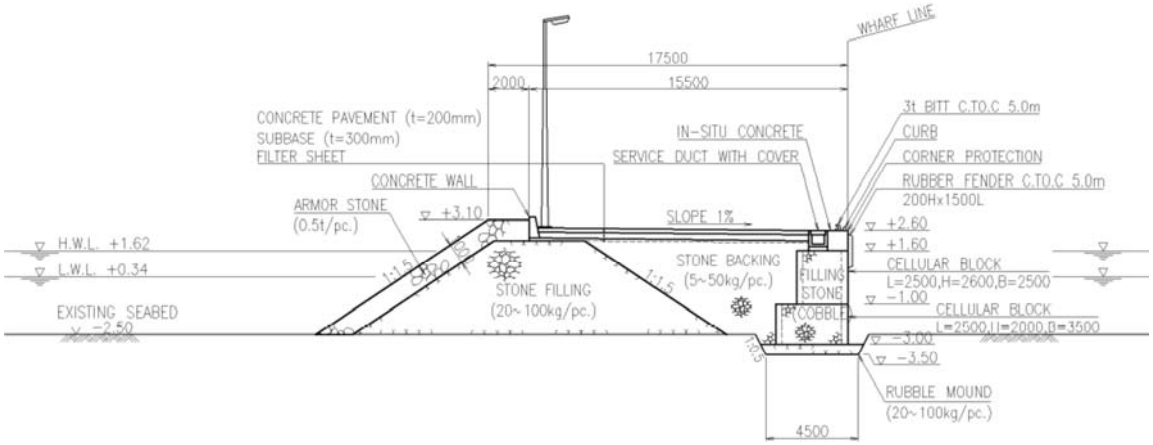


Figure 2-2-3-2(2) Layout Plan of Civil Facilities

< Typical Cross Section of Breakwater >



< Cross Section of Breakwater at Waterway Culvert>

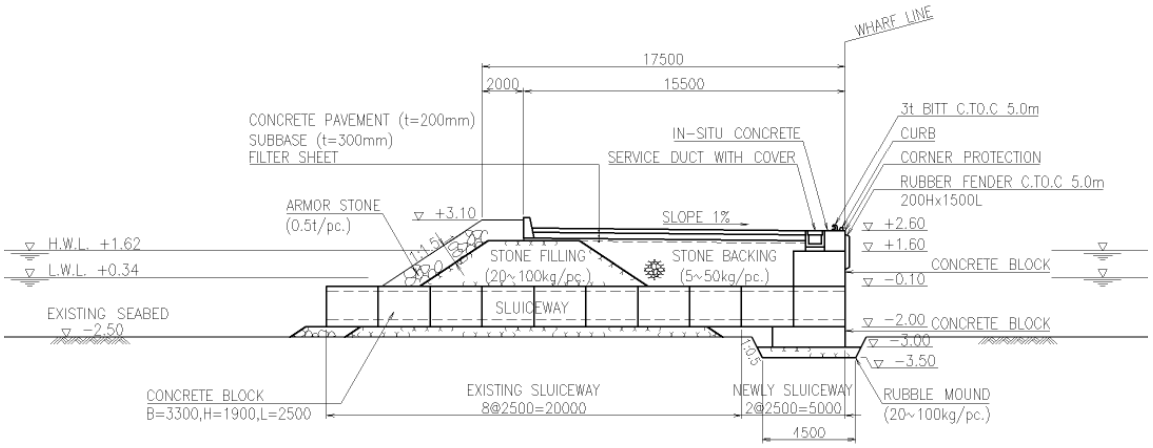


Figure 2-2-3-2(3) Typical Cross Section of Breakwater

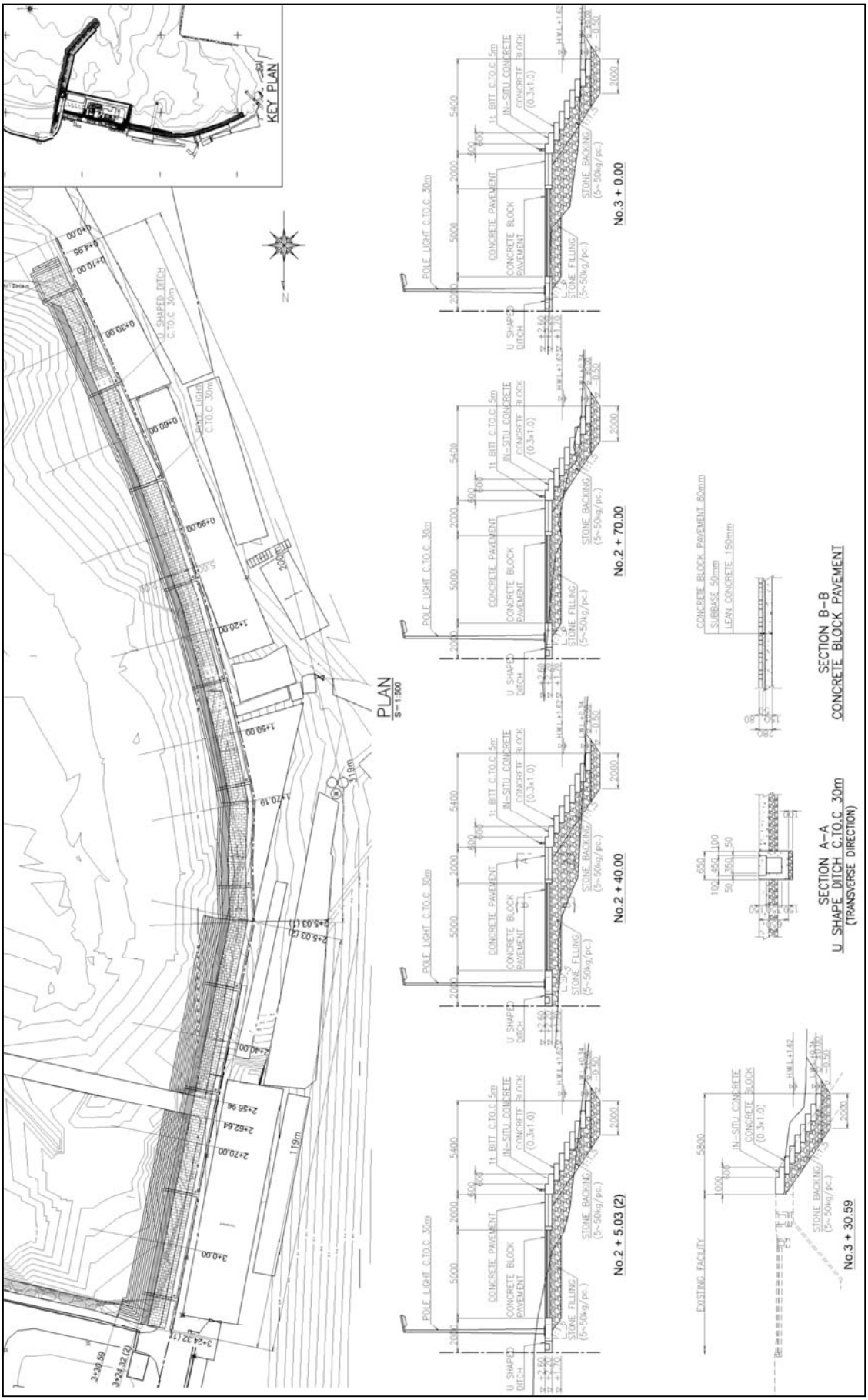


Figure 2-2-3-2(4) Typical Cross Section of Access Driveway (1)

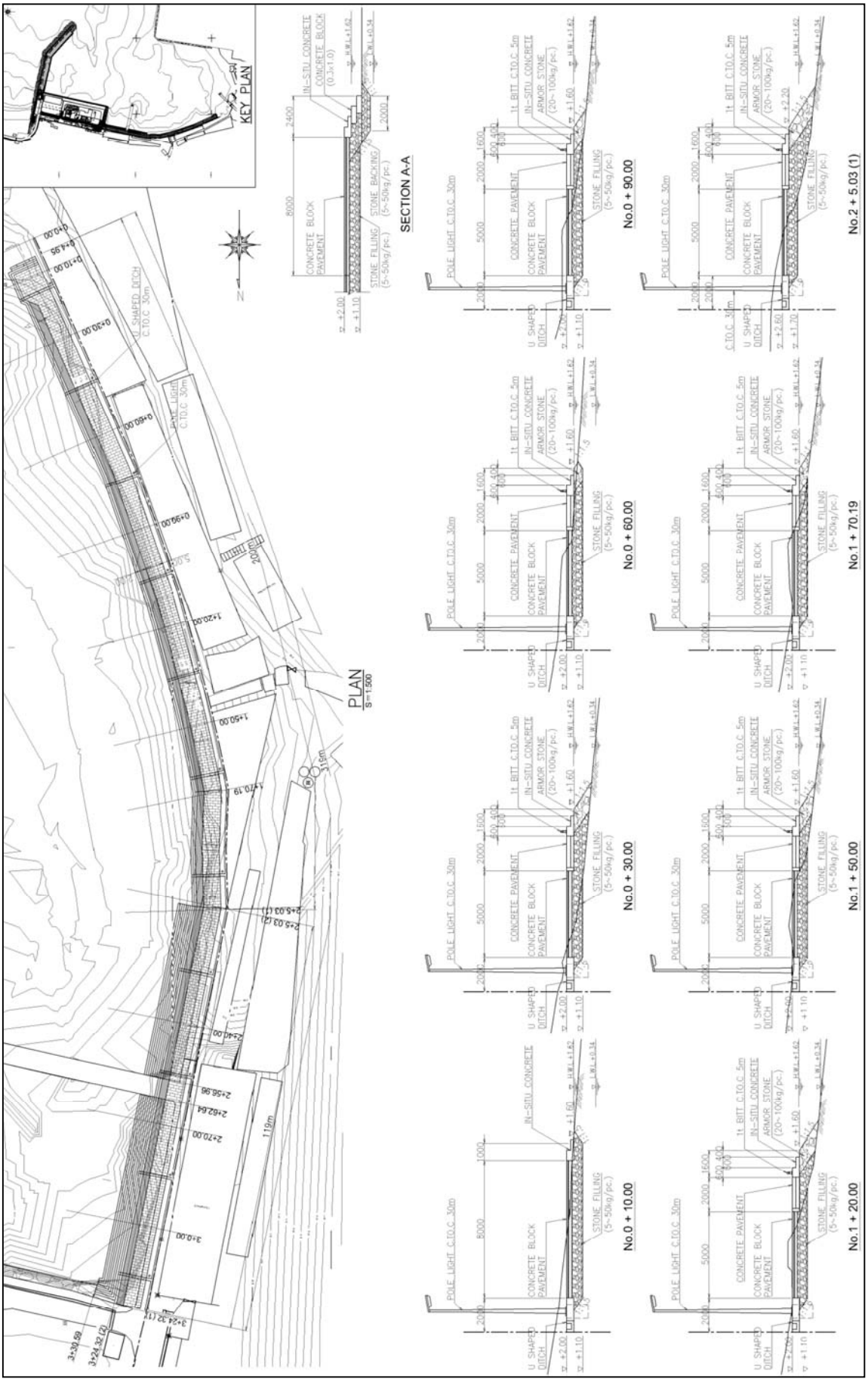


Figure 2-2-3-2(5) Typical Cross Section of Access Driveway (2)

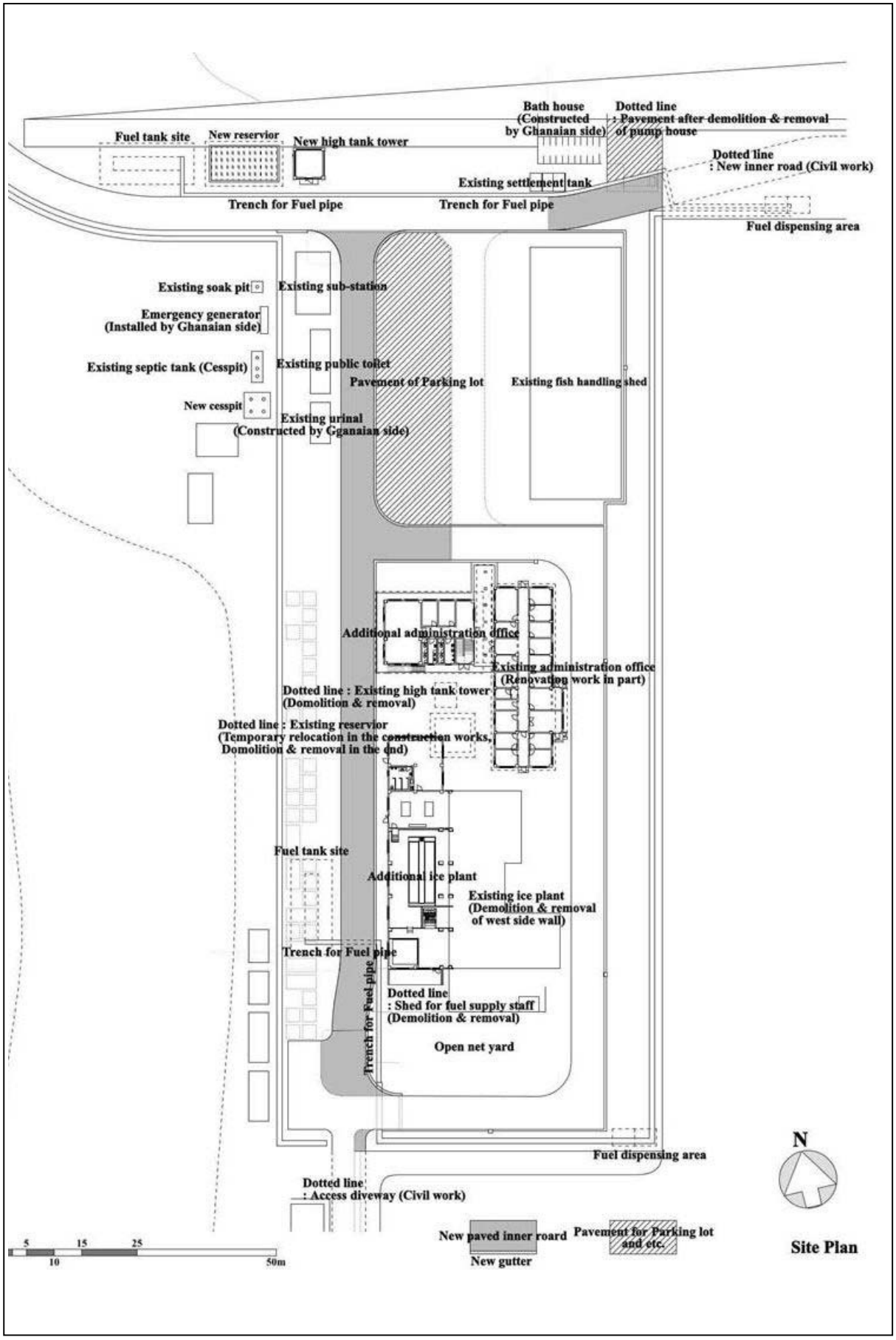


Figure 2-2-3-2 (6) Layout Plan of Land Facilities

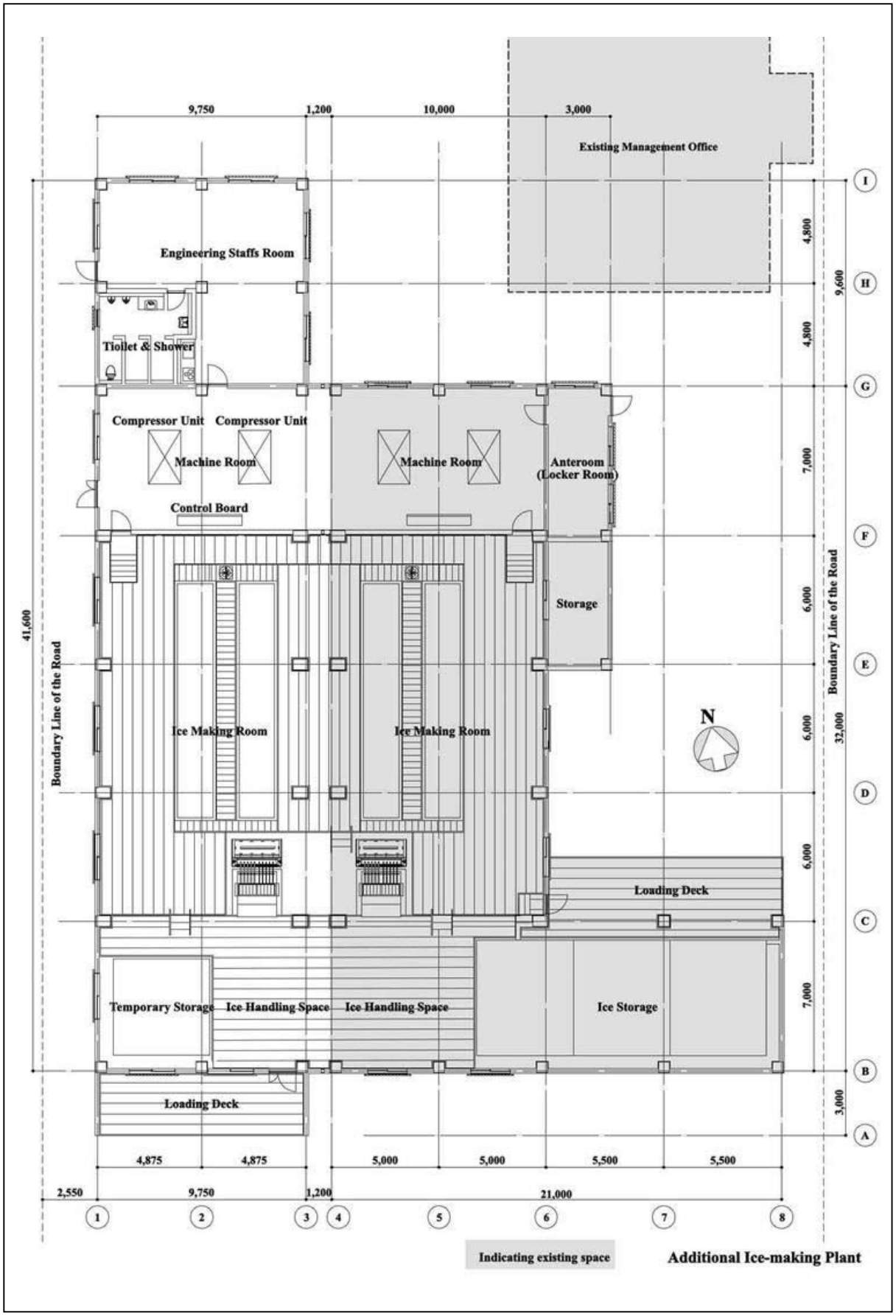


Figure 2-2-3-2(7) Layout Plan of Ice Plant

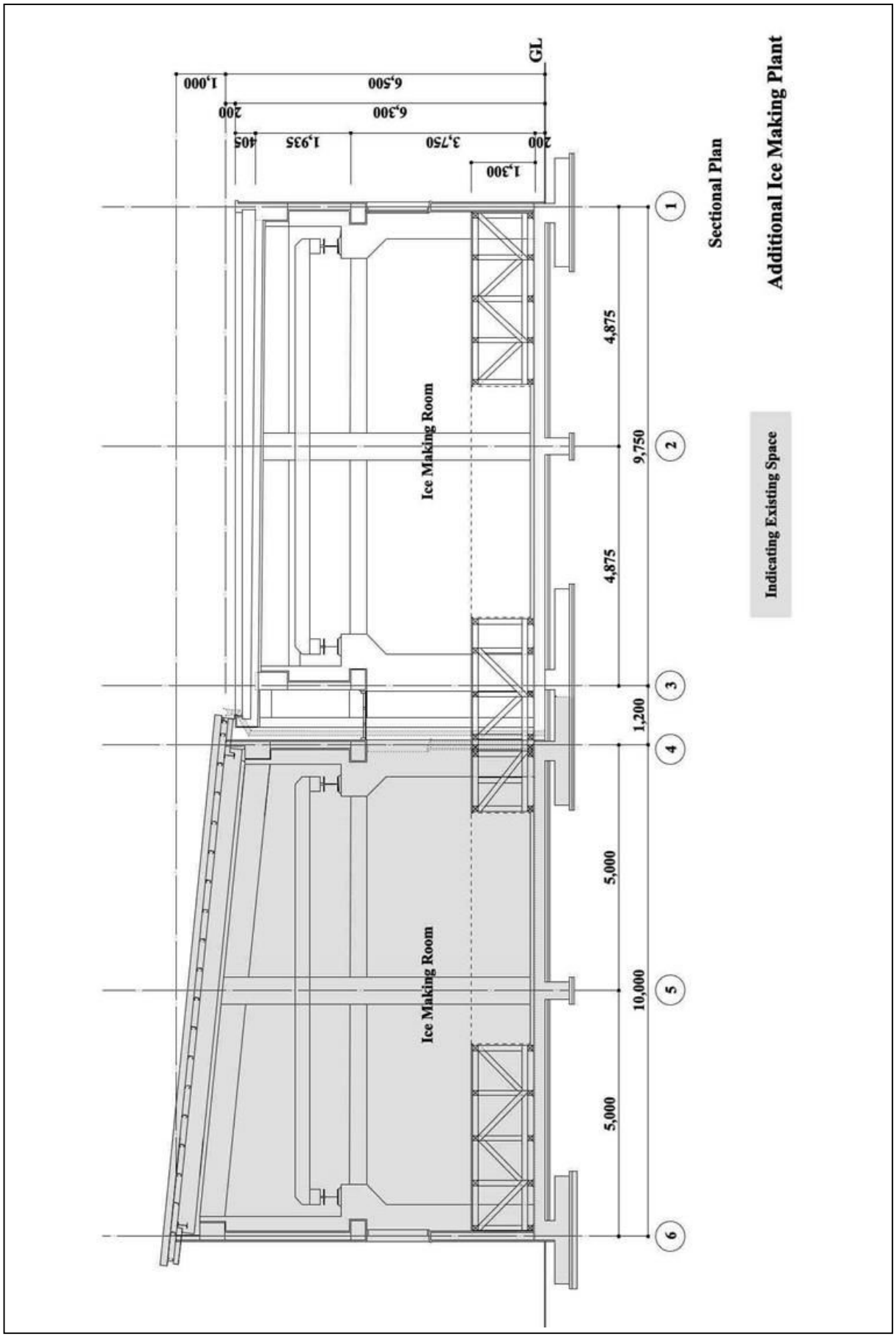


Figure 2-2-3-2(8) Sectional Plan and Elevation of Ice Plant

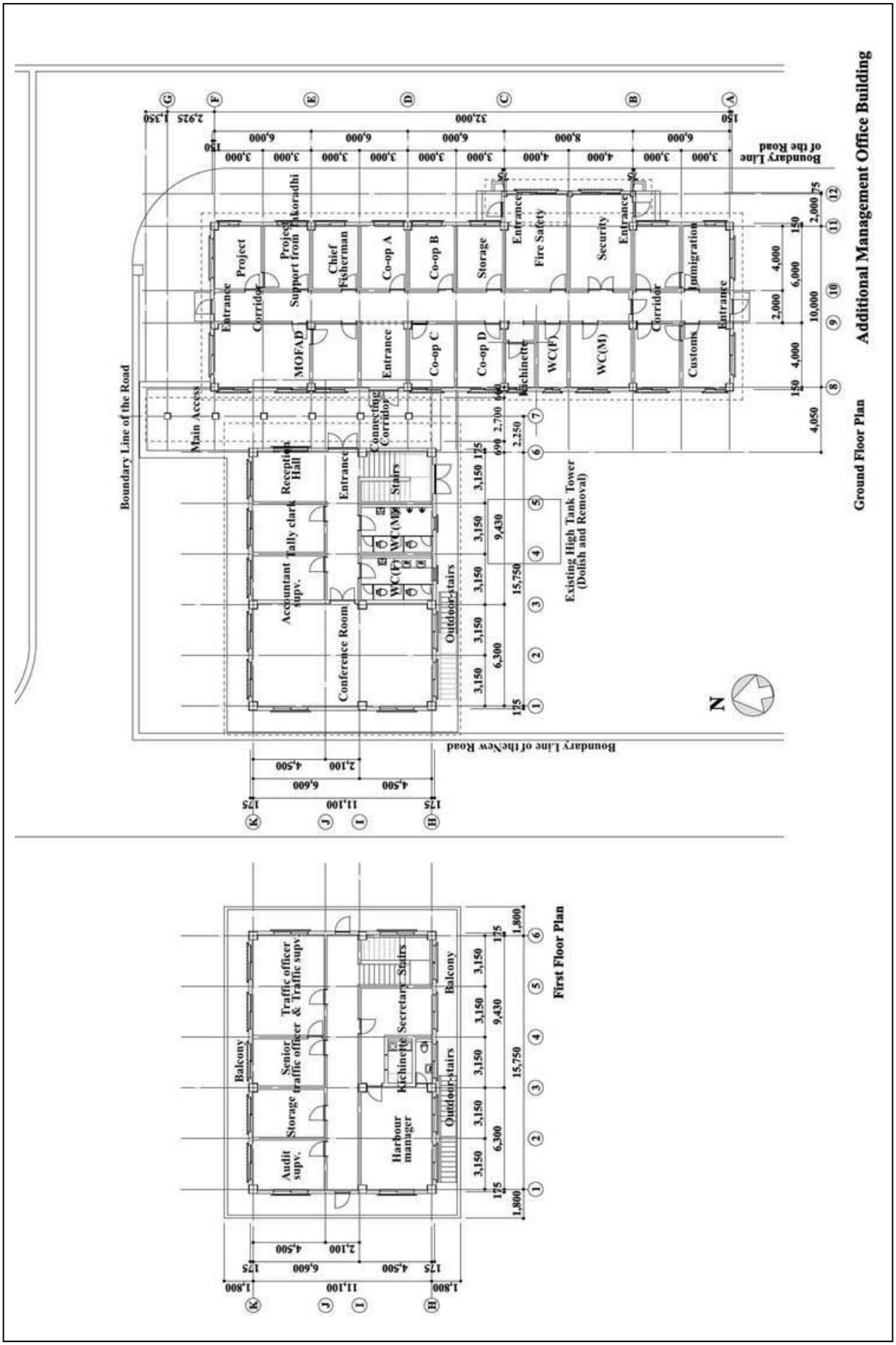


Figure 2-2-3-2(9) Layout Plan of Administration Office

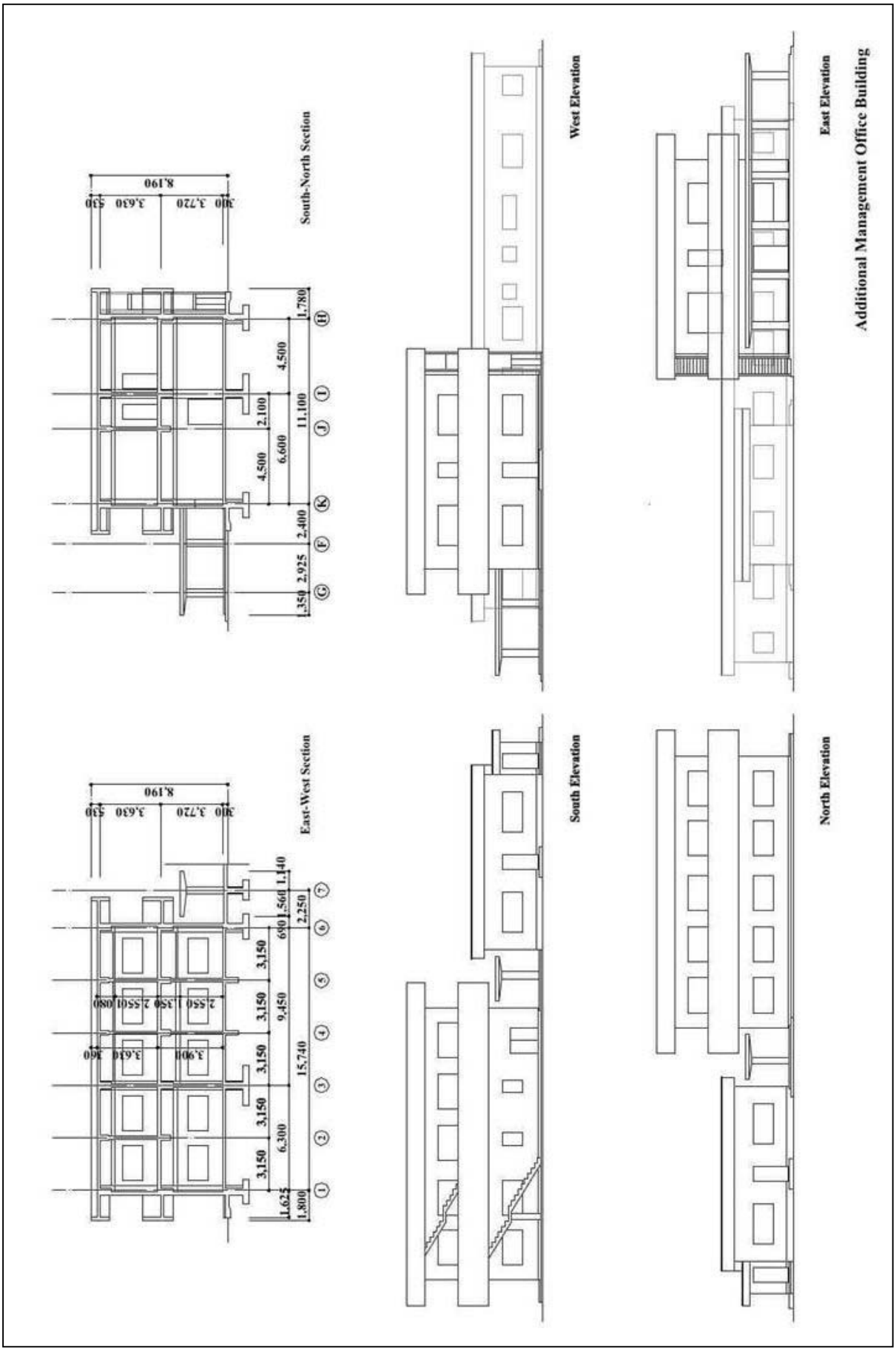


Figure 2-2-3-2(10) Sectional Plan and Elevation of Administration Office

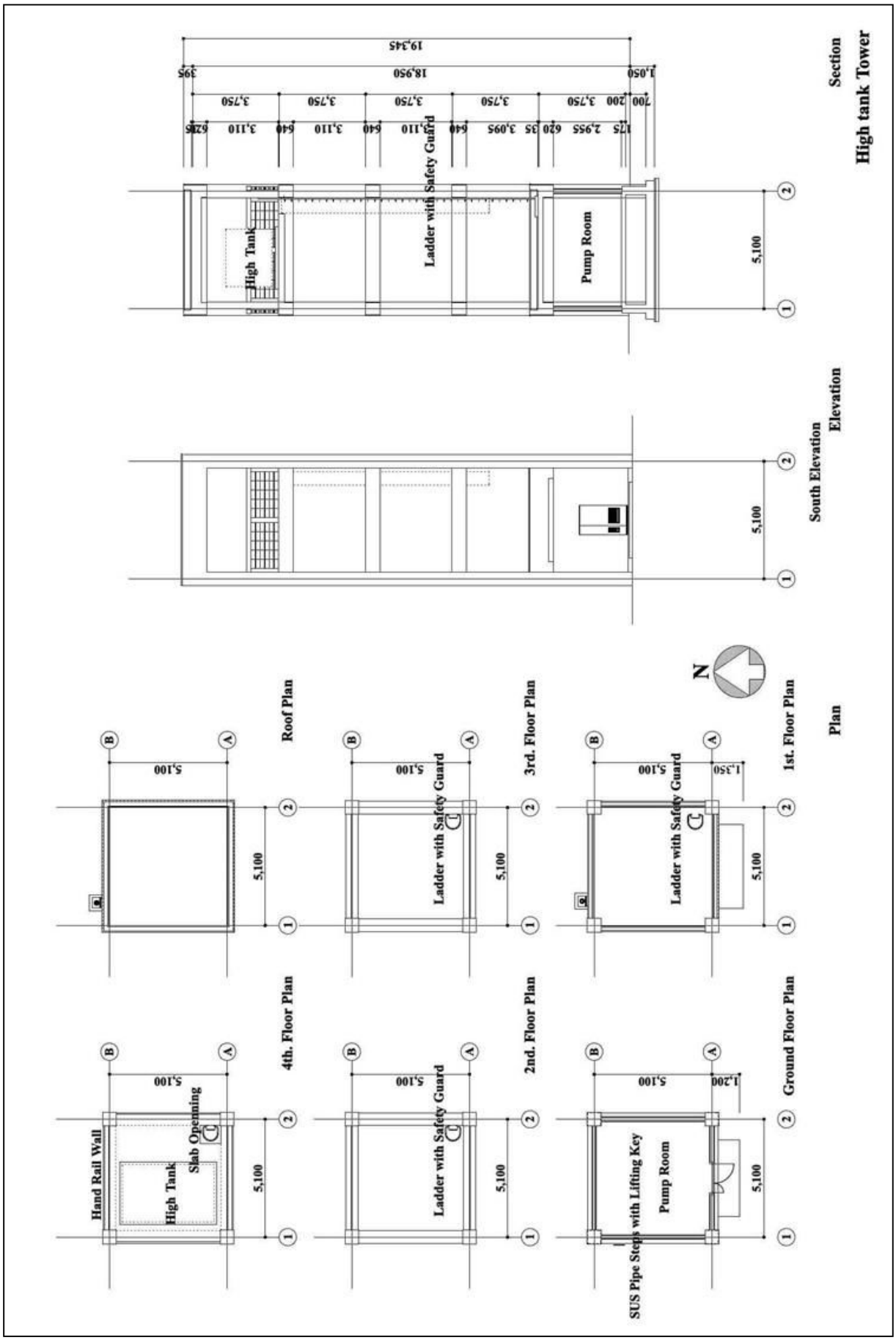


Figure 2-2-3-2(11) Layout, Sectional Plan and Elevation of High Tank Tower

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Basic Matters for Implementation

(a) After concluding the Exchange of Notes (E/N) between the Government of Ghana and the Government of Japan, the Grant Agreement (G/A) concerning the implementation of the Project for Fisheries Promotion in Sekondi is to be concluded between the Government of Ghana and JICA. The Consultant Agreement shall then be concluded between the Government of Ghana and the Consultant which holds Japanese nationality.

(b) The Government of Ghana needs to undertake procedures for environmental permits and obtain environmental approval before the tender qualification evaluation.

(c) The Consultant shall produce drawings, specifications and tender documents necessary for the construction as well as drawings necessary for the contract and, by the tender, through the evaluation of tender qualification and tender documents and upon receiving approval from the Government of Ghana, select a construction company which holds Japanese nationality.

(d) The construction work shall be executed in accordance with the Construction Contract which will be concluded between the Government of Ghana and a selected construction company.

(e) Procedures for tax exemption to be carried out by a Japanese construction company require at least 3 months for approval from the Ghanaian Parliament.

(e) Judging from the scale of the project facilities, the contents and the conditions of the construction site, the implementation design including tender and construction work will require 6 months and 18 months, respectively.

(2) Construction and Procurement Policy

(a) The civil facilities to be constructed or upgraded in the Project are the wharf improvement which upgrades the existing breakwater as well as development of an access driveway. Land facilities to be constructed are an additional ice making plant, an additional administration office, water supplying facilities and the exterior facilities.

(b) The Project is for the upgrading of an existing fishing harbour where fishing activities are conducted crowdedly on a limited site. The construction plan and schedule shall be made to secure the safety of fishermen, workers and consumers and minimize the impact on existing fishing activities.

(c) Fish are being landed and catches are being traded on the existing wharf and in the harbour adjacent to the landing berth of the project site. Thus, a silt fence to prevent water pollution shall be installed for environmental protection when putting in rubble stones, carrying out earth removal and when other works that may cause turbidity to the water are conducted.

(d) The quality and supply capacity of locally available materials and equipment shall be examined carefully and local procurement will be prioritized as much as possible to minimize procurement from Japan or third countries for cost reduction.

(e) As a principle, existing facilities that are damaged through construction work shall be recovered to their original state by the construction company.

2-2-4-2 Implementation Conditions

(1) Safety

(a) Construction vehicles will travel from the temporary yard to the project site on the main road behind the Sekondi Fishing Harbour and this will cause frequent traffic congestion for the local residents and regular vehicles. There is need to work in cooperation with the police and allocate traffic control staffs.

(b) Because the Project is to be executed while fishing activities are being conducted on the small project site, safety measures need to be taken for the transit of heavy machinery and construction vehicles transporting materials and equipment involved in the construction of the additional administration office, ice-making plant and access driveway in the existing fishing harbour. Thus, traffic control staffs (safety watchers) shall be assigned at the intersections where fishing harbour workers and construction vehicles cross.

(c) A fence will be installed around the project site and signboards put up to clarify the hazardous zones as efforts to prevent entry from third parties in the site.

(d) Because fishing vessels are likely to be traveling around the breakwater and the access driveway, sign buoys shall be placed to show the working water zone during the earth removal and wharf block installation work as an effort to prevent accidents.

(e) Temporary floating road shall be used for water access of fishermen for the use of canoe jetty. Because it is not only for the access but fishing net and gear, ice, water and fuel tank are also transported, access way with the width of approx. 5 m will be secured.

i) Upgrading work for the breakwater will be carried out first and its partial use will begin after completion with consideration given to congestion of existing fishing vessels.

ii) Temporary floating road (unifloat), etc., shall be installed for fishermen and port workers to secure their access to the existing canoe jetty during construction of the access driveway.

iii) Attention shall be paid to prevent accidents in places such as the construction site and exterior work area on the project site where fishing activities and construction vehicles are busily working.

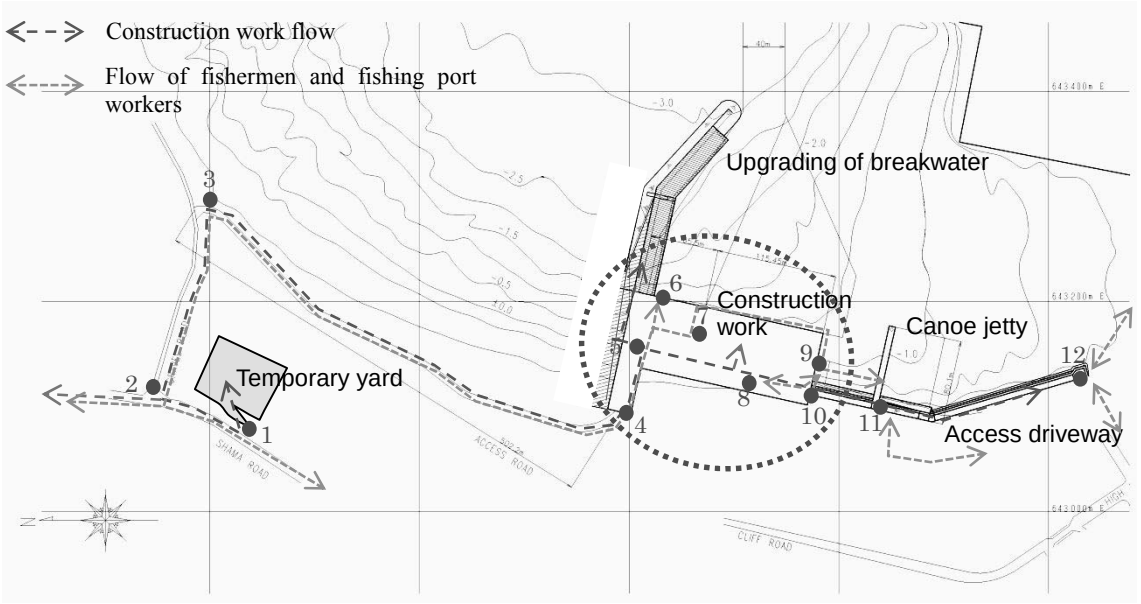


Figure 2-2-4-2(1) Allocation of Traffic Control Staffs during Construction

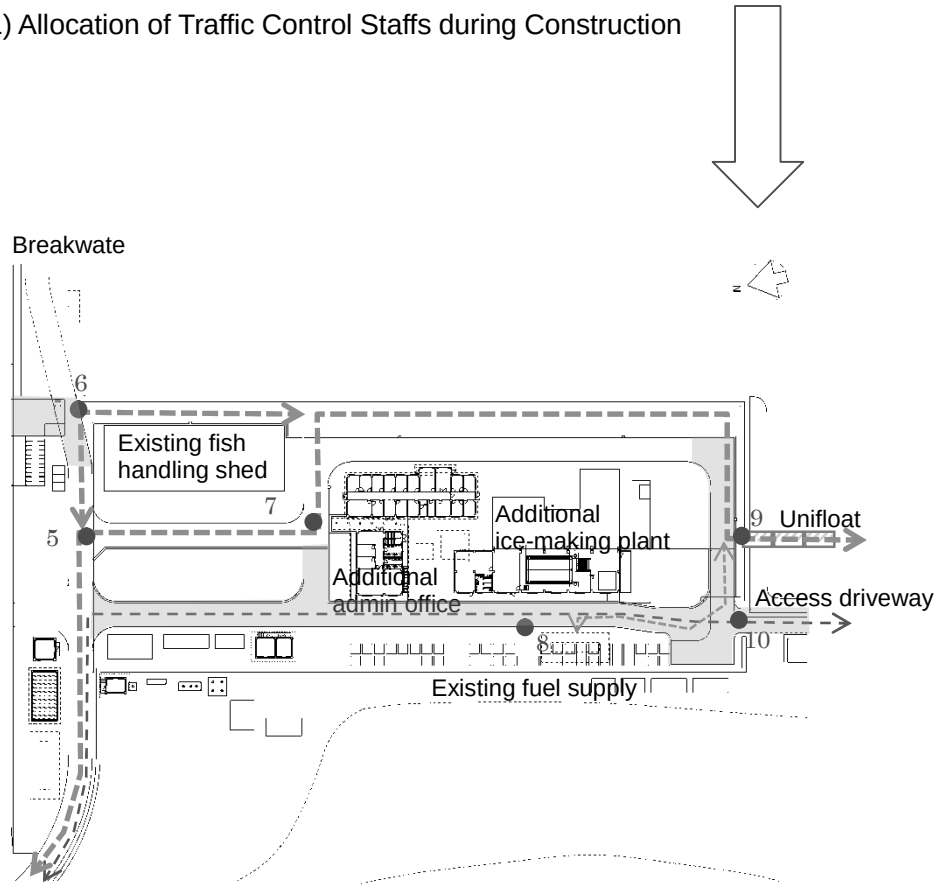


Figure 2-2-4-2(2) Allocation of Traffic Control Staffs during Construction (Close-up)

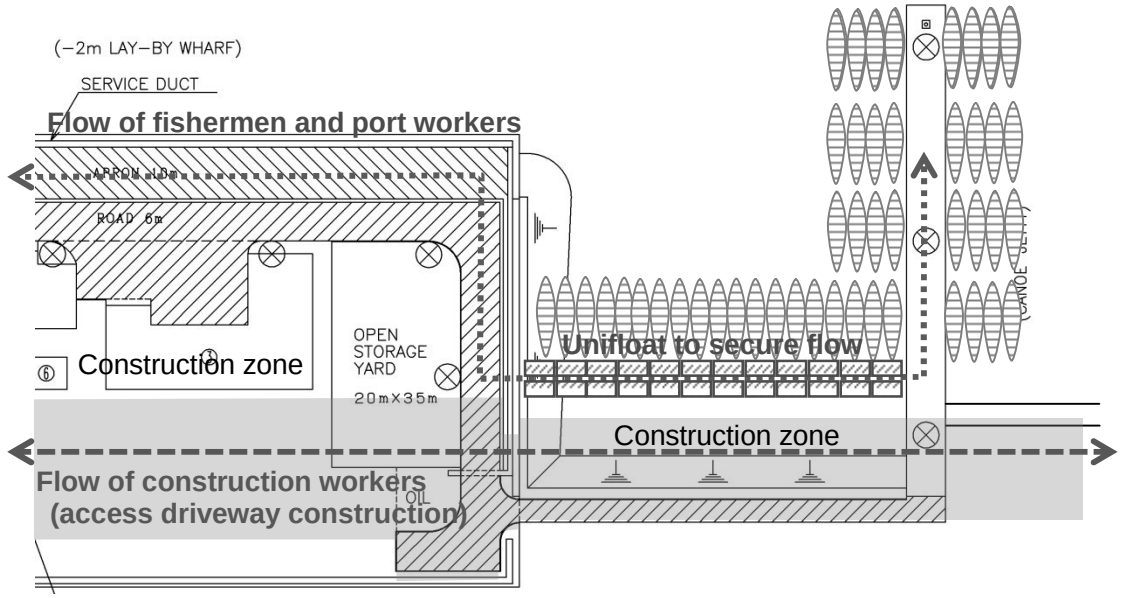


Figure 2-2-4-2(3) Secure Flow of Fishermen using Temporary Floating Road (Unifloat) during Construction

(2) Concerns related to Construction

(a) The additional lay-by berth (improvement of existing breakwater) shall be constructed from land using the spreading method to reduce the construction period and cost.

(b) When planning temporary facility, construction method and schedule, local natural conditions (1.3 m tide range) shall be appropriately taken into consideration.

(c) The number of staff and expert engineers to be dispatched from Japan, the timing and duration shall be planned properly in accordance with the progress of the Project.

(d) Locally available materials shall be used as much as possible to minimize procurement from overseas.

(e) Because soil discharged from earth removal contains a great deal of silt and sludge, it needs to be treated at a certain disposal area.

(f) The breakwater improvement works for the immediate use as berthing facility shall be constructed first.

(g) The Project is likely to include relocation of small stores (locally referred to as kiosks and containers) to be carried out by the Ghana side for the construction of the access driveway. A total of 15 stores (13 persons) are subject to temporary relocation and, at a meeting on August 1, 2013, they agreed on the temporary relocation due to the project implementtion. The GPHA is to secure the temporary relocation site.

(h) The GPHA is to notify owners of abandoned and sunken vessels and used engines in the Sekondi Fishing Harbour to request they remove them within a certain period and it is to dispose of them if they are not removed. The GPHA issued the notice to request their removal by October 21, 2013, in the newspaper (Ghana Times) on October 3, 2013.

(3) Basic Information on Project Site and Surroundings

1) Temporary Construction Yard

The GPHA approved the 3 ha area for the temporary construction site shown in Figure 2-2-4-2(4). The temporary construction yard necessary for construction work is estimated to require an area of approx. 7,200m^2 including a yard for casting and shifting concrete blocks of approx. 2,400m^2, stone storage area of 1,800m^2, workshop / construction material storage area of approx. 1,200m^2, office and heavy machinery storage of approx. 1,800m^2.

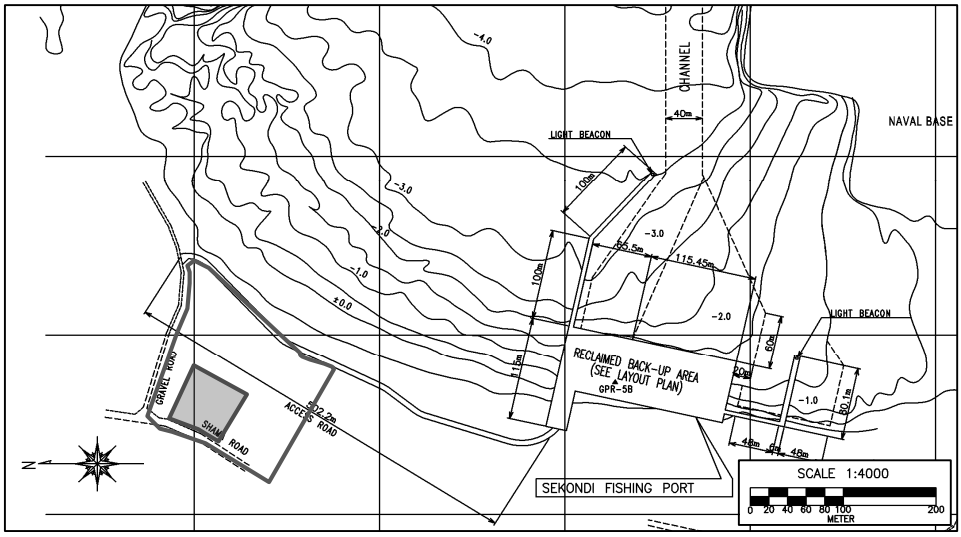


Figure 2-2-4-2(4) Temporary Construction Yard Layout

2) Soil Disposal and Construction Waste Disposal Site

The soil and construction waste disposal site is located approx. 7km from the project site as shown in Figure 2-2-4-2(5). It needs to be treated at a proper site in an environmentally friendly manner, particularly because the bottom soil of the fishing harbour contains sludge.

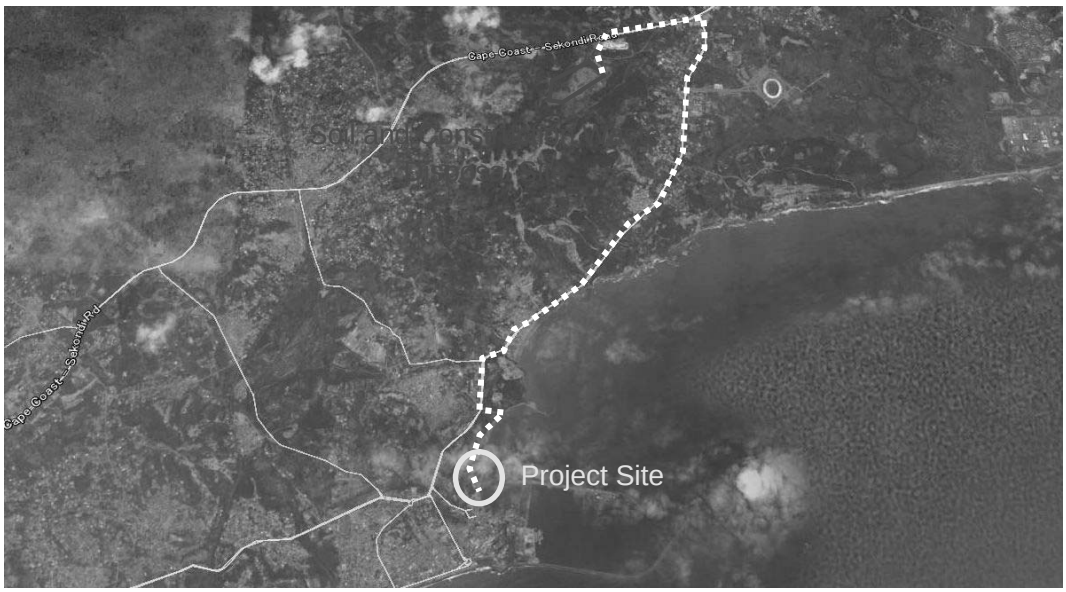


Figure 2-2-4-2(5) Location of Disposal Site

(4) Construction Conditions

1) Construction Company

Construction companies in a construction rush in Ghana are concentrated in Accra, the capital and Tema. Road pavement work, revetment work along the coastline and hotel and building construction have been conducted recently in Takoradi-Sekondi partly due to the impact of oil field excavation. Some builders have experience as subcontractors of other grant aid projects and thus they will not have performance problems in pavement work and general construction works. There are quarries around Sekondi Fishing Harbour and construction companies also provide ready-mixed concrete from quarries and produce interlocking blocks and concrete blocks.

Thus, local construction companies are likely to have the technical capacity to serve as subcontractors under a Japanese construction company. However, as they have little experience in concrete block installation for berth construction, for which accuracy is required, such work needs to be performed under the instruction of skilled engineers from Japan and third countries.

2) Labor

Labor necessary for general earth work, pavement and construction work will be procured in Ghana. However, as large crawler cranes are needed for installation of cellular concrete blocks in the Project, skilled workers who can operate them need to be dispatched from Japan. Thus, there will be some offshore work. Divers who are experts in port and harbour construction works need to be dispatched from Japan to supervise the work.

Ice making plant is a special facility and also requires special skills. Assembly defects in the assembly works of the ice making tank, welding defects in pipes and brine and refrigerant leakage lead to fatal defects. It is also difficult to install electric systems locally as it requires collaborated control settings, etc. Thus, the ice making plant work shall be performed under the supervision of engineers, welders and electricians to be dispatched from Japan.

3) Construction Machinery

Local construction companies own general construction machinery for earth works, pavement work, construction and transportation in Ghana. However, they do not own barge type platforms for offshore work or large cranes and such work is performed by overseas construction companies.

Thus, as a principle, construction works shall be carried out on land with consideration given to locally available machinery and 100 t and 50 t crawler cranes needed for the Project will be procured from Japan as it is difficult to obtain them from neighboring counties.

4) Construction Materials

Construction materials produced in Ghana include stone materials, cement, ready-mixed

concrete, secondary concrete products, timber and re-bars. Although general construction materials are locally available, stores are small and most of them are imported and concentrated in Tema. Thus, when they are needed in large quantities, subcontractor construction companies import them from overseas for each project. The main materials are supplied as described below.

(a) Ready-mixed Concrete

Commercial concrete plants are near the project site and it can be supplied.

(b) Stone and Aggregate

There is a stony mountain near the project site and they can be supplied.

(c) Interlocking Blocks and Concrete Blocks

There are local suppliers and they can be supplied.

(d) Re-bars and Steel Materials

An India-based company began production of re-bars, H-shaped steel, L-shaped steel, flat steel and wire mesh, etc., in the inland city of Kumasi and sells them based in Tema where there is a high demand. Although there is no problem with quality, as they inspect the products by each production lot, they are nearly twice as expensive as those in Japan and it is less expensive to purchase them from Japan even when transportation cost is included. Thus, as a principle, they shall be procured in Japan.

2-2-4-3 Scope of Works

The scope of works to be undertaken by the Government of Japan and the Government of Ghana is as follows.

(1) Scope of Works to be Undertaken by the Government of Japan

1) Construction Works

(a) Additional lay-by berth (improvement of existing breakwater)
(b) Access driveway with canoe berthing facilities
(c) Additional ice making plant
(d) Additional administration office
(e) Pavement of the area behind the fish handling shed (including access driveways, parking lot/net mending area and street lights)
(f) Utilities (water supply, septic tank, high water tower, refueling and water ducting, etc.)

2) Technical Assistance (Soft Component)

Soft component for maintenance and operation is to be provided.

(2) Scope of Works to be Undertaken by the Government of Ghana

a) Implementation of Environmental Impact Assessment (EIA)	GHS	300,000	(Approx. 15.0 million Yen)
b) Relocation OF small stores (transfer)	GHS	4,500	(Approx. 0.23 million Yen)
c) Disposal of wastes in project water basins (abandoned and sunken vessels, etc.)	GHS	100,000	(Approx. 5.0 million Yen)
d) Disposal of wastes in project sites (used engines, etc.)	GHS	10,000	(Approx. 0.5 million Yen)
e) Fencing around existing fuel supply station	GHS	32,000	(Approx. 1.6 million Yen)
f) Installation of fuel supply station	GHS	150,000	(Approx. 7.5 million Yen)
g) Soil disposal expense associated with excavation of the seabed	GHS	68,000	(Approx. 3.4 million Yen)
h) 2 personnel for technical assistance (soft component):	GHS	30,000	(Approx. 1.5 million Yen)
i) Banking arrangement fees:	GHS	39,000	(Approx. 1.95 million Yen)

2-2-4-4 Consultant Supervision

Consistent and smooth detailed design work and construction supervision work of the Project shall be executed by the consultant who understands well the Preparatory Study in accordance with the policies of Grant Aid Cooperation of the Government of Japan. The consultant shall dispatch a resident supervisor who has enough experience in construction works and also dispatch expert engineers at the necessary times for work progress inspection, supervision and instruction to be executed in addition to the work for construction supervision and liaison.

(1) Policy of Construction Supervision

(a) The supervisor aims to have close contact with both national relevant organizations and the persons in charge and complete facilities without delay in accordance with the construction schedule.

(b) The supervisor gives timely and proper instructions and advises to persons related to the construction of facilities so that construction conforms to the design drawings.

(c) The supervisor, as much as possible, gives priority to adopting local construction methods with local materials.

(d) The supervisor deals with technical transfer related to construction methods and techniques and produce the effects as Grant Aid Cooperation.

(e) The supervisor persuades proper instructions and advises on smooth operations concerning the maintenance of the project facilities after completion.

(2) Construction Supervision Work

(a) Service for Construction Contract

The Selection of Contractor, decision on the construction contract type, doccumentation of the draft of construction contract, checking construction breakdown, witnessing construction contracting and others are to be executed.

(b) Service for Inspection and Confirmation of Shop Drawings

Inspection shall be done for shop drawings, materials and others which will be proposed by the contractor.

(c) Service during Construction Works

Examination of the construction plan and construction schedule, instruction for the construction company and report on construction progress to the Client.

(d) Cooperation for Payment Approval Procedure

Cooperation for checking invoices of construction fees which will be paid during construction and after completion of construction shall be made.

(e) Witness on Inspection

When required, inspection as each work progresses during the construction period shall be done and instructions given to the construction company. The Consultant shall finish the work upon confirming that all construction contracts have been fulfilled and construction work completed and witnesses the handing over of the facilities which are described in the contract with receipt confirmation from the Client. In addition, the consultant shall report necessary matters for work progress during the construction period, payment procedures and handing over after completion to the Government of Japan.

2-2-4-5 Quality Control Plan

Materials to be used in the construction shall be controlled in conformity with Common Specification for Construction of Fishing Ports (National Association of Fisheries Infrastructure, Japan), Common Specification for Construction of Port and Harbor (Ministry of Land, Infrastructure, Transport and Tourism, Japan), Japan Industrial Standards (JIS), British Standards (BS) and the American Society for Testing and Materials (ASTM) and they shall get prior approval from the Consultant before their actual use.

As for the ready-mixed concrete to be used in the construction, composition of concrete shall

be designed, and strength, mixing time, etc., shall be confirmed through a trial mixing before using and the casting method shall be examined.

2-2-4-6 Procurement Plan

(1) Procurement Policy

As for locally available materials and equipment, their quality and supply capacity shall be fully examined and local procurement shall be prioritized as much as possible. Those that are hard to be procured locally shall be obtained from Japan or third countries.

(2) Transportation Route

A procurement and transportation plan has to be made for materials and equipment to be procured in Japan, that require production on order or processing in Japan, in consideration of the time from order placement to manufacturing, packaging and shipment. The surface transportation from Japan to Sekondi shall be via Cape Town and transshipment is required in Shanghai and Tema before arriving at the final destination of Takoradi Harbour. It shall be land transportation from Takoradi Harbour to Sekondi Fishing Harbour. Thus, the transportation is estimated to require 2.5 months.

(3) Procured Items

(a) Construction Materials

Procurement sources of main construction materials are shown in Table 2-2-4-6(1).

Table 2-2-4-6(1) Procurement Source of Main Construction Materials

Construction Materials		Procurement Sources			Remarks
		Local	Japan	Third Country	
Civil	Ready-mixed concrete	○			
	Stone material	○			
	Interlocking block	○			
	Reinforcing steel bar		○		Price, quality
	Berth accessories (fender, bollard)		○		Availability
Building	Ready-mixed concrete	○			
	Re-bar, steel frame		○		Price, quality
	Concrete block	○			
	Timber, forming materials		○		
	Roof material	○			
	Electric and equipment materials	○			
Special facility	Ice making plant		○		Availability, quality

(b) Construction Machinery

Table 2-2-4-6(2) shows procurement sources of main construction machineries.

Table 2-2-4-6(2) Procurement Source of Main Construction Machineries

Main Construction Machinery		Supplying Country			Note
		Locally	Japan	Third Country	
Bulldozer	3t, 5t	○			
Backhoe	0.8m^3, 1.4m^3	○			
Dump truck	10t	○			
Crawler crane	Lifting capacity of 50t, 100t		○		Availability
Truck crane	25t	○			
Vibration roller	3～4t	○			

(4) Tax Exemption

All materials and equipment procured locally, or in Japan or third countries are exempted from taxation. It usually takes three months from the application for tax exemption to the approval from the Parliament. Attention needs to be paid to ensure that the application form has a master list of materials and equipment to be procured under company names including the subcontractors for tax exemption. The specific procedures are described below.

(a) The construction company prepares a master list of all materials and equipment and equipment to be procured locally or in Japan or third countries (including those for subcontractors) after tender and obtains approval from the GPHA and the Ministry of Transport. The materials and equipment shall have their name, unit price, volume, price, and country where they are procured as well as the company names of subcontractors if any.

(b) The master list shall be submitted to customs and the amount of tax shall be assessed.

(c) The document listed below shall be submitted to the Ministry of Finance and the procedures complete upon the approval from the Cabinet and Parliament.

- Grant agreement and contract agreement
- Master list of materials and equipment for the Project (prepared by construction company)
- Tax assessment on the master list of materials and equipment for the Project (prepared by customs)

2-2-4-7 Operation Guidance Plan

The Project does not include equipment procurement. Although procurement of ice making plant as special facilities is planned, there is no problem related to the maintenance of existing ice making plant as the local engineers are highly capable and the newly procured units are the same type as the existing ones. Thus, no instructions on initial and normal operation shall be given.

2-2-4-8 Soft Component (Technical Assistance) Plan

(1) Background of Soft Component

1) Position of Soft Component

The Project for Fisheries Promotion in Sekondi is to expand the lay-by wharf and access driveways and expand the fishing harbour administration office and ice making plant in order to improve the capacity and function of the harbour.

The capacity and function of the fishing harbour as a result of the project implementation will be promoted. There is no problem related to the financial capacity of GPHA or the technical maintenance capacity of the harbour facilities. However, instructions on fishing harbour operation and management will be given to the harbour operators as its administrators have been insufficient after the completion of Phase I while fishing vessels that use the harbour have increased, the berthing facility has become crowded and the net storage area is in short supply. As a result, the facility is not functioning fully, causing more congestion. Although facility utilization fees are set, more than a few users fail to pay them. It is mainly because of a lack of capacity from harbour administrators and a lack of recognition from harbour users. Most people believe that GPHA regards Sekondi Fishing Harbour as an infrastructure for social contribution and tried to satisfy the requests of many users, which resulted in vague user classifications.

Under such circumstances, it is essential that the harbour's operation and management, including the traffic control in the harbour, is properly conducted after the project completion is regarded as one of the aims of the technical assistance.

2) Contents of Soft Component

It is important to formulate an operation and management plan for the enhancement of the harbour operation capacity. The technical assistance on matters outlined below need to be provided.

(a) Improvement of the operation and management system with clear descriptions of responsibilities

(b) Establishment of Fishing Harbour Advisory Committee consisting of representatives of harbour users

(c) Regulations on fishing harbour usage with zoning (fish landing zone, preparation and resting zone, fuel and water supply zone, fishing gear storage, etc.)

(2) Goal of Soft Component

The goal of the soft component is as follows.

<Goal>: To enhance operation capability of the operation and management organization of Sekondi Fishing Harbour for its appropriate use.

(3) Achievement of Soft Component

The following is expected to be achieved by installation of the soft component:

Achievement 1: Formulation of feasible fishing harbour operation and management plan

Have GPHA prepare a basis for operation and management plan (draft) to discuss its feasibility with fishing harbour operators and administrators. Have a stakeholder meeting (first session) by harbour user group on the regulations for using the harbour, including the zoning, to build consensus. Review the plan based on the stakeholder meeting results to finalize the plan (draft).

Achievement 2: Compliance and understanding of regulations on harbour usage by harbour users

Have GPHA fishing harbour operation instructors fully understand harbour use regulations and educate instruction methods in the workshop. Have a stakeholder meeting (second session) with such user groups as fishermen and fish mongers to raise their awareness of the regulations and understanding of the effects of the proper fishing harbour operation so they will comply with the regulations.

(4) Confirmation Method of Achievement

The method to confirm each achievement above is listed in Table 2-2-4-8(1).

Table 2-2-4-8(1) Confirmation of Achievement Level

Achievement	Check list for confirmation of achievement level
Achievement 1: Formulation of feasible fishing harbour operation and management plan	(i) Final operation and management plan
	(ii) Minutes of the stakeholder meeting (first session) on usage regulations for each harbour user group to see the progress of consensus
Achievement 2: Compliance and understanding of regulations on harbour usage by harbour users	(i) Workshop record for GPHA fishing harbour operation instructors
	(ii) Minutes of the stakeholder meeting (second session) for each user group
	(iii) Installation of signs and zoning signboards that clearly show the zoning for fishing harbour users
	(iv) Awareness of harbour users on facility usage fees

(5) Soft Component Activities (Input Plan)

The soft component is related to enhancement of operation of Sekondi Fishing Harbour and is carried out in two sessions of 1.5 months expected in the high season during the construction period and for 1.0 month expected before handover of the project facilities (before completion of construction).

Table 2-2-4-8(2) Soft Component Activity (Input Plan)

Achievement 1	Formulation of feasible fishing harbour operation and management plan
Activity	• Discuss the feasibility of an operation and management plan (draft) prepared by GPHA with fishing harbour operators and administrators. • Stakeholder meetings (first session x 7 times of detailed meeting by zone) with harbour user groups on the regulations for using the harbour, including the zoning, to build consensus. • Review the plan (draft) based on the stakeholder meeting results to finalize it. <Target> GPHA's Fishing Harbour Advisory Committee (10 members), GPHA staff in charge of fishing harbour operation (8 members), chief fisherman, inshore vessel association, canoe associations (2 associations of net fishing and handline fishing), fish mongers, store operators, smoked product makers, fish retailers and fishermen
Execution Resources	• 1 Japanese consultant: 1.5 MM • 1 Local interpreter: 0.5 MM
Products	<Japanese side> • Minutes of stakeholder meeting (first session x 7 times of detailed meeting by zone) with harbour user group • Finalization of operation and management plan • Operation report
Achievement 2	Compliance and understanding of regulations on harbour usage by harbour users
Activity	• Have fishing harbour operation instructors fully understand harbour use regulations and educate them on instruction methods in the workshop. Have a stakeholder meeting (second session) with such user groups such as fishermen and fish mongers to raise their awareness of the regulations (including user fees) and understand the effects of the proper fishing harbour operation. <Target> Fishing Harbour Advisory Committee (10 members), GPHA staff in charge of the fishing harbour operation (8 members), chief fisherman, inshore vessel association, canoe associations (2 associations of net fishing and handline fishing), fish mongers, store operators, smoked product makers, fish retailers and fishermen
Execution Resources	• 1 Japanese consultant : 1.0 MM • 1 Local interpreter: 0.5 MM
Products	<Japanese side> • Records of workshop for fishing harbour operation instructors • Minutes of stakeholder meeting (second session x 6 times of detailed meeting by zone) by harbour user group • Completion report <Ghana side> Signs and signboards that show harbour zoning

(6) Execution Resources for Soft Component

The soft component is provided by one Japanese consultant as described above, who will be dispatched from the consultants in charge of the preparatory survey to effect achievement, efficiency and consistency with basic design concepts. GPHA shall also dispatch two employees with experience in working as Sekondi Fishing Harbour Manager as local assistants (GPHA is responsible).

The English literacy rate in Western Region of Takoradi-Sekondi City is approx. 47% and a local interpreter is needed during the stakeholder meetings for fishermen and fish mongers working in Sekondi Fishing Harbour as they understand only the local language (Akan).

(7) Execution Schedule of Soft Component

The execution schedule of the soft component (for reference) is shown in Table 2-2-4-8(3).

Table 2-2-4-8(3) Execution Schedule of Soft Component (for reference)

Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
* Construction tender	▲																			
(1) Formulation of activity execution plan									▒											
(2) Discussion with GPHA on operation and management plan (draft)										■										
(3) Stakeholder meeting (first session)										■	■									
(4) Finalization of operation and management plan										■	■									
(5) Workshop for fishing port operation instructors																	■			
(6) Stakeholder meeting (second session)																	■	■		
(7) Summarization of activity achievement																	■	▒		
* Construction completion																			▲	

(Note) ▒ Japan ■ Ghana

(8) Obligation of Recipient Country

GPHA needs to reform the operation and management system of Sekondi Fishing Harbour that is to be organized in the project by 7 months after tender prior to the execution of the soft component to have it ready for operation. It shall dispatch two employees with experience in working as Sekondi Fishing Harbour Manager as local assistants (GPHA is responsible) while technical assistance is provided.

It is also expected to work in cooperation with the Japanese consultant for holding stakeholder meetings and workshops (preparation, provision of venue, invitations to participants, chairperson, etc.).

2-2-4-9 Implementation Schedule

The Grant Agreement is going to be concluded between JICA and the Government of Ghana after concluding the Exchange of Notes between both governments when this project is implemented through the Grant Aid Cooperation of the Government of Japan. Following this, the Government of Ghana shall select the Consultant which has Japanese nationality, and the

design and supervision contract between the Government of Ghana and the Consultant shall be concluded. Thereafter, through the detailed design, making up of tender documents, tendering, construction contract and construction works, the project will be completed.

(1) Detailed Design Works

After concluding the Consultant Service Agreement between the Ghanan implementing agent of this Project (GPHA) and the Consultant, through the approval of the contract by JICA, the Consultant shall commence the detailed design. At that stage, detailed design documents, specifications, one set of tender documents including drawings and tender procedures will be prepared. During this period, the discussion on the contents of the project facilities and equipment with the Government of Ghana shall be held and the approval on one set of tender documents shall be given at the last stage. Because the Project requires temporary relocation of small stores and environmental approval from the government of Ghana, the progress also needs to be confirmed.

Detailed design needs approx. 3.5 month period to be completed.

(2) Tender Procedure

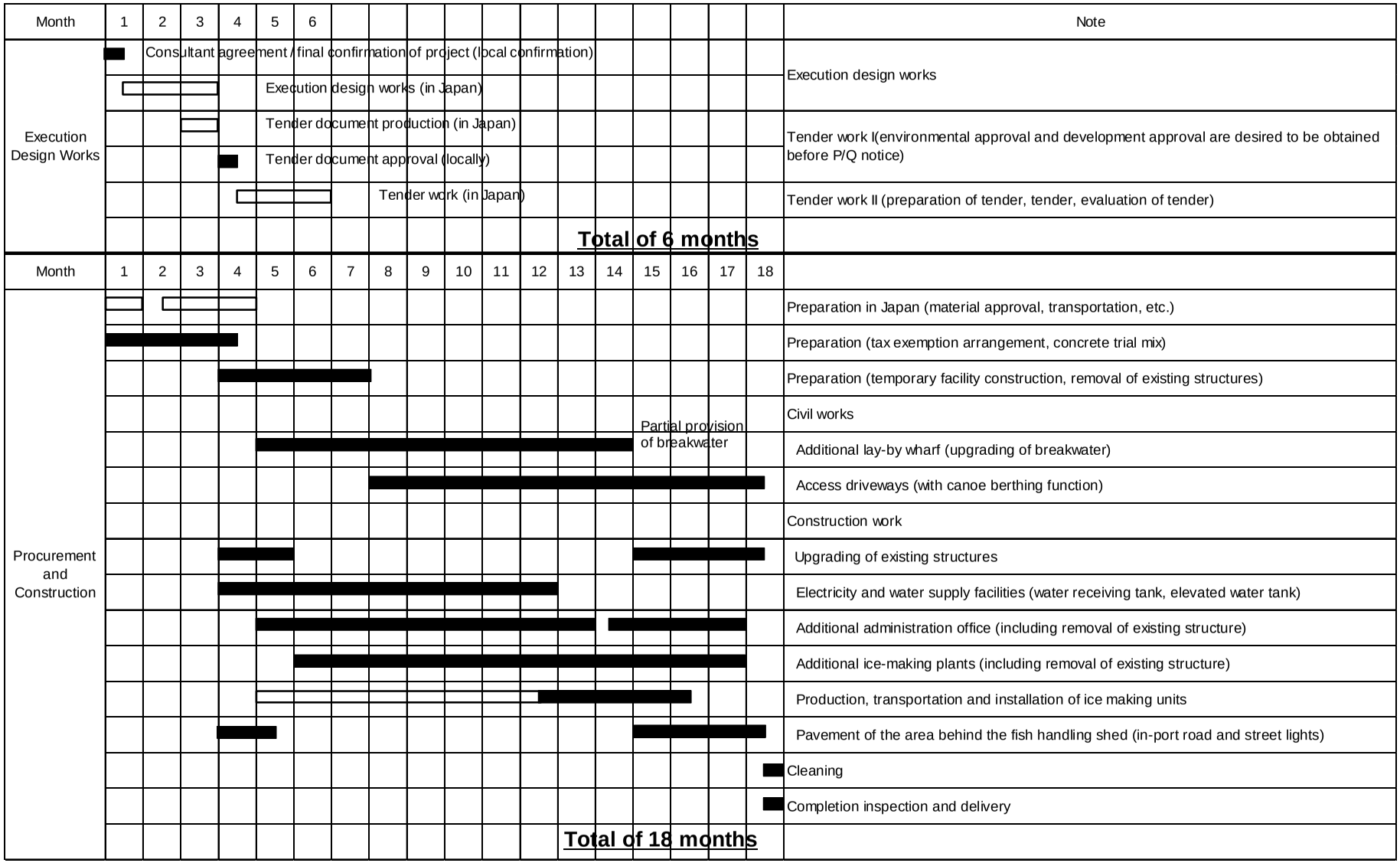
A Construction Company of Japanese nationality for this project is going to be selected by tender. The tender takes approx. 2.5 months through requiring tender notice, receipt of participation interest, prequalification, issuance of tender documents, execution of tender, evaluation of tender result, appointment of the construction company and creation of the construction contract, in that order.

(3) Construction Work

After conclusion of the construction contract, the construction shall be commenced following verification of the contract by JICA. The construction period is estimated to require 18 months (with the precondition that the tax exemption procedures are completed within 3 months) based on the condition that the relocation of small stores, handling of abandoned and sunken vessels, removal of used engines is completed and environmental approval is obtained from the government fo Ghana and in consideration of the facility's scale, contents and the local construction conditions.

The project implementation schedule from the conclusion of the Exchange of Notes (E/N) to the completion of the Project is shown in Table 2-2-4-9(1).

Table 2-2-4-9(1) Project Implementation Schedule



2-3 Obligations of the Recipient Country

As indicated in the Minutes of Discussions on this preparatory survey, obligations of the recipient country are outlined as follows.

(a) Land acquisition of the project site

(b) Implementation of EIA (Environmental Impact Assessment) and obtainment of Environmental Permission prior to the project implementation

(c) Temporary relocation of small stores

(d) Site clearance such as removal of abandoned/sunken fishing vessels, used engines left on the harbour ground, multiple fuel supply tanks, and ship building/repair yards occupying the beach

(e) Diversion and detour of sewerage channels that discharge waste water to Old Beach

(f) Provision of a temporary construction yard during the construction work, and cutting of trees and plants on the project site

(g) Installation of fuel tanks for fishing vessels (diesel and premix), fuel pipes and dispensers

(h) Temporary administration office, if necessary

(i) Provision of a dumping site and final waste treatment for disposal of sludge from the seabed excavation in the course of the extension work of the resting and preparation berths along the existing breakwater

(j) Notification to Sekondi Fishing Harbour users regarding limited access to several facilities during the construction work

(k) Installation of fences and gates around the Project site and around fuel supply station

(l) Personnel allocation to support implementation of technical assistance (soft component) associated with the Project

(m) Maintenance dredging of harbour basin of Sekondi Fishing Harbour in future

(n) Personnel and budget allocation necessary to operate and maintain the harbour facilities

(o) Exemption from tax and other related levies for imported equipment and materials

(p) Exemption from tax and other levies for the Japanese staffs who enter and stay in Ghana to perform works related with the approved contract and associated duties

(q) Necessary undertakings for the Japanese staffs who enter and stay in Ghana to perform their works related with the approved contract

(r) Commission payment for Banking Arrangement (B/A) and Authorization to Pay (A/P)

(s) Proper and effective utilization of the constructed facilities and installations provided by Japanese Grant Aid Cooperation

(t) Bearing all the costs to be out of the Grant Aid Cooperation by the Government of Japan

2-4 Project Operation Plan

2-4-1 Implementation Scheme of the Project

The government of Ghana proposed a tentative "Operation and Management Plan" that defines an operational structure of Sekondi Fishing Harbour to implement this project on November 11, 2013. The proposed plan outlines preconditions to entrust GPHA with budget and operation of Sekondi Fishing Harbour. It has given a mandate to GPHA to manage Sekondi Fishing Harbour in a way that enhances food safety and fosters economic development of the country. The Plan also highlights strategic objectives of Sekondi Fishing Harbour to improve livelihoods of small scale fishing communities and sustain their socio-economic activities, while optimizing the limited natural resources.

Although Sekondi Fishing Harbour is not a profit-seeking harbour, the tentative plan calls for fair collection of user fees to maintain its facilities. Currently, personnel costs form a large proportion of total expenditures. Check on utilities usage as well as better work efficiency is required to obtain more profits. The plan also requires Sekondi Fishing Harbour to submit a written annual performance review and an annual work report.

Under the management of Director of Port Takoradi, the fishing harbour manager is responsible for the harbour administration. 4 major units, as currently operating, include "Finance/Account and Audit Unit," "Operation Unit," "Engineering and Management Unit," and "Security Management Unit."

In addition to these units, Multi-Stakeholder Advisory Committee (MSAC) will be established under the fishing harbour manager to pursue sound management of the fishing harbour. MSAC will represent harbour users to make rules of facility use and fishing operation, while also setting a user fee structure. It is intended to redress unequal access to the harbour facilities among various users as well as a problem of unpaid tolls caused by disagreement between the administrators and users concerned. MSAC will concurrently deal with conflicts arising between canoes and inshore purse seiner vessels. User fees of the fishing harbour will be revised in consultation with MSAC. Assigned under the fishing harbour manager, the proposed members of MSAC are listed as follows.

【<Members of the Multi-Stakeholder Advisory Committee <Provisional Membership>】

(a) Sekondi Fishing Harbour Manager (GPHA)
(b) Civil Engineer (GPHA)
(c) Representative of Fisheries Commission (MOFAD)
(d) Marine Police
(e) Representative of Ghana Inshore Fisheries Association
(f) Representative of Canoe Owners Association
(g) Representative of Line & Hook Association
(h) Chief Fisherman

(i) Representative of Fish Mongers Association

(j) Representative of Environmental Protection Agency

2-4-2 Operation and Management Organization

(1) Structure and Organization Chart of Sekondi Fishing Harbour

A new organizational structure of Sekondi Fishing Harbour in this project is as shown in Figure 2-4-2(1). According to the "Operation and Management Plan" submitted by GPHA, the total number of the personnel will be 70 staffs, increased from 55 staffs who are currently assigned (including 6 security guards working on a three-shift system totaling 18 staffs). However, the project has excluded a component of slipway installation, and a total of 65 workers are proposed to fulfill new fishing harbour operations.

In addition to the abovementioned new structure, the Project will allocate the MOFAD staff in the Administration Office to restore well-managed operations in pursuant to guiding principles and rules of responsible fishing management.

(2) Increased Job Category in New Organization

In the new organizational structure, 4 harbour operation staff will be assigned along with additional 5 workers at a new ice making plant (including an electrical engineer) and a toll collector. Duties of respective positions are described below.

1) Port Operation (4 Additional Staff)

Under the guidance of the senior traffic officer and traffic supervisor, harbour operation staff will coordinate all activities in the fishing harbour related to vessels, vehicles and harbour users. They will also be in charge of berthing and deberthing vessels. In addition to submitting tally records of catches and a daily report on the above activities, harbour operation staff will develop a regular contact with the ice making section and the finance and account unit. They will also serve as a local liaison for MOFAD in carrying out its research fishing and surveys of fish resources. In addition to controlling daily marine transport and facility operations, harbour operation staff checks regularly duties related to specific objectives assigned in the Performance Indicators.

2) Ice Men (4 Additional Staff)

Currently, 8 ice men engage in production, sales and transport of ice. As the project plans to provide an additional ice making plant, Sekondi Fishing Harbour will need to assign 4 more ice men. The existing ice making plant will be operated by 6 ice men, while the new plant requiring another 6 staffs, totaling 12 staffs.

3) Electrical and Mechanical Engineers (1 Additional Staff)

The fishing harbour currently has 3 electrical engineers and 4 mechanical engineers within the ice making plant. To maintain additional ice making plant, an additional engineer will be assigned. Besides the ice making plant, 4 engineers will also be in charge of operation and maintenance of electrical and mechanical installations of whole facilities in the harbour.

4) Toll Collector (1 Additional Staff)

Though the fishing harbour currently has a toll collector, fees are collected only for the ice sales service and wharfage from large trawlers. Since 4 additional harbour operation staff will be assigned in this project and user fees for wharfage, landing and other charges will also be collected, the number of toll collectors will be increased from 1 to 2 staff.

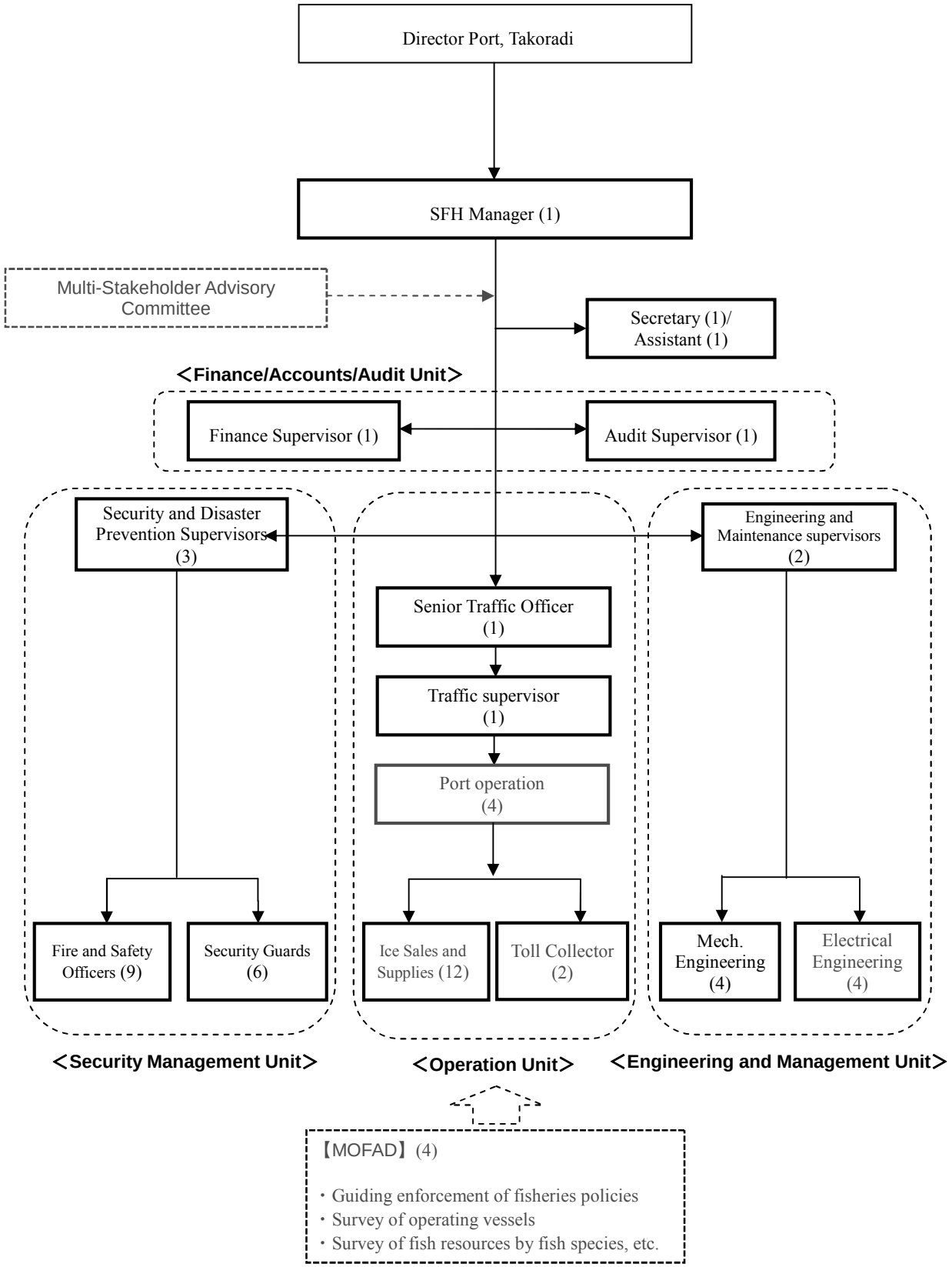
5) MOFAD Staff (4 Staff)

In addition to the operation pursued by GPHA, MOFAD staff will be assigned in the Sekondi Fishing Harbour Administration Office, which was originally intended but not realized in Phase I of this project. This will allow fisheries policies of Ghana and regulations to be implemented immediately at Sekondi Fishing Harbour. Also, given that fisheries management policies aim at providing high-valued-added products and improving fishermen's livelihoods, the local MOFAD staff is expected to establish a common practice of freshness control with chilling treatment and proper hygiene storage of fish products.

Table 2-4-2(1) New Organization of Sekondi Fishing Harbour

	Position	Duties	Current No. of Staff	Proposed No. of Staff
Administration	Fishing harbour manager	Administrative supervisor of Sekondi Fishing Harbour	1	1
	Secretary-1	Secretary	1	1
	Secretar-2	Secretary assistant	1	1
Finance/ Account /Audit	Finance supervisor	Finance supervisor	1	1
	Audit supervisor	Audit	1	1
Operation	Senior traffic officer	General management of operations and services at Sekondi Fishing Harbour	1	1
	Traffic supervisor	General supervision of vessels using the harbour	1	1
	Harbour operation	Management of ground facility operations and control of vessels entering/departing berths, task coordination with ice production and finance/audit section, and check of work performance using the Performance Indicators	0	4
	Ice man	Storage, sales and transport of ice	8	12
	Toll collector	Collection of user fees	1	2
Engineering	Electrical engineering supervisor	Electro-mechanical engineering supervisor of ice-making plant	2	2
	Electrical engineer	Electrical maintenance of ice-making plant and port facilities	3	4
	Mechanical engineer	Facility maintenance of ice-making plant and port facilities	4	4
Security	Security and disaster prevention management supervisor	Fire/security manager	3	3
	Fire prevention	Fire prevention of port facilities	9	9
	Security guard	Security maintenance of port facilities (a total of 18 security guards with the shift)	6(18)	6(18)
Total			43(55)	53(65)

※Security guards work on a three-shift system each day, totaling 18.



Note: Displays with red letters are Increased Job Category in New Organization

Figure 2-4-2(1) New Organization Chart of Sekondi Fishing Harbour

2-4-3 Operation Plan

Following sections present the proposed zoning of habour use (facility use) (draft) and proper operation of facilities and setting up usage fees (draft)

1) Zoning of Harbour Use (Facility Use)

Figure 2-4-2(2), (3) illustrate the current and the proposed harbour use respectively. New net storage area will obtain the almost same area as the existing counterparts, with three locations on the breakwater along the lay-bay berth, north revetment and south revetment. The number of nets in those areas may actually decreased by imposing a new storage charge. On the other hand, as the existing fuel supply area will be smaller if a fuel tank is provided by the Government of Ghana, effective use of the space may become available for net storage in the future.

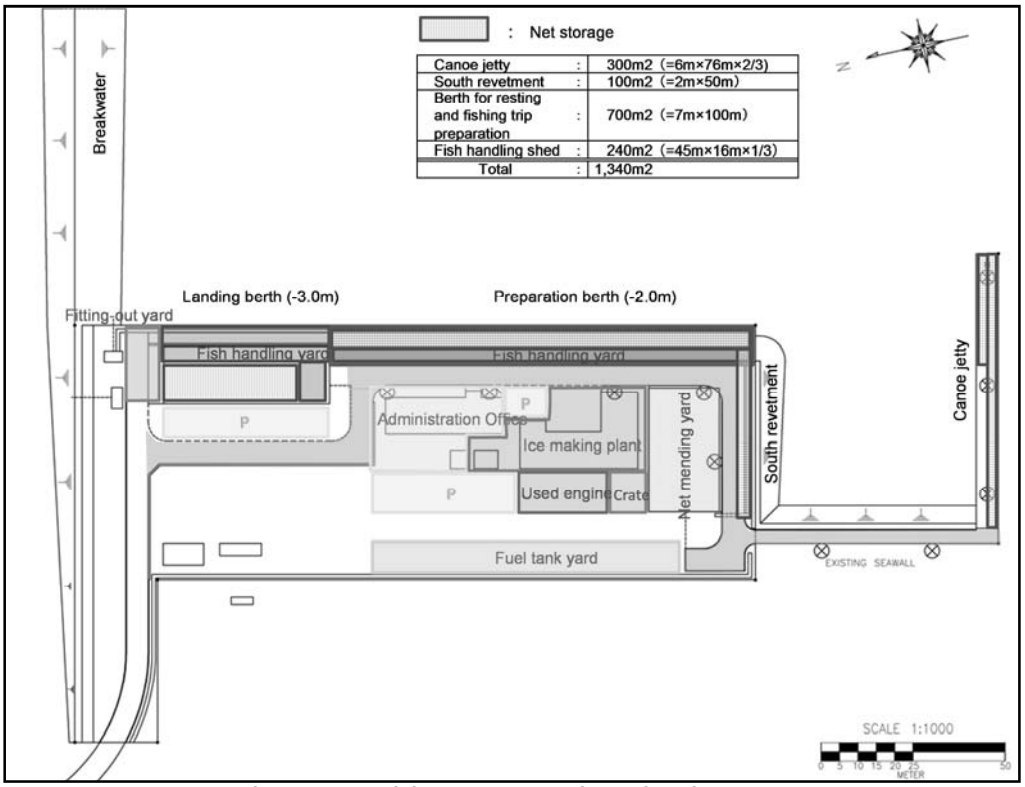


Figure 2-4-2(2) Current Zoning of Habour Use

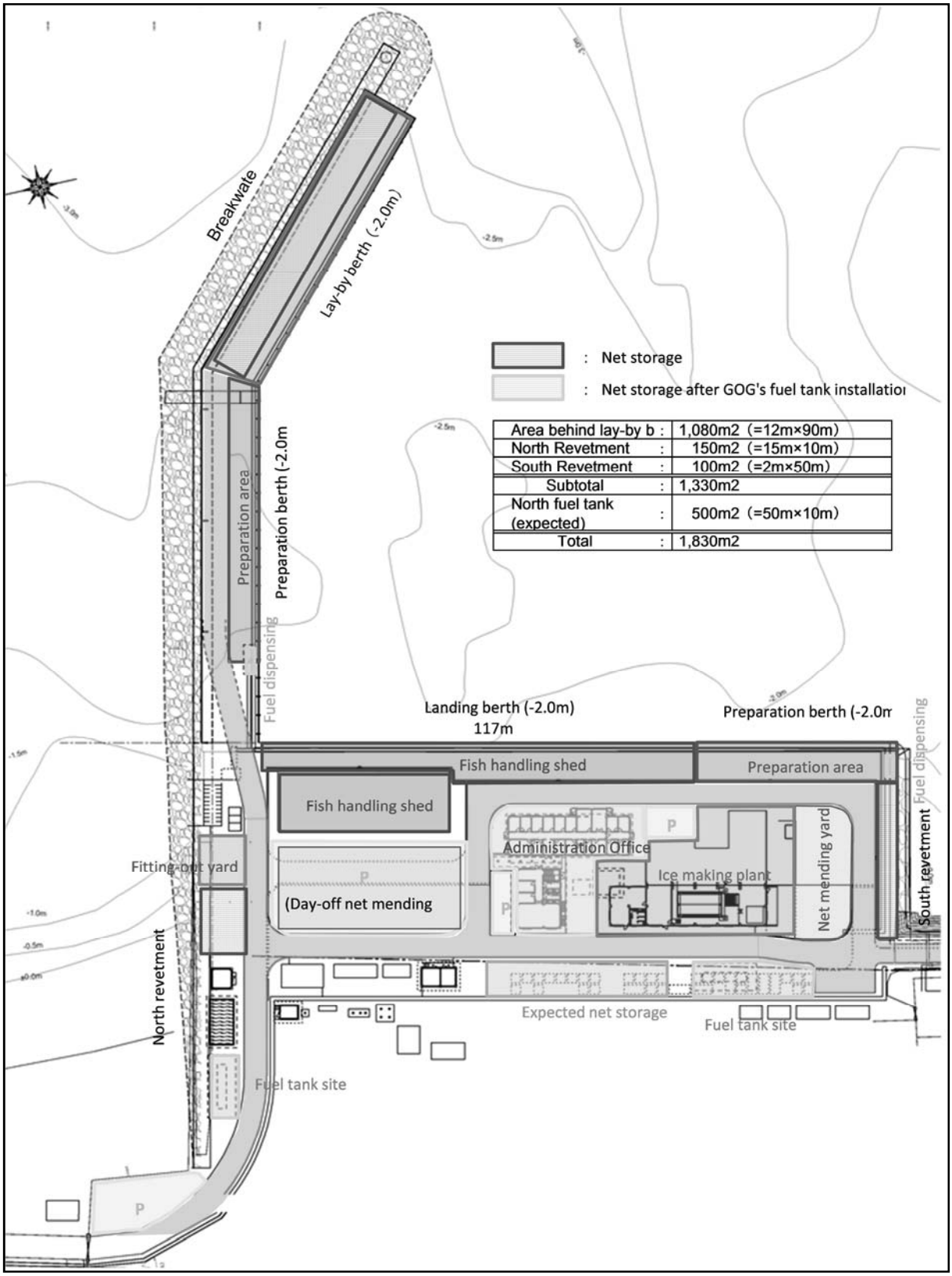


Figure 2-4-2(3) Zoning of Harbour Use Proposed by the Project

(2) Proper Facility Use and User Fees (draft)

1) Management of Landing Berth and Charge

Currently, the landing berth is mostly occupied by mooring vessels and large trawlers resting or preparing for fishing operation. This has undermined the intended function of the landing berth. The Project is designed to allow equal and every access of vessels to the berth by sufficiently extending the extension and designating the zone for the landing purpose.

The resulting improvement will enable fair charge collection. At present, the wharfage is collected only from the large trawlers, depending on their landing volumes. In Tema Fishing Harbour, all vessels, regardless of their types, pay for wharfage in accordance with their landing volumes.

Given such variability, proper harbour use, including tariff structure of landing wharfage, needs to be guided by MSAC. The following benchmarks may be applicable to setting the rate.

<Proposed Landing Fee Structure (Draft)>

- Charge in accordance with fish catch (the number of fish pans)
- Charge in accordance with time required for fish landing

2) Management of Resting and Preparation Berths and Charge

Currently, many idle vessels rest on the berth, hindering departing vessels to use the area for preparation. The Project is designed to allow equal and every access of registered vessels to the lay-by wharf by sufficiently extending the length and designating the zone for intended use.

In this project, offshore mooring is encouraged as a viable method to rest idle vessels. Improvement of the existing breakwater will allow vessels in up to 4 lines to lie alongside the berths.

The wharfages at Sekondi Fishing Harbour and Tema Fishing Harbour are shown in Table 2-4-2(2). A rate of Sekondi is considerably lower than Tema Fishing Harbour. Unlike the former, the latter receives a variety of fishing vessels such as medium-sized and large commercial vessels, and its charge structure has been set in accordance with the length of the vessels.

Table 2-4-2(2) Current Wharfage at Secondi and Tema Fishing Harbour, 2013

(1) Current Secondi Fishing Harbour	Charge	
1) Inshore Purse Seiner	GHS 5.0/year	This fee is not collected currently.
2) Large Trawler	US$ 700/year	
(2) Tema Fishing Harbour	First 24 hours	Additional charge (for every 12 hours)
1) Vessel length less than 30 m	US$ 11.0	US$ 8.0
2) Vessel length between 30 and 40 m	US$ 21.5	US$ 15.0
3) Vessel length more than 40 and less than 50 m	US$ 32.0	US$ 23.0

Considering that migratory pelagic fishery in this coastal area requires frequent trips, increasing fishing fleets would preferably use low-cost Sekondi as their focal harbour. In effect, extremely low wharfage rate or an annual charge will result again in congestion of vessels as it is occurring now.

Offering more convenient access than offshore mooring, the lay-by wharf on the breakwater is available for a limited number of vessels for an operational reason. Thus, wharfage on the wharf should be collected.

In the light of above, while proper harbour use, including coherent fee structure of wharfage for resting and preparation, needs to be guided by MSAC, the following benchmarks may be applicable to setting the rate.

<Proposed Charge on Resting Berth (Draft)>

- Charge in an hourly rate in accordance with time required for berthing (charge per hour and per additional 30 minutes)

<Proposed Charge at Lay-by Wharf (Draft)>

- Charge higher than offshore mooring
- Charge on a semiannual basis in accordance with the fishing season

3) Management of Net Storage and Rate of User Fee

Currently, net storage is free of charge, and given the limited facility space, nets are left in the existing berth apron and fish handling shed. This has hindered efficient fish landing and handling. Nonetheless, except for high season, there are quite a few nets left in the apron at all times.

These fishing nets should be properly stored in the designated area, following the proposed harbour use mentioned above. To ensure such practice, it is desirable that a net storage fee is charged. This will presumably reduce the number of rarely-used or unused nets left.

In the light of above, proper port use, including coherent net storage fee, needs to be guided by MSAC. The following benchmark may be applicable to setting the rate.

<Proposed Net Storage Charge (Draft)>

- Annual charge in accordance with area of net storage or with each storage section

4) Management of other Facilities and Rate of User Fees

Other user fees include ice, fuel, water, toll and harbour service user fee charged on fish mongers.

Ice sales are currently the most profitable service of the fishing harbour. To be competitive with external suppliers, ice sales at the market price in the fishing harbour should be kept, which is desirably equivalent of the current price level.

At present, fuel is supplied by several private oil distributors. The ongoing price structure will be retained unless Ghana side provides an integrated fuel supply facility under GPHA's management. Furthermore, the administrators need to understand the cross contamination cannot be controlled until oil feed piping to the berth is provided for fuel supply station installed by Ghana side.

For other fees such as water supply service and entry, the rate should be determined by MSAC, considering that fishermen will be also responsible for their wharfage that SFH, not currently collecting.

2-4-4 Monitoring

(1) Execution of Monitoring

The primary objectives of this project are to "relieve congestion in berths and in-port facilities", "restore intended fishing harbour functions", "keep safety and security in the harbour", and "provide fresh fish products". To achieve them, it is imperative to pursue regular monitoring of harbour utilization.

(2) Performance Indicator (draft)

To achieve sustainable and proper operations of the fishing harbour facilities, GPHA will implement Performance Indicators which are defined and updated as necessary in accordance with "Instructions on Sekondi Fishing Harbour" developed through the technical assistance of the Project and MSAC. In particular, the Performance Indicators assigned to managerial positions should target their overall efforts to increase profits, along with strategic facility management including securing the operation budget. With experiences learned from the past practices, these Indicators are intended to foster the best performance of the staff at service points such as fish handling, ice production, supply of water and fuel. The Performance Indicators and the operational structure would be reviewed annually for rearrangement as required. Addressing major issues such as the limited access of vessels to berths and lack of net storage, the Project will restore harbour functions by promoting proper facility use.

Operation unit, which includes the harbour operation staff assigned by the Project, will be responsible for collecting and managing data necessary to verify outcomes set in the Performance Indicators.

Table 2-4-2(3) indicates viable performance indicators designed for the post project operational stage to cope with the issues and problems facing the fishing harbour. As GPHA, Sekondi undertakes its future operations, the components of the Performance Indicators and the associated data collection may need updates to respond to identified problems or discharge solved ones. Moreover, as a preliminary step for smooth post-project operation, the Project will provide technical assistance (soft component) to finalize the Performance Indicators proposed herein.

Table 2-4-2(3) Tentative Performance Indicators (Draft)

Objectives	Countermeasures	Performance Indicators	Baseline	Outcomes	Methods of Verifiable Data Collection
(1) Relieve congestion of increasing vessels in the harbour	1) Control the number of incoming vessels within the planned capacity	○ Maximum number of incoming vessels permitted in the harbour	(Planned number of vessels permitted) ・Inshore purse seiner: 106 ・Large trawler: 9 ・Canoe: Approx. 130	・Keep the number of vessels within the planned numbers.	・Check the number of the registered vessels with Ghana Inshore Fisheries Association and Canoe Owner Association. ・Check the number of incoming vessels. ・Frequency of check: monthly
	2) Restrict entrance of large trawlers	○ Number of incoming vessels exceeding the planned ship length	(Planned ship length) ・Inshore purse seiner: 21.5 m ・Large trawler: 25.0 m	・Number of incoming vessels exceeding the planned ship length: None	・Check on a monthly basis the sizes of the largest registered vessels with Ghana Inshore Fisheries Association and Canoe Owner Association. ・Port operation staff checks the sizes of the vessels mooring outside of harbor as a part of their daily duties.
	3) Reduce the number of inactive vessels mooring on the berths	○ Number of inactive vessels mooring on the berths	・Approx. 50 nos.	・Not more than 20 nos.	・Port operation staff checks the number of inactive mooring vessels on a monthly basis.
(2) Restore intended functions of landing and preparation berths.	1) Enforce a crosswise mooring system in the landing and preparation berths	○ Number of vessels moored in multiple rows in the landing and preparation berths.	・Approx. 40 nos.	・None	・Port operation staff controls mooring on a daily basis.
	2) Increase efficiencies in landing and preparation for departure.	○Average time required for landing and preparation respectively	・Landing time: 50 minutes Preparation: 70 minutes	・Landing time: Not more than 50 minutes Preparation: Not more than 70 minutes	・Check on a monthly basis mooring time per vessel. ・Daily record shall be available when wharfage is paid according to the number of fish boxes or the specified landing time.
	3) Prohibit mooring on the berths for the purpose of other than landing and preparation for departure.	○ Number of resting vessels on the landing and preparation berths	・Approx. 50 nos.	・None	・Port operation staff records the number of mooring vessels.
(3) Increase efficiencies in fish handling and preparation for departure.	1) Prohibit net storage around the landing berths and in the fish handling shed.	(a) Proportion of space occupied with nets behind the berths (b) Proportion of space occupied with nets in the fish handling shed	(a) Approx. 70% (b) Approx. 30%	(a) 0% (b) 0%	・Port operation staff records the situation of net storage on a daily basis.
	2) Prohibit long-term net storage over the preparation berth.	○Proportion of space occupied with nets over the preparation berth (temporary storage is allowed during preparation for departure)	・Approx. 70%	・0%	・Port operation staff records the situation of net storage on a daily basis.
(4) Ensure safety in the harbour.	1) Take regular checking of water depth in the harbour, and maintenance dredging shall be made where necessary.	○Sedimentation volume	・Approx. 50 cm (during 15 years)	・Not more than the current rate of sedimentation volume	・Annual sounding survey ・Sorting-out of records on maintenance dredging
	2) Restrain a dangerous fuel supply practice using plastic containers.	○ Number of vessels using plastic containers to supply fuel	・Approx. 100 nos./day (Inshore purse seiner: 48nos./day, canoe: 52 nos./day)	・None (Fuel should be supplied directly from a dispenser)	・Port operation staff makes sure fuel is supplied with a dispenser.
(5) Provide safe and quality marine products	1) Increase the use of ice on vessels and among fish mongers producing more ice supply.	(a) Rate of icing marine products on vessels (b) Rate of icing marine products by fish mongers	・High season: 53% on average ・Low season: 46% on average ・Post-landing: 0%	・High season: more than 55% on average ・Low season: more than 50% on average ・Post-landing: more than 10% on average	・Carry out a three-days sampling survey targeting about 20 fishing vessels every other month. ・Check the amount of ice sold at SFH's ice making plants.
	2) Reduce the risk of cross-contamination of the marine products associated with fuel supply.	○Number of vessels supplying fuel where they landed fish	・Approx. 100 nos./day (Inshore purse seiner: 48 nos./day, canoe: 52 nos./day)	・None	・Port operation staff checks daily practices at the related service points.

2-4-5 Technical Consideration in Fishing Harbour Operation

According to the result of field survey, water depth in harbour basin has fallen by approximately 50 cm in comparison with the result of bathymetric survey conducted as Phase-I in 1994. The shoaling speed is equivalent to approximately 3 cm/year. And, design water depth in existing harbour basin at the time of Phase-I was -3m in front of "Landing Berth" and -2m in front of "Preparation Berth" however, the average water depth currently is -2m that shows sedimentation tendency. Furthermore, as the measure to cope with the congestion in the basin by increasing number of inshore vessels, offshore mooring at the water basin behind Naval Base is the fundamental thought in this project.

Therefore, in order to continue safe and stable utilization by objective vessels in Sekondi Fishing Harbour, maintenance dredging in the future by the government of recipient country is considered to be necessary at harbour basin, waterway and water area in front of wharf.

And, in case of executing future maintenance in Sekondi Fishing Harbour, especially, as the wharf is made by gravity type structure, it is necessary to put it in mind that wharf structure will be possibly fallen if dredging is made deeper than design water depth in front of wharf.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The estimated cost borne by the government of Ghana is as follows,

(1) Cost Born by the Government of Ghana

1) Implementation of Environmental Impact Assessment (EIA)	GHS	300,000	(Approx. 15.0 million Yen)
2) Relocation OF small stores (transfer)	GHS	4,500	(Approx. 0.23 million Yen)
3) Disposal of wastes in project water basins (abandoned and sunken vessels, etc.)	GHS	100,000	(Approx. 5.0 million Yen)
4) Disposal of wastes in project sites (used engines, etc.)	GHS	10,000	(Approx. 0.5 million Yen)
5) Fencing around existing fuel supply station	GHS	32,000	(Approx. 1.6 million Yen)
6) Installation of fuel supply station	GHS	150,000	(Approx. 7.5 million Yen)
7) Soil disposal expense associated with excavation of the seabed	GHS	68,000	(Approx. 3.4 million Yen)
8) 2 personnel for technical assistance (soft component):	GHS	30,000	(Approx. 1.5 million Yen)
9) Banking arrangement fees:	GHS	39,000	(Approx. 1.95 million Yen)
Total	GHS	733,500	(Approx. 36.68 million Yen)

(2) Conditions of the Cost Estimation

1) Date of estimation: August, 2013

2) Exchange rate: US$1.00 =100.47JPN
GHS1.00 =50.78 JPN

3) Project period: Detailed design and construction period are as indicated in the implementation schedule.

4) Other: Project costs shall be estimated in accordance with the provisions of the Japanese Grant Aid Cooperation.

2-5-2 Operation and Maintenance Costs

The revenues and expenditures of the post-project operational stage are estimated using baseline data of 2012 in which Sekondi Fishing Harbour had the largest deficit after the completion of Phase I. This estimation takes into account of revenues obtained from the ice making plants as well as additional personnel costs required for harbour operation. It should be noted that while in 2012 a trouble of the ice making plant reduced the ice production in half, post-project revenues estimated herein assume that the plant operated properly throughout a year.

(1) Revenues

1) Profits from Ice Sales

The existing ice making plant (15 t) has a daily production capacity of 600 ice blocks. A new 15 t ice making plant will provide another 600 ice blocks daily throughout 6 months during high season. For the other 6 months during low season, 11 t of ice will be still required, as indicated in Table 2-2-2-2(6) (subtracting 7.8 t of external ice supply and 15 t of the current ice making capacity from 33.8 t of the total ice demand). This anticipates a daily production of 440 ice blocks (=11 t ÷ 0.025 t). Therefore, a total of 340,800 ice blocks will be provided annually, as shown in Table 5-2(1).

The price of an ice block is equivalent to 3 of GHS, and annual ice sales will amount to GHS1,022,400.

Table 2-5-2(1) Ice Production of Post Project (Estimate)

	Existing ice making plant (15 t)	New ice making plant (15 t)	Annual ice sales (estimate)	Remarks
High season	600 blocks/day ×320days	600 blocks/day×160 days	192,000 blocks/year	Excluding a non-operating day on Tuesday
Low season		440 blocks/day×120 days	148,800 blocks/year	Assuming 20 operating days per month
Total			340,800 blocks/year	

2) Other Revenues

Currently uncollected wharfage and landing charges will have a set of new rates revised by MSAC. For the estimation purpose, the rate of these fees is referred to the existing data of 2012.

(2) Expenditures

1) Personnel Costs

The Project expects a total of 10 additional staffs, including 4 harbour operation staff, 4 ice men and 1 electrical engineer and 1 toll collector. This will require annual personnel costs of GHS 78,400.

Table 2-5-2(2) Personnel Costs

Position	Number of staff	Wage/day	Annual wages (320 days/year)	JPN
Harbour operation	4	GHS 70	GHS 22,400	¥1,120,000
Ice man	4	GHS 22	GHS 7,040	¥352,000
Electrical engineer	1	GHS 88	GHS 28,160	¥1,408,000
Toll collector	1	GHS 65	GHS 20,800	¥1,040,000
Total	10		GHS 78,400	¥3,920,000

2) Utilities for Ice Making Plants

The existing 15 t ice making plant requires GHS 151,040 annually for electricity and water. Thus, the post-project 30 t plants will need GHS 344,560 for utilities per year. Utilities paid for the ice making plant in 2012 was GHS 207,331. This does not include a charge of GHS 75,520 per year during the plant downtime. Thus, the total utilities of the plant, if fully operated, shall be revised as GHS 282,851 in 2012.

(a) Water

GHS 1.82/m^3×15m^3/day×2.0 (ratio of water used for defrosting) ×1.03 (specific cost)
= GHS 56.2/day …… (A)

(b) Electricity

35.275kw/plant ×2 plants ×5hour = 352.8KWh (Initial operation phase 85A)
24.900kw/plant ×2 plants ×11hour = 547.8KWh (Normal operation phase 60A)
(Total) = 900.6KWh
Specific charge = GHS 0.263/KWh × (900.6KWh×1.05) = GHS 249.1/day
Basic charge = GHS 5,000/month ÷ 30 days = GHS 166.7/day
Total electricity charge = GHS 249.1/day + GHS 166.7/day = GHS 415.8/day…… (B)

(c) Total Costs of Water and Electricity {(A)＋(B)}

Adding (A) and (B), daily water and electricity costs are expected to be GHS 472.0, amounting to GHS 151,040 per year.

(3) Annual Balance Sheet

Based on the manpower planning of new harbour facilities, the resulting minus balance will decrease from GHS 730,000 (37 million Yen) to GHS 520,000 (26 million Yen), reducing a deficit of GHS 220,000 (10 million Yen). Moreover, the potential revenues from a new ice making plant will cover the personnel costs of additional staff assigned by this project plan.

It should be noted that the abovementioned annual balance is a provisional estimation associated with installing a new ice making plant. Landing fees and harbour facility user fee will be determined by MSAC in the post-project operational stage, and hence do not constitute the change in the projected revenues.

While GPHA intends to cover the deficit of Sekondi Fishing Harbour, it is of vital importance for the fishing harbour to provide equal access to the public facility by collecting MSAC authorized user fees, which will in turn sustain its operations and services.

Table 2-5-2(3) Expected Balance Sheet of Post Project

(Unit: GHS)

Item/year	2012	2012 (Revised)	Post project (Estimate)
Revenues			
Ice sales	334,333	576,000	1,022,400
Water sales	36,569	36,569	36,569
Landing charge	63,539	63,539	63,539
Entry	114,809	114,809	114,809
Other	151,173	151,173	151,173
Total revenues (1)	**700,423**	**942,090**	**1,388,490**
Expenses			
Personnel costs	1,296,708	1,296,708	1,375,108
Utilities	207,331	282,851	433,891
Repair parts	14,239	14,239	14,239
Office expenses	20,085	20,085	20,085
Depreciation expenses	61,216	61,216	61,216
Total expenditures (2)	**1,599,579**	**1,675,099**	**1,904,539**
Balance {(3)=(1)+(2)}	**-899,156**	**-733,009**	**-516,049**
*Exchange rate：GHS1.00=JPN50	(-45 million Yen)	(-37 million Yen)	(-26 million Yen)

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

The preconditions of the project implementation are as per shown below. Especially, the execution of EIA and environmental permit are scheduled to obtain by July, 2014. And, relocation of small scale shops and site clearance are scheduled to complete before the commencement of the construction works.

(a) Land acquisition for this project (project site)
(b) Execution of EIA and obtainment of environmental approval and construction permit
(c) Relocation and temporary relocation of small shops including the necessary compensation
(d) Project site clearance (removal of abandoned ships, sunken ships, used engines, fuel tank facilities, ship building and repair facilities occupying beach)
(e) Diversion and detour of drainage channel of waste water discharging in Old Beach
(f) Provision of temporary construction yard during construction work, and cutting of vegetation
(g) Installation of fuel tank for fishing vessels (diesel and pre-mixed) and fuel piping and fuel dispenser
(h) Temporary fisheries office (when necessary)
(i) Provision of a dumping site and final disinstallation for disposal of sludge from the seabed excavation in the course of the extension work of the resting and preparation berths along the existing breakwater
(j) Notification to Sekondi Fishing Harbour users regarding limited access to several facilities during the construction work
(k) Installation of fences and gates around the Project site and around fuel supply station
(l) Personnel allocation to support implementation of technical assistance (soft component) associated with the Project
(m) Maintenance dredging of harbour basin of Sekondi Fishing Harbour in future
(n) Personnel and budget allocation necessary to operate and maintain the harbour facilities
(o) Exemption from tax and other related levies for imported equipment and materials
(p) Exemption from tax and other levies for the Japanese staffs who enter and stay in Ghana to perform works related with the approved contract and associated duties
(q) Necessary undertakings for the Japanese staffs who enter and stay in Ghana to perform their works related with the approved contract
(r) Commission payment for Banking Arrangement (B/A) and Authorization to Pay (A/P)
(s) Proper and effective utilization of the constructed facilities and installations provided by Japanese Grant Aid Cooperation
(t) Bearing all the costs to be out of the Grant Aid Cooperation by the Government of Japan

3-2 Necessary Inputs by Recipient Country

The items that the the recipient country should undertake in order to accomplish and maintain the project effects are shown in Table 3-2(1).

Table 3-2(1) Necessary Inputs by Recipient Country

Period	Items
(1) Before Construction	1) Execution of EIA, obtaining environmental approval and construction permit related with the facilities construction of this project 2) Relocation and compensation of small scale shops 3) Project site clearance (removal of abandoned ships, sunken ships, used engines, fuel facilities, shipbuilding, repair facilities occupying beach and etc.) 4) Provision of temporary construction yard during construction works and cutting down of vegetation 5) Land acquisition for the project site 6) Securement of temporary fisheries office, when necessary 7) Work permit and tax exemption on the staffs of Japan and the third countries related with this project 8) Tax exemption on the construction materials , equipment and etc. related with this project 9) Commission payment fo Banking Arrangement (B/A) and Authorization to Pay (A/P)
(2) During Construction	1) Notification to Sekondi Fishing Harbour users regarding limited access to several facilities during the construction work 2) Securement of dumping site for sludge to be pulled up from sea bottom and the final waste disposal in conjunction with the project works 3) Personnel allocation to support implementation of technical assistance (soft component) 4) Installation of fuel tank for fishing vessels (diesel and pre-mixed) and fuel piping and fuel dispenser 5) Exemption from tax and other related levies for imported equipment and materials 6) Approval of payment in accordance with A/P and the Contract
(3) After Construction	1) Proper, effective utilization and operation management of facilities constructed by Japan's grant aid cooperation scheme 2) Personnel and budget allocation necessary to operate and maintain the harbour facilities 3) Periodical inspection and well maintenance of the constructed facilities 4) Installation of fences around the project site and fuel supply station 5) Ongoing deficit-covering in the operation of Sekondi Fishing Harbour 6) Maintenance dredging in the Sekondi Fishing Harbour in the future 7) Detour of flow drainage channel discharging in Old Beach

3-3 Important Assumptions

The external conditions to develop and maintain the effect of the project after completion of facilities are as shown below.

(a) Control of number of fishing vessels using Sekondi Fishing Harbour to the planned number
(b) Proper control of the standard design length of vessels
(c) Utilization according to the zoning in the fishing harbour and proper facility operation
(d) Prohibition of fishing nets storage at the apron of landing berths
(e) Non-operated fishing vessels basically to berth offshore basin, although partially possible to moor to head of the breakwater
(f) Proper maintenance management so as not to cause the impaired utilization by the vessel's accident, abandoned vessels in mooring water area, waterway and basin
(g) Effective facility operation by the proper allocation of necessary staff
(h) Stable operation of GPHA, executing organization by covering ongoing deficit in Sekondi Fishing Harbour
(i) Proper management for securement of the design water depth by maintenance dredging and etc. against the water depth change by sand deposition and others

3-4 Project Evaluation

3-4-1 Relevancy

This project is evaluated as reasonable for the project to be implemented by Grant Aid Cooperation Scheme with the following reasons.

(1) Consistency with Upper Plans

In the National Development Plan "Ghana Medium Term National Development Policy Framework (2010-2013)", targets are the total development of artisanal fisheries and improvement of existing fish landing sites. In the fishery sector, "promotion of data collection for fishery management", "build a system for compliance with fishery resources regulations and monitoring and surveillance", "development and enhancement of co-management system with fishing community", "promotion of intra-sector cooperation in fishery management" and "sustainable management of fishery resources" are the main initiatives to develop the fishery industry for the food security and profit earning.

In the Development Plan in Sekondi-Takoradi District, "Ghana Vision 2020" that was made with the target year of 2020, and the basic targets are "poverty reduction", "food security", "sustainable fisheries management" and "conservation of habitats and biodiversity". Especially, fisheries industry is requested to cope with income level of fishery related people due to decrease of fishery products, quality loss and drop in fish price and "fishery related infrastructures to prevent post-harvest loss", "fishery promotion and development for safety foods and profits" and

etc. become main initiatives.

In the Fishery Development Plan "Ghana National Aquaculture Development Plan (2010-2015)", with the background for the reduction in income of fishermen by luck of fund for over-catch and added value, the development targets are "preservation of fishery management, fishery resources and fishery resource environment", "added value in the fisheries sector and life improvements for fishing community", "more support for MOFAD and other supporting agencies" and etc.

As this project is to aim effective fisheries promotion by the capacity and better function of Sekondi Fishing Harbour through the improvement and expansion of the fishing harbour facilities, GPHA who manages the harbour shall execute "data collection for fishery management" and "establishment of monitoring system for sustainable resource management" together with local stakeholders and MOFAD. And, this project is considered to be consistent with upper plans since this project is to aim the supply of better quality fishery products by means of wharf expansion where increase fishing vessels and congested now due to the scattered fishing nets, and the restoration of facility function and work efficiency by utilization zoning, and providing additional ice making plant now is lucking.

Furthermore, judging from the situation that many domestic fishing vessels are calling to Sekondi Fishing Harbour for fish landing since there are only two fishing harbours, namely Sekondi and Tema Fishing Harbours, in the country as the fishery infrastructure, therefore this project is not only good for the consistency with upper plans but the intended effects are considered to be very high.

(2) Operation and Maintenance

The main components of this project are the extension and expansion of lay-by wharf in the existing fishing harbour and additional driveway, ice making plant and administration office. These facilities will not change greatly the current operation and maintenance sysytem.

Increase of the number of staff is for the traffic and facility operation management such as proper facility use control and control of fishing vessels to use this harbour and other than these, additional staffs is assigned for periodical checking of the performance indicator and for the additional ice making plant.

Annual balance sheet in the current operation of Sekondi Fishing Harbour is with deficit of approximately 40 million yen and the management body, GPHA, intends to stably operate it by covering this deficit for the future as well. After the implementation of this project, additional annual revenue of approximately 10 thousand yen can be expected by ice sales and facilities utilization.

And, the current operation of the fishing harbour is occupied by particular fishing vessels and the rest of facilities are very congested by many other vessels. However, after implementation of this project as this fishing harbour becomes highly public, and as it is provided equivalent access to the public facility and collecting facility usage fees are setting out through

MSAC, which will in turn sustain its operations and services.

(3) Environmental Social Consideration

The execution of this project will require temporal and permanent relocation of several small shops called “kiosks” and “containers” locating with the construction of access road. Relocation is easy work using forklift and the places after relocation are already agreed between GPHA and the shop owners. And GPHA is ready to compensate for their business when relocated. As the relocation objectives are not their living places, the adverse effect on environmental social aspect is not expected to be serious.

While, implementing this project, removal of sunken ships, abandoned ships and many used engines placed in the site will be made as the item of environmental social consideration. As planned site of Sekondi Fishing Harbour is quite limited area, the removal of them in the congested fishing harbour will promote the harbour safety, proper utilization of facilities, effective utilization of narrow area and contributes to the environmental improvement.

(4) Beneficial Effects

Sekondi Fishing Harbour in the planned site is located at Sekondi-Takoradi District with 450 thousand populations and becomes activity base for artisanal fishermen. As the population of fisheries industry in the country is regarded about 10% of the total population, the number of population working with fishing industries in Sekondi Fishing Harbour are estimated about 40 thousand. And according to the traffic survey from/to Sekondi Fishing Harbour and Old Beach, approximately 20 thousand people per day in high season is confirmed including harbour employee, fisheries related people and consumers in the survey period.

While, approximately 130 vessels uses the fishing harbour in high season against 106 vessels registered as inshore vessels in Sekondi Fishing Harbour, since domestic inshore fishing vessels are highly mobilized to other harbours and other landing sites. And as the vessels registered in Sekondi Fishing Harbour are landed to other harbours, the distribution of fishery products is regarded to distribute throughout the country not exclusively distributed at around Sekondi-Takoradi District. Actually, in this survey, there confirmed that many smoke fishes are distributed to inland area like Kumasi City evaluating from distributed routes of fishery products.

Direct beneficiaries:	Approximately 40 thousand employees by Sekondi Fishing Harbour and fishery related people
Indirect beneficiaries:	Approximately 25 million all people of the Republic of Ghana

(5) Consistency with Japanese Assistance Policy

In recent years, overseas investment is active concerning with oil and gas production in the offshore of Takoradi-Sekondi District and Japanese companies show their interests on Ghana’s resources.

On the contrary, Ghana has many problems such as the existence of regional differences, poverty infrastructures, inadequate public services and to overcome these problems becomes inevitable to make firm stable social and economic development in Ghana.

With the above, the Ghana supporting policy of Japan, in order to promote economic growth toward development of total country, put emphasized on “economic infrastructure (power and transportation/traffic)” as the emphasis target to encourage independent effort and stable economic operation. Therefore, the relevancy to expand Sekondi Fishing Harbour for the promotion of Fisheries Development for Ghana is evaluated to be high.

With the result above, as this project widely contributes to the promotion of Basic Human Needs (BHN) and poverty reduction, the relevancy to implementation under the scheme of Grant Aid Cooperation of Japan can be confirmed for the part of this cooperation.

3-4-2 Effectiveness

The outcomes of quantitative and qualitative effects by the implementation of this project are considered as follows,

(1) Quantitative Effects

Table 3-4-2(1) Quantitative Effects

Index	Standard Value (Actual in 2013)	Target Value (2019: 3 years after completion)
Congestion ratio of landing berths and preparation berths (%)	400%	100% or less
Occupation ratio by fishing nets behind preparation berth (%) (except short storage for preparation works)	70%	10% or less
Sufficiency ratio to ice demand in Sekondi Fishing Harbour (annual average) <making ice demand volume at the time of this plan as standard>	45.5%	70% or more

(2) Qualitative Effects

The achievement items of qualitative effects by this project are as follows,

1) Not only recovery of the original function but also fair and equivalent utilization of the facilities become possible with the thoroughness of instruction and management to the users by fishing harbour management staff as well as clarification of zoning.

2) With removing fishing nets scattered and stored disorderly in the fishing harbour, the functional recovery of landing, preparation and resting berths and the safety promotion of related works can be made.

3) The risk of cross contamination for landed fishes and fishes in holds by fuel supply operation will be decreased with the installation of fuel supply facility for fishing vessels.

4) Qualitative promotion of the fishery statistic data being collected in the fishing harbour and promotion of capability for fishing training can be attained to fishermen by means of staff stationing from MOFAD in administration office.

5) Convenience for the access from hinterland and movement of logistic related people will be promoted with the improvement of access driveway from the project site to Old Beach where artisanal fishing vessels are piled up and the distribution between two landing sites will be speeded up.