

**MEKONG INTEGRATED WATER RESOURCES MANAGEMENT PROJECT  
PHASE 3**

**FISHERIES ADMINISTRATION**

**ENVIRONMENTAL MANAGEMENT PLAN FOR THE HATCHERY SUBPROJECT  
FINAL**



**November 2015**

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## Acronyms

<b>BP</b>	Bank Procedures
<b>CMAC</b>	Cambodian Mine Action Centre
<b>CNMC</b>	Cambodia National Mekong Committee
<b>CSC</b>	Construction Supervision Consultant
<b>EA</b>	Environmental Assessment
<b>EMP</b>	Environmental Management Plan
<b>ESMF</b>	Environmental and Social Management Framework
<b>FIA</b>	Fisheries Administration
<b>GP</b>	Good Practices
<b>MAFF</b>	Ministry of Agriculture, Forestry and Fisheries
<b>MoE</b>	Ministry of Environment
<b>OP</b>	Operational Policy
<b>DoE</b>	Department of Environment
<b>RGC</b>	Royal Government of Cambodia
<b>UXO</b>	Unexploded Ordnance
<b>WWF</b>	World Wildlife Fund

## 1. Introduction

1. Mekong Integrated Water Resources Management Program (M-IWRM) is a regional Series of Project (SOP) supporting Lao PDR, Cambodia, Vietnam, and the Mekong River Commission (MRC). Following the first phase (Lao PDR and MRC which refers to as M-IWRM1) and the second Phase (Vietnam which refers to as M-IWRM2), the World Bank and the Royal Government of Cambodia (RGC) has been collaborating closely for the preparation of the third phase (M-IWRM3). The M-IWRM3 comprises the following two components; (a) Component 1: Fisheries Resources Management in Stung Treng and Kratie Province, and (b) Component 2: River Basin Management in Northeastern Cambodia. Cambodia National Mekong Committee (CNMC) is the overall executing agency of M-IWRM3. However, implementation of Component 1 has been delegated to the Fisheries Administration (FiA). FiA has established a component management unit (CMU) within its Inland Fisheries Research and Development Institute to implement and manage the component.
2. Under Component 1, construction of a hatchery in Stung Treng is proposed. This EMP sets out the principle and framework for the measures to mitigate potential negative environmental impacts during both construction and operational phases for the hatchery. This environmental management plan (EMP) has been developed based on the outline of the simple EMP included in the Environmental and Social Management Framework (ESMF) prepared for the project.
3. The objective of this EMP is to (a) describe detailed potential negative and positive impacts due to the subproject implementation, along with propose mitigation measures to be taken during the implementation and operation to eliminate or offset adverse environmental impacts, and (ii) the actions needed to implement these measures.



8. Current aquaculture practices in the project area are mainly based upon the grow-out of fingerlings of non-native species of fish (African catfish *Clarias gariepinus* and Nile tilapia *Oreochromis niloticus*) in small concrete tanks and artificial (earth) ponds. These non-native species have established markets in the project location, with production systems shown to be profitable based upon low cost infrastructure and techniques (see PAD).
9. Environmental concerns arise when non-native species escape the confines of the aquaculture system and spread into natural aquatic ecosystems where they may hybridize with indigenous fish species, alter habitats, impact water quality, compete for food and space, prey on native fish and result in the introduction of non-native parasites and diseases (Nuov et al., 2005).
10. The two non-native species selected for culture have established breeding populations in the Lower Mekong Basin but do not form significant populations, nor appear to have significant impacts on the ecosystem. Most non-native species that have become established in the Mekong are fairly generalized feeders preferring benthic organisms and detritus which are currently abundant and for which little competition among species exist (Welcomme & Vidthayanom, 2003).
11. According to Welcomme & Vidthayanom (2003) “there is little reason why [*Clarias gariepinus*] should not enter the Mekong fauna as a permanent element. No immediate detrimental environmental effects have been noted in the Mekong or other areas to which the species has been introduced”. Hybrids of *C. gariepinus* (*C. gariepinus* male x *C. macrocephalus* female) may be responsible for declines in *C. batrachus*, in some parts of Thailand and the Mekong basin but evidence in support of this hypothesis is currently lacking. *O. niloticus* is reported to have no noticeable impacts (Welcomme & Vidthayanom, 2003).
12. Cambodia has no policy on non-native species introductions. Furthermore, no guidelines or regulations exist concerning the use of non-native species for culture, to prepare environmental impact studies, or to establish environmental standards for fish farms (grow-out operations) (Nuov et al., 2005). Existing laws and regulations (CITES, SPS and the law of importation of goods) only apply to the international trade and importation of non-native species.
13. However, over the years, live non-native species (including African catfish) have been traded between the project area and with Vietnam by the private sector without oversight.
14. The culture of indigenous species is less common at the project site (and elsewhere in Cambodia), and is mainly based upon the culture of striped catfish *Pangasius hypophthalmus* in cages suspended in rivers. This system requires significant investment and variable (feed-related) costs are high. These culture systems are therefore not suitable for the project’s target fisher communities who are mainly asset-poor. Furthermore, culture techniques for most indigenous species are still being developed and refined, and grow-out operations are not yet economically viable in many cases.
15. The culture of indigenous fish species is one of the options that the Fisheries Administration (FiA) is considering to eventually replace non-native species. In the meantime, the FiA encourages the culture of non-native species if appropriate safeguards are in place to prevent individuals escaping into natural water bodies (Nuov et al., 2005).
16. With appropriate safeguards in place, the hatchery aims to support the culture of both non-native and indigenous species.

17. According to the World Bank’s safeguard policies and procedures on Environmental Assessment (OP/BP/GP 4.01), the sub-project has been classified as a Category B. This requires the Borrower to prepare and implement the “Environmental Management Plan” (EMP) in order to prevent, minimize or mitigate site-specific environmental impacts.

18. The present EMP has been prepared by the FiA to ensure that maintenance and rehabilitation under the Project protect the populace and environment from key risks such as noise, soil erosion on steep slopes, protection of waterways, etc. The EMP also includes a check on potential impacts on Physical Cultural Resources (PCR). Archaeological chance finds are covered by a chance-finds procedures clause included in the works contract.

### **3. Environmental Setting of the Proposed Hatchery Construction Works**

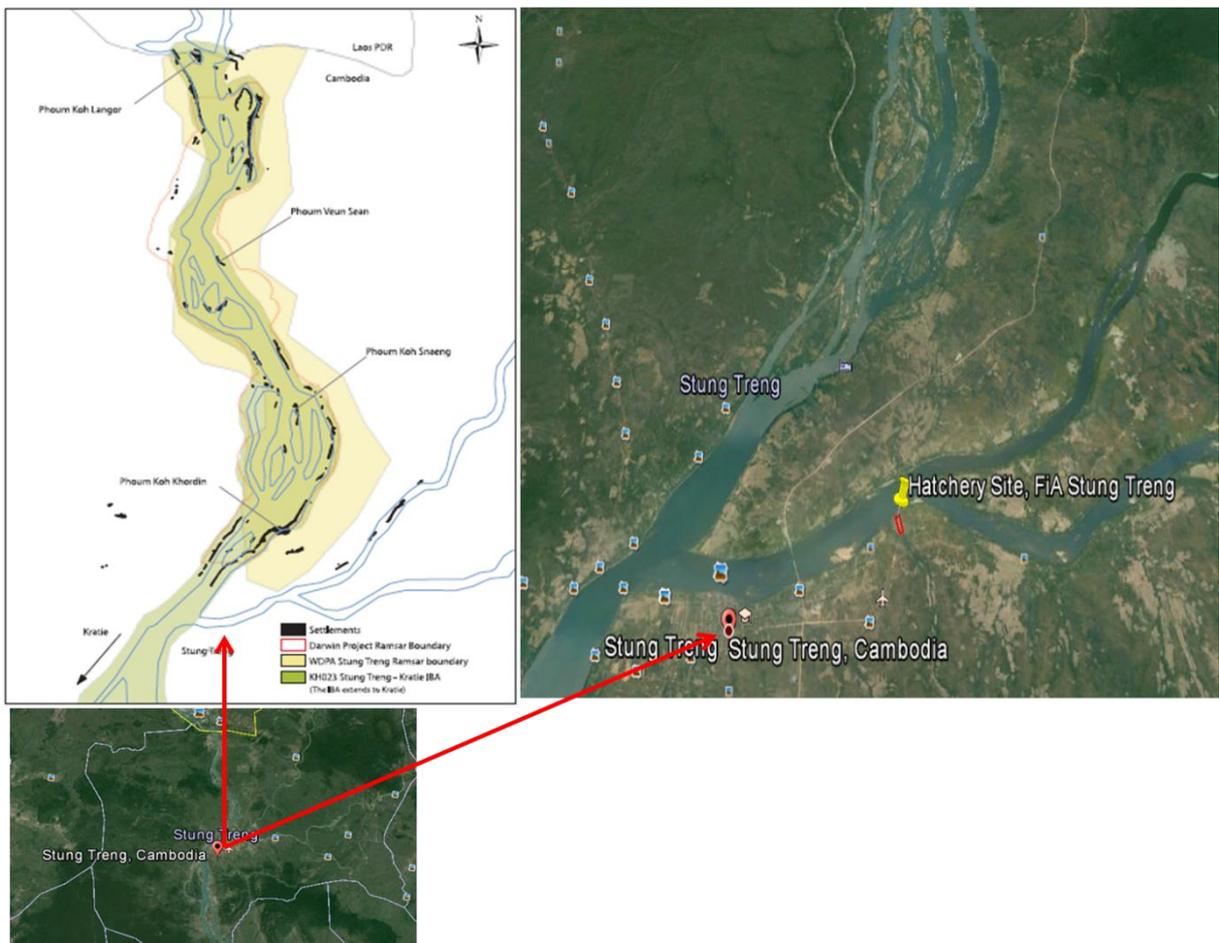
19. The proposed land (4.1 ha) assigned for the hatchery construction belongs to the Stung Treng Fisheries Administration Cantonment. Land availability for rebuilding of the hatchery was confirmed by the official letter from the Ministry of Agriculture. The hatchery is located in Srepo village, Srapresay commune, Stung Treng District, about 5.4 km North of Stung Treng (see Figure 1). It is located outside the Stung Treng Ramsar Site and about 7 kilometer far from its designated boundary. The size of the overall hatchery station is 4.1 ha and the station is about 50 meter from the Sekong River<sup>1</sup> bank and 1.5 km from the closest house. It will be placed on the rocky road which leads from Strung Treng to Sesan. The end of the land is near a small stream which can be used for drainage– this stream flows into Sekong River. Land leveling will be conducted prior to pond construction. The site will consist of: (a) 3 buildings (fish hatchery, office with accommodation, and storage room), (b) concrete tanks for the production of *moinas* (5 tanks) and the keeping of the fingerlings (10 tanks), and (c) the earthen ponds. The staff will include 8 people. The hatchery will include a set of large tanks designed for the reproduction of the carps, with a pair of large concrete tanks and 8 circular tanks made of fiberglass.

20. Water from the Sekong River will be first pumped into the reservoir and then into the ponds. The reservoir will contribute to the water settling, especially during the rainy season when the water in the Sekong River is very turbid. The hatchery is expected to use up to 250 cubic meters which is very small as compared to 90 billion cubic meters of the annual flow of the Sekong River.

21. Wastewater from the hatchery station including domestic wastewater and wastewater from fish ponds will be treated through septic tanks and wastewater treatment pond, respectively. Wastewater from fish ponds after treated will be sent back to the reservoir for recycling.

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<sup>1</sup> Sekong river is an international river that originates from Vietnam and flows through south Laos and then northeast Cambodia. It is a tributary of Mekong river. The hatchery was notified to China and Myanmar as per OP 7.50. Laos and Vietnam are part of the regional program.



**Figure 1: Location map of the hatchery station subproject**

### **3.1 Potential impacts of the subproject**

22. The construction of the hatchery requires no dismantling or demolition of existing structures. The construction of a new hatchery aims to contribute to the conservation of the fisheries resources in the Mekong River. Promoting aquaculture as an alternative livelihood to fishing in the project location will help to reduce fishing pressure on wild fish stocks. This will complement other fisheries management activities undertaken by the project that are designed to achieve more sustainable rates of exploitation of fish resources in the project location. A positive environmental impact arising from a reduction in fishing pressure is therefore expected. Potential impacts associated with the culture of indigenous and non-native species of fish during the hatchery operation phase are discussed in detail below.

23. Potential negative impacts of the hatchery during the construction and operation phases follow:

#### **3.1.1 Construction Period**

24. The negative impacts anticipated during construction include those resulting from: (i) extraction and transport of construction materials; (ii) digging fish ponds; (iii) disposal of construction wastes; and (iv) potential soil erosion and flood. The details are as follows:

25. *Extraction of construction materials.* According to the Cambodia Law a license is required for the extraction of any natural resources such as stone and gravel. Also, crushing operators should have an environmental permit covering the operation of their equipment. All contractors under the subproject will be required to use only fully licensed and permitted operators as sources for raw materials. Such certificates are periodically renewed, and contractors should ensure that they have on file copies of valid documentation and provide them to the FiA. No major impact during the transport of the materials is envisaged since all quarries identified should have proper access roads. However, crushers and vibrating screens will generate significant noise and dust during crushing and screening operations.

26. *Construction related waste materials.* Technical specifications currently in use in Cambodia require the collection and containment of all waste materials with bituminous content in specific landfills. There is no licensing requirement for the transport of waste materials but all contractors would be required to conform to environmental regulations and practice relating to proper disposal. The identification of the disposal site to be used and the appropriate quantities for each site are to be included as part of the documentation of the hatchery construction.

27. Short-term impact from *noise, dust, vibration, and traffic accident* during the construction is inevitable. Noise levels will increase due to movement of construction machinery and vehicles. This impact will be minimized under the subproject by (i) specifying in all subproject contracts the responsibility of contractor to undertake appropriate work site mitigation actions as a part of their management of work sites, and (ii) the supervision of compliance of contractors by the Construction Supervision Consultant/field engineer. Mitigation measures may include the following actions: use of sprinklers to wash down roads and suppress dust emissions during soil transport; cover vehicles to prevent spills and transport borrow materials during daytime only; plant dust screening vegetation along roadsides and at locations sensitive to air pollution like schools, hospitals, etc; reduce noise by using noise absorbing/protecting building materials, planting noise absorbing trees, provide workers with ear plugs and helmets and generally prevented from prolonged exposure to high noise levels, etc. However, the magnitude of the impacts will not be substantial and can be mitigated with implementation of proper management; the structural works would be of small scale, and the location of the hatchery is far away from the residential area.

28. *Physical Cultural Resources (PCR).* Construction may uncover archaeologically or culturally significant findings. Consideration of such concerns is provided in the works contracts that will include requirements that the contractor is obliged to look for chance finds and immediately stop the construction work at the contested location and alert the Engineer and the responsible authorities in case of chance finds.

29. This EMP sets out the provisions similar to the Environmental Codes of Practice to be attached to the civil works contract (Annex 1) in order to mitigate above-mentioned potential negative environmental impacts during construction period.

### **3.1.2 Operation Period**

30. Once the hatchery is constructed, the hatchery would be operated under the Stung Treng Province of the FiA. No impacts on the Ramsar Site are anticipated because the hatchery is located outside and downstream of the Site.

31. Potential negative environmental impacts during the operational period include: (a) floods; (b) wastewater and sediment discharge from the hatchery; (c) disposal of sludge; and

(d) impacts on the environment arising from the introduction to the wild of cultured individuals of indigenous and non-native species. These impacts and planned mitigation measures are described below:

32. *Impacts from potential floods.* Because the hatchery station is close to the river bank of Sekong River (50 meters from the riverbank) potential erosion and floods are foreseen since the area, including the proposed land was flooded in years of 1996 and 2000. To mitigate this potential soil erosion and flood, the detailed design should take into account hydro-meteorological data and geological surveys (e.g., erosion rate, peak flood, annual rainfall, soil texture, etc.) for the main structure of the hatchery.

33. *Wastewater and sediment from the hatchery.* Long-term environmental impact includes generation of wastewater and sediment from fish ponds. The conceptual design has proposed the following two measures to mitigate these impacts: (a) reuse the water through filtration and minimize the discharge (at this moment, the estimated discharge amount is about 250 cum per year, which is about 0.003 percent of the annual flow of the Sekong River (90 billion cu m) and (b) installation of a nutrition stripping pond to reduce the organic materials and sediment from the discharged water. Further under the hatchery operational plan, the quality of discharged water shall be monitored periodically.

34. *Accumulated Sediments from the Ponds.* The sediment in the ponds will accumulate and the hatchery needs to be cleaned from time to time (semi-annually) by operation unit under FiA. The amount of the sediment is not large (less than 1 cubic meter per year) and can be disposed in a temporary designated area within the hatchery. A large part of the nutrients accumulate into the sediments. Therefore, the sediment periodically removed from the bottom could be spread on the embankment of the ponds and used for either reinforcement or gardening if toxicity results are within the admissible limits. The sediment could be also spread as fertilizer onto the paddy fields once confirmed that it does not contain hazardous chemicals.

35. *Introduction to the wild of cultured individuals of indigenous species.* There is a risk that individuals of indigenous species could escape into the wild from the hatchery or grow-out facility and cause ‘genetic swamping (dilution)’ whereby the original genetic character of the host population are lost to the escaped individuals. This may cause problems for populations that have adapted to local conditions. Conversely, when stocking to enhance wild populations, genetic diversity may be reduced if stocked individuals are derived from a small broodstock. This in turn can lead to diminished growth, survival and reproductive potential in the host population. Escaped or stocked fish may also transmit diseases and parasites into wild or host populations.

36. To minimize the risk of genetic swamping, broodstock will be obtained only from local sources. Genetic diversity will be maintained by careful broodstock management. For each species, a broodstock comprising at least 50 individuals will be maintained and any type of hybridization will be prohibited. Furthermore, broodstock will be replenished annually from local sources.

37. Broodstock and progeny will be monitored daily for signs of disease and parasites and treated only when necessary with approved drugs and treatments. Movements of fish will be controlled if signs of disease or parasites exist.

38. *Introduction to the wild of cultured individuals of non-native species.* There is a risk that individuals of non-native species could escape into the wild from the hatchery or grow-out facilities. Non-native species can negatively impact upon ecosystems by causing environmental disturbance and by influencing rates of growth, survival and reproduction in populations of other species mediated through predation, competition, disease introductions and genetic contamination or hybridisation. These effects are described in detail by Welcomme & Vidthayanom (2003).

39. As described above, the two non-native species selected for culture are already widely cultured in Cambodia and have established populations in the wild with no evidence of negative impacts. Hybridization between *Clarias* hybrids and native *C. macrocephalus* has occurred in the wild and broodstock populations of *C. macrocephalus*. This introgressive hybridization, however, has not led to a swamping of the *C. macrocephalus* gene pool by *C. gariepinus* alleles. Gene flow from hybrid catfish into *C. macrocephalus* populations has been limited (Senanan *et al.*, 2004).

40. The risk of individuals of both indigenous and non-native species entering the wild from the hatchery is low because water from the facility is recycled via settling (water treatment) ponds and a reservoir (see above). No water will be released from the hatchery into natural drainage channels or the river network. This type of system is known as a closed Recirculating Aquaculture System (RAS). To further reduce risk, all water inlets and outlets will be screened with appropriate size mesh screens.

41. Outside ‘greenwater’ nursing ponds for juveniles, and broodstock ponds will be designed with permanent and effective mesh screening to all inlet and outlets. The settlement pond will provide a final barrier and trap to remove any fish when drained.

42. To minimize the risk of individuals entering the wild during the grow-out stage, fingerlings of non-native species will be grown-out (raised) only in confined, low water exchange ‘closed systems’ i.e. concrete tanks or artificial earth ponds with no hydrological connection to the river system. Furthermore, only tanks and ponds located outside of the flood zone and not in close proximity to water courses of the river system will be permitted to grow-out non-native species. As an additional precaution, all inlets and outlets will be screened with appropriate size mesh screens.

43. The greatest risk of introduction to the wild arises when air-breathing species such as *Clarias* are transported live as fingerlings from the hatchery, or at the harvest stage to and from markets. Some of these individuals may be deliberately stocked into open water bodies for various reasons. Education and awareness-raising among local communities will be undertaken to reduce this risk.

## **4. Environmental Impact Mitigation Plan**

### **4.1 Measures to Mitigate the Environmental Impacts**

44. This section sets out the key principles of the Environmental Management Plan (EMP) and includes measures to address all potential impacts listed above; it will be implemented during subproject implementation by contractors. More specifically, construction works contracts will include in the Technical Specifications contractual clauses (Annex 1) on environmental protection, and the Mitigation Plan (Annex 2) as well as the Monitoring Plan (Annex 3) will be attached to these Technical Specifications.

45. During the construction period, the FiA Component Management Unit (CMU) will monitor the implementation of the EMP, particularly measures related to the construction. CMU will assign construction supervision consultant firm (CSC). The Design Consultants will ensure that all relevant issues are adequately addressed at the design stage, and the Employer will ensure that the contract document includes the relevant clauses. The Contractor that will perform the civil works will also follow the requirements of the current related regulations. The Consulting Firm that will assist the FiA CMU in overall subproject management will also assist FiA CMU in the supervision of environmental and social aspects. The CSC/field engineer will supervise the construction works. Compliance with the RGC regulations and the terms of the present EMP will be monitored and verified in the monthly reports submitted to the FiA CMU by the CSC/field engineer, based on consultations with contractors and site visits. Also, the CSC/field engineer will also look into any new critical issues that may come up during the civil works and suggest actions for various agencies.

46. Annex 2 sets out the particular mitigation measures during the construction period. Such measures include aspects to: (a) mitigate risks of erosion and sedimentation around watercourses; (b) restrict water and soil contamination on work sites and around work camps (including littering and waste disposal); (c) restrict generation of dust during construction; (d) reduce risk of fire, cutting of trees for firewood, and trapping by construction workers; and, (e) minimize risk of accidents and ensure occupational safety of workers at construction sites.

47. Implementation of standard impact prevention or mitigation measures through adopting normal engineering practices will ensure that: (a) adequate temporary and permanent drainage is constructed; (b) the faces of embankments become stabilized and planted to prevent erosion; and (c) tree planting and landscaping. Also, in case of finding any rare/endangered (mammals, birds and fish) species during the construction activities, the present EMP prompts the contractor to inform the wildlife authorities.

48. Annex 2 also sets out the mitigation measures during the operational period.

49. Implementation of standard impact prevention or mitigation measures through adopting normal engineering practices will ensure that: (a) health risk due to use of chemicals is eliminated; (b) waste is properly collected and treated to avoid environment pollution and health impact ; (c) genetic integrity of the wild fish populations is maintained; and (d) labor accident risk is controlled. Detailed mitigation measures for above-mentioned issues are described in details in Annex 2.

## **4.2 Environmental monitoring and supervision**

50. A monitoring tool has been designed to cover all aspects of construction, including borrow pits and site management to mitigate erosion and siltation, as well as control of pollution and wastes at work sites and camps. There will be day-to-day supervision of earthmoving and construction works to ensure there is sound environmental practice employed during the contract period. Regular subproject reports shall simultaneously be shared with relevant Cambodian authorities (e.g., MoE, CNMC).

51. All such environmental and social measures will be monitored and enforced, together with health and safety measures (including accident prevention) applied by the contractor. It is a part of the EMP that the CSC/field engineer conduct a quarterly subproject audit of the EMP to: a) ensure it is up to date and relevant to the situation on the ground; b) to ensure that non-compliance and corrective actions are appropriately documented; c) to review training inputs; d) to review emergency procedures and implementation status; and e) to evaluate corrective responses of the contractor.

52. Environmental monitoring and supervision will be integrated into the project management and reporting system. Relevant Government authorities will be involved in auditing subproject performance and will receive copies of monitoring reports. There are no significant environmental risks or subproject negative social impacts which will not be accounted for through implementation of the EMP. Annex 3 summarizes the proposed monitoring activities under the subproject and specifies the parameters to be monitored, location of the monitoring sites, frequency and duration of monitoring. Overall, two types of monitoring reporting is suggested: (i) monitoring on work progress, and (ii) environmental compliance monitoring.

### 4.3 EMP Implementation Arrangement

53. While the CNMC will be the executing agency for the M-IWRMP, the FiA CMU, which is the implementation agency for Component 1, will implement the subproject, and will maintain files including copies of all contracts and environmental permits. The FiA CMU will designate a liaison officer for environmental protection and mitigation for the subproject and compliance with EMP requirements.

54. The Contractor will be responsible for compliance with environmental covenants as indicated in the contract. In the case of chance finds the contractor must immediately stop work (until resolution has been obtained) and notify the project manager who would immediately notify the FiA CMU. The FiA CMU would further notify the appropriate Government or local authority within 24 hours. The appropriate Government body notified would undertake necessary actions to record the findings and determine mitigation requirements within seven working days.

**Table 2: Responsibility for subproject EMP implementation**

Community/agencies	Responsibilities
CNMC	<ul style="list-style-type: none"> <li>• CNMC is responsible for overall monitoring and reporting on the project safeguards policy compliance</li> <li>• As part of the periodical reporting, the safeguards compliance shall be compiled by the CNMC as the project owner, which will submit the report to the Bank once every six months and the MOE once every three months</li> </ul>
FiA CMU	<ul style="list-style-type: none"> <li>• FiA CMU is responsible for the maintenance and operation of the hatchery as well as for the overall monitoring and reporting on the subproject EMP implementation</li> <li>• FiA CMU may hire an environmental consultant to assist in monitoring and supervising of the subproject EMP implementation</li> <li>• FiA CMU is responsible for preparing the quarterly monitoring reports to submit to CNMC and provincial department of environment</li> </ul>
CSC and/or Field engineer	<ul style="list-style-type: none"> <li>• The CSC/field engineer on the site will assist FiA for monitoring the environmental aspects of the project during implementation. The CSC/field engineer will explain to the contractors their responsibilities in meeting the mitigation plans included in the contract. The CSC/field engineer will play a major role in monitoring. He will be responsible for:</li> </ul>

Community/agencies	Responsibilities
	(i) providing to the FiA a monthly monitoring report of the implementation of the EMP till the completion of the work; and (ii) taking timely measures in case of noncompliance of suggested EMP measures including indication of any variances from the EMP, any chance finds, and specific mitigation actions that have been taken or need to be taken
Contractor	<ul style="list-style-type: none"> <li>• Take actions to mitigate all potential negative impacts in line with the subproject EMP</li> <li>• Actively communicate with local residents and take actions to prevent disturbance during construction</li> <li>• Ensure that all staff and workers understand the procedure and their tasks in the environmental management plan</li> <li>• Report to the FiA on any difficulties and their solutions</li> <li>• Report to local authority the subproject manager if environmental accidents occur and coordinate with agencies and key stakeholders to resolve these issues</li> </ul>
Local authority and community	<ul style="list-style-type: none"> <li>• Participate in the process of subproject preparation and ensure that their views are taken into account</li> <li>• Monitor contractor's activities in terms of safeguards policies compliance</li> <li>• Report problems to CSC/field engineer</li> <li>• Provincial Department of Environment will be responsible for inspecting the hatchery operation</li> </ul>

55. Conclusions and recommended steps to ensure that the EMP is implemented are as follows:

- To ensure that contractors pay attention to environmental impact mitigation, the EMP will be included in the Technical Specifications of the contract.
- To ensure the contractors understand the actions to be taken and the cost implications of environmental management and to ensure that required actions and measures are priced in bid proposals. The pre-bidding meetings will discuss the EMP.
- Once the contract is signed, the Contractor will be briefed by the Employers on the impact prevention/mitigation processes, the EMP requirements as outlined in their contracts, and the environmental monitoring processes.
- The CSC/field engineer should provide monthly report on Contractor performance and progress with regard to EMP compliance.

#### 4.4 Capacity development and training

##### 4.4.1 EMP training

56. Training in the EMP will be provided for FiA staff responsible for EMP implementation, contractors, CSC and/or Field engineer and local authority during subproject implementation. This is to ensure that: (a) the proposed subproject activities will be adequately screened; (b) mitigation measures are included in the bidding documents and contracts and supervision and monitoring of the contractor performance is conducted by FiA

and/or its environmental consultant; and (c) close consultation with local agencies and communities is carried out throughout subproject planning and implementation. The cost estimate of this training is US\$15,000 and included in the cost of project safeguards training.

#### **4.4.2 Hatchery operation training**

57. Training is very important to the success of the hatchery operation. Since there is no hatchery in Stung Treng before, all staffs will need training. The cost estimate of this training is US\$30,000 and included in operation cost. The training should be divided into 3 categories as follows:

- Training for the hatchery manager
- Training for Fisheries Biologists
- Training for the farmers

##### ***4.4.2.1 Training for the hatchery manager***

58. The hatchery manager should be a person with experience in fish breeding and fish culture, with managerial qualities. He/she will be responsible for the overall technical, financial and organizational management. Training needed for this position are fish production programming, hatchery management, financial planning and budgeting, and personnel planning. The training should be conducted before the operation of the hatchery.

##### ***4.4.2.2 Training for Fisheries Biologist***

59. The Fisheries Biologists will responsible for fish breeding, nursing and culturing. They needed to know all aspects of fish breeding, nursing and culturing. Several training courses are needed for these people. There includes:

1. Fish breeding
2. Fish nursing
3. Fish culture
4. Fish feed and feeding
5. Fish disease
6. Water quality
7. Moina production
8. Hatchery management
9. Fisheries extension

60. These trainings should be done during the construction of the hatchery, prior to full operation. The training can be carried out locally in Cambodia or at one of the MRC Fisheries Programme riparian countries including Thailand or Vietnam.

##### ***4.4.2.3 Training for fish farmers***

61. Since fish culture is very new to the area, farmers should be trained on several aspects of fish culture through extension programme. The training for farmers can be divided into 2 categories i.e., training for small hatchery operation and training for fish culture. The hatchery owners should be trained on fish breeding and nursing including feed preparation, disease and pond preparation. Aquaculture farmers should be trained on fish culture, feed preparation and disease. These trainings will be carried out by the provincial hatchery staffs from the second year of the hatchery operation.

#### **4.5 Public consultation and information disclosure**

62. The impacts due to construction of the hatchery will be discussed with the local authorities, the local community and independent organizations operating in the subproject

area of influence. The approach used shall include group discussions and observations during subproject site visits. Routine consultations should be planned during the stages of the subproject (detailed design prior to commencement of construction and during construction).

63. In line with the World Bank policy on Access to Information and OP 4.01 (Environmental Assessment) FiA provided a summary of the proposed subproject's objectives, description, and potential impacts and mitigation measures for groups being consulted prior to consultation to ensure that they have sufficient time to review and contribute their views during consultation. The final EMP will be disclosed to the public through the website of FiA and Stung Treng Province in local language. Hard copies of the final EMP will be made available in the commune office accessible to the key stakeholders.

## 5. References

1. Cambodia Law on Environmental Protection and Natural Resources Management
2. Cambodia Law on Fisheries
3. Cambodia Law on Labour
4. Cambodia Law on Protection of Cultural Heritage
5. Draft Feasibility Study for Stung Treng Hatchery
6. Environmental and Social Management Framework for the Mekong Integrated Water Resources Management Project Phase 3
7. Sub-decree on Solid Waste Management (No.36ANRK.BK)
8. Sub-decree on the Control of Air Pollution and Noise Disturbance (No.42 ANK.BK)
9. Sub-decree on Water Pollution Control (No.27 ANK.BK)

## 6. Annex 1: Contract Provisions

The Technical Specifications of the Contract will include the following provisions on Environmental Protection.

This section describes the environmental mitigation requirements to be followed by the Contractor and measures to be carried out by the Contractor related to environmental protection. Contractors shall follow all RGC laws and regulations related to environmental protection. Additionally the Contractor shall provide an environmental mitigation and monitoring plan in connection with the submission of the Program based on the provisions of the Environmental Management Plan prepared during subproject preparation and set forth in these Technical Specifications. The Engineer may interrupt the Contractor's work, if the provisions of the approved environmental plan are not followed. The Contractor shall also nominate one of his senior staff members to be responsible for follow-up of the implementation of the provisions of the environmental plan as well as for the guidance of the rest of the staff and reporting to the Engineer. The environmental monitoring and management plan shall be provided as a part of the method statement of the Contractor's proposed arrangements and methods of execution of the works required by of these Technical Specifications.

### **DO:**

1. Limited working hour during the day time, especially in residential areas, and control driving speed;
2. Minimize earth excavation and appropriate disposal of spoil;
3. Minimize opening of new borrow pits and ensure proper closure;
4. Minimize traffic congestion, dust and noise generation;
5. Proper maintenance of construction equipment and vehicles;
6. Provide appropriate safety sign (day and night) and closely inform local residents;
7. Avoid spill of used oil and other toxic materials, including safe transportation and storage;
8. Apply good housekeeping in the construction and/or storage sites to ensure safety of workers and peoples (Gather up and remove debris to keep the work site orderly and safe; Plan and implement adequate disposal of scrap, waste and surplus materials; Keep the work area and all equipment tidy. Designate areas for waste materials and provide containers; Keep stairways, passageways and ladders free of material, supplies and obstructions; Secure loose or light material that is stores on roofs or open floors; Keep materials at least 2m (5ft) from openings, roof edges, excavations or trenches; Remove or bend over nails protruding from lumber; Keep hoses, power cords, welding leads from laying in heavily traveled walkways or areas; Ensure structural openings are covered/protected adequately; Provide the appropriate fire extinguishers for the materials found on-site. Keep fire extinguisher stations clear and accessible;
9. Ensure access to clean water and latrines by workers and provide mosquito net; and
10. Avoid social/cultural conflict between workers and local population.

### **DO NOT:**

1. Do not permit rubbish to fall freely from any locations of the project and/or access by animals (dogs, cats, pigs). Use appropriate containers;
2. Do not throw away tools or other materials;
3. Do not raise or lower any tool or equipment by its own cable or supply hose;

4. Use grounding straps equipped with clamps on containers to prevent static electricity buildup; and
5. Do not allow hunting of animals by workers in protected areas.

**SPECIAL NOTE ON FLAMMABLE/EXPLOSIVE MATERIALS:**

1. Store flammable or explosive materials such as gasoline, oil and cleaning agents apart from other materials.
2. Keep flammable and explosive materials in proper containers with contents clearly marked.
3. Dispose of greasy, oily rags and other flammable materials in approved containers.
4. Store full barrels in an upright position.
5. Store empty barrels separately.
6. Post signs prohibiting smoking, open flames and other ignition sources in areas where flammable and explosive materials are stored or used.
7. Store and chain all compressed gas cylinders in an upright position.
8. Mark empty cylinders and store them separately from full or partially full cylinders.
9. Ventilate all storage areas properly.
10. Ensure that all electric fixtures and switches are explosion proof where flammable materials are stored.

**Health, Safety and Accidents**

The Contractor shall ensure, to the extent that is reasonable, the work environment health, safety and welfare of his employees including those of his sub-contractors and of all other persons on the site. The organization of the construction sites and work places shall generally be in accordance with the existing safety regulations in Cambodia. His responsibilities shall include:

- (a) The provision and maintenance of construction plant, equipment and systems of work that are lighted, safe and without risks to health.
- (b) The execution of suitable arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage, transport and disposal of articles and substances.
- (c) The provision of protective clothing and equipment, first aid stations with such personnel and equipment as are necessary and such information, instruction, training and supervision as are necessary to ensure the health and safety at work of all persons employed on the works all in accordance with the Laws of Cambodia.
- (d) The provision of a qualified officer or designation as Safety Officer of one of his senior staff who has specific knowledge of safety regulations, and experience of safety precautions on similar works and who shall advise on all matters affecting the safety of workmen and on measures to be taken to promote such safety.
- (e) The provision and maintenance of access to all places on the site in a condition that is safe and without risk of injury.
- (f) The provision of adequate waterborne sanitation, refuse collection and disposal, complying with the Laws of Cambodia, all local by-laws and to the satisfaction of the Engineer, for all houses, offices, workshops and laboratories erected on the camp site or sites.
- (g) The provision of an adequate number of suitable latrines and other sanitary arrangements at sites where work is in progress to the satisfaction of the Medical Officer in the area.
- (h) The execution of appropriate measures in consultation with the appropriate Public Health Authority to control within the Site, including the camp sites, mosquitoes, flies and pests including the application of suitable chemicals to breeding areas.

(i) Reporting details of any accident to the Engineer and the Police, if appropriate, as soon as possible after its occurrence.

The Contractor shall appoint one responsible member of his staff to act full-time as Safety Officer, and he shall notify the Engineer of such appointment. The Safety Officer shall be experienced in all matters relating to health and safety on Sites and shall be familiar with all relevant safety regulations and legislation. The Safety Officer shall have the power to receive instructions from the Engineer on matters relating to the health and safety of personnel on Site and the safe conduct of site operations. The Safety Officer shall organize and all workmen shall be required to attend an orientation/safety induction course within their first week on Site.

### **Protection of Water Resources**

(i) During construction, the contractor shall carry the full administrative and legal responsibility for any pollution of surface waters according to the existing legislation.

(ii) The contractor shall ensure that no oil products, fuel, lubricants, detergents, paint or other harmful substances are introduced into streams and irrigation or drainage facilities.

(iii) The storage or production or waste as well as filling and parking of machinery or cars is not permitted within a distance of 100 m of any stream including drainage or irrigation facilities. The discharge of oil and fuel onto open soils is prohibited. Filling of any machinery shall be restricted to stationary and or mobile filling stations and shall exclusively be carried out by using suitable taps or nozzles. The contractor shall make all necessary arrangements to ensure that pollution of soils and groundwater will be avoided as far as possible.

(iv) The contractor shall submit a plan to the relevant authorities indicating the type of installation and their respective locations e.g. fuel and material storage, stationary filling sites, asphalt plant, mixing plant, car wash facilities etc. For each installation the contractor shall indicate the approximate closest distances to irrigation and drainage channels as well as public or private wells. For each installation beforehand the Contractor shall indicate in written form to the Engineer in addition to the above the approximate closest distances not less than 250 m to the specified green or protected areas.

(v) The Contractor shall submit to the Engineer an emergency plan for hazardous spills and leakage subject for approval before commencement of the works. This does not overrule requirements of the section i) above vi) the direct discharge of sewage from worker's camps into any stream is prohibited. Sewage from these installations shall be collected in septic tanks or soaking pits.

### **Noise Control**

The Contractor shall follow all the existing laws and regulations concerning the noise control in construction works, asphalt plant and borrow pit activities. The contractor shall submit a plan to the relevant authorities indicating the type of installation and their respective locations e.g. asphalt plant, mixing plant etc, which is subject for approval before commencement of the works. The Contractor shall elaborate and adopt effective measures both in management and technology to minimize noise, especially in proximity to residential areas. The contractor should conduct appropriate prior maintenance to minimize the noise-level of equipment. The use of high-level noise generating plant and equipment shall not be carried out at night unless

otherwise approved by the Engineer. All noise not relating to the construction shall be avoided as far as possible.

### **Dust Control**

The contractor will specify and follow mitigation measures to control dust from the operation of equipment and construction. If stone crushing operations are undertaken at site, care shall be taken to ensure that any dust emanating from the operations is contained to prevent nuisance to adjoining properties. The Contractor shall submit a plan indicating the proposed routes for material transport and make statements on the proposed method of dust control where transport through settlements cannot be avoided.

### **Solid waste from construction and construction camps**

(i) Wherever possible recycling/re-use of materials shall be considered; (ii) As a rule, solid wastes generated during the construction phase shall be systematically collected, stored and disposed of in suitable locations approved by the subproject manager and in accordance with national and local relevant regulations.

(a) Construction debris shall generally be removed from the site in an orderly manner and disposed of in accordance with the existing regulations. (b) Clean soil material, i.e. later indicated as Spoil Material that is not reusable shall be removed from the site and transported to the soil dumping areas in accordance with relevant regulation, or designated in the design documents. (c) Domestic waste from temporary construction camps shall be systematically collected and hauled to the designated areas in accordance with the relevant regulation. Should construction camps be erected within a reasonable distance to larger settlements, camp's solid waste may be integrated into existing collection and disposal facilities of nearby communities by their approval.

### **Fire Protection**

The Contractor shall comply with the provisions for fire protection according to RGC legislation or as otherwise directed by the Engineer.

### **Materials**

The contractor will restrict the use of materials to sources appropriately licensed under RGC legislation for permits. The contractor will be responsible for having on file evidence of such permits.

### **Sewage**

The contractor will contain, collect, and treat any sewage in accordance with the requirements of environment protection and as approved by the Project Manager and the local department of environmental protection.

### **Social Issues**

The contractor will follow social mitigation actions as indicated in the designs provided for the hatchery. In the case of disputes, the contractor will refer the issue to the subproject manager. Specific concerns include but are not limited to access to residences, source of income generation, and water and other utilities.

## **Chance Finds**

In line with Cambodia law on Protection of Cultural Heritage, when construction work or any other activity bring to light cultural property such as monuments, ruins, ancient objects, remains of inhabited sites, ancient burial sites, engravings or any property likely to be of interest in the study of prehistory, history, archaeology, ethnology, paleontology or other branches of science dealing with the past or of human sciences in general, the person finding the property and the owner of the site where it was discovered are obliged to stop the construction work and immediately make a declaration to the local police, who shall transmit it to the Governor of the province without delay. The Governor shall in turn inform the competent authority and shall take the measures necessary to ensure the protection of the objects and the site.

## **Supervision and Monitoring**

The CSC and/or field engineer will be responsible for monitoring and verifying that all construction is in compliance with the terms of the EMP and that there have been deviations from neither the terms of this contract or the EMP.

## **Payment**

Except when otherwise specified, there will be no payment for actions taken in support of the environmental protection as specified in this section. All costs associated with this task will be considered as being covered by the overall payments specified in the contract for the construction work (bill of quantities). All costs entailed in sampling, testing and in carrying out trial areas for the purpose of environmental protection as set in these Technical Specifications, shall be deemed to be included in the prices and rates entered by the Contractor in the Bill of Quantities.

## 7. Annex 2: Mitigation Plan

Phase	Issue	Mitigation measures	Cost	Responsibility for implementation	Responsibility for supervision
<b>Pre-construction</b>					
	Site selection	Conduct a screening through careful site investigation with participation of professional experts (e.g., geologist, biologist, archaeologist, hydrologist); Consult with local authority and people; Make sure that problems with UXO, flood, erosion, depression, damage to significant cultural resources, land acquisition and resettlement, loss of biodiversity to be adequately managed before commencement of detailed design.	Preparation cost	FiA CMU	CNMC
	UXO clearance	CMAC will be hired to detect and clear UXO from the hatchery site; CMAC will inform concerned agencies, local authority and people about a detailed plan for detection and clearance of UXO at least one week before work starts.	Preparation cost <sup>2</sup>	CMAC <sup>3</sup>	FiA and CNMC
	Detailed design	Results from screening and hydro-meteorological and geological survey data	Preparation cost	Design consultant	FiA CMU

<sup>2</sup> US\$ 6,000 will be allocated for UXO clearance

<sup>3</sup> The **Cambodian Mine Action Centre (CMAC)** is Cambodia's leading demining organization, working in the key areas of Survey and Land Release, Mine and UXO Clearance, Mine and UXO Risk Education and Training, Research and Development. .

		should be taken into consideration at detailed design stage; Detailed design should be reviewed and appraised by the panel of professional experts to ensure that operation of the hatchery station will not face any environmental problem.			
<b>Construction</b>	<b>Construction site</b>				
	Site clearance	Clearing and grubbing, debris generated due to dismantling of existing road, tree cutting, etc. before the commencement of the construction activities shall be done in accordance with local regulations.		Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>a) Noise disturbance including vibrations</i>	The construction equipment will strictly conform to Cambodia noise standards; Vehicles and equipment used shall be fitted with exhaust silencers and shall be checked regularly; Noisy construction activities will be at least a distance of 100m from the hospitals, educational institutions ect., and 150 m from the nearest habitation; Construction activity should be restricted between 6.0 AM - 7.0 PM near habitations; Workers shall be provided with earplugs; Suitable noise barriers or double-glazing of windows will be provided to the noise sensitive receptors.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>b) Dust/air quality</i>	Water will be sprayed on earthworks, temporary haulages and detour roads to prevent dust generation; Vehicles delivering fine materials like sand and fine aggregate shall be covered to reduce spills on roads; The asphalt plants, crushers will be sited at least 1 km in the downwind direction from the nearest human	Construction cost	contractor	CSC/field engineer FiA CMU Provincial DoE

		settlement; It shall be ensured that the dust emissions from the crusher and vibrating screen at the stone quarries are within the emission standards.			
	<i>c) Traffic disruption during construction activity</i>	Traffic management plan with appropriate measures and signaling system to redirect traffic that are easily seen or easy to follow.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>d) Vehicle and pedestrian safety when there is no construction activity</i>	Traffic management plan with appropriate fencing, lighting and well defined safety signs.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>e) Soil erosion</i>	Control soil erosion/sedimentation through use of dikes, fiber mats, mulches, grasses, slope, drains and other devices.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>f) Quarries, sand &amp; borrow pits</i>	Only licensed quarries and borrow sites will be used; precaution will be required to prevent the spillage of materials during transportation; all vehicles will be covered to avoid spillage during transportation of quarry materials.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>g) Drainage and flood hazard</i>	All the existing flowing water bodies (rivers, streams, canals including irrigation canals) hazard are provided with culverts to maintain the natural drainage of the area.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>h) Water and soil pollution from improper material storage, management and usage</i>	Organize and cover material storage areas; isolate concrete, asphalt and other works from watercourse by using sealed formwork; isolate wash down areas of concrete and asphalt trucks and other equipment from watercourse by selecting areas for washing that are not free draining directly or indirectly into watercourse.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>i) Water and soil pollution from</i>	Dispose waste material at appropriate location protected from washing out, specified by local	Construction cost	Contractor	CSC/field engineer FiA CMU

	<i>improper disposal of waste materials</i>	<p>authorities.</p> <p>Some 17,672 cubic meters of excavated soil will be generated from digging fish ponds. A large part of this soil will be used to (1) build the dikes at 0.5-2 m above the ground level, (2) to raise the floor of the buildings and the road at the same level as the ponds dikes and (3) to add 1 m to the surrounding dike of the station. The latest will be 740 m in length by 1.5-3 m final height and 1 m final width at the top; it might be useful for reducing more the risk of flooding. On the whole, 12,679 m<sup>3</sup> of soil will be used for those dikes arrangements, which is equivalent to 71.7% of the digged volume of soil. Therefore about 30% of soil might remain; it could be given or sold in the surroundings.</p>			Provincial DoE
	<i>j) Potential contamination of soil and water from improper usage of construction equipment</i>	Proper handling of lubricants, and solvents by secured storage; ensure proper usage of construction equipment; collect all waste and dispose to permitted waste place.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>k) Air pollution from improper maintenance of equipment</i>	Maintain construction equipment to good standard, improper functioning machinery that causes excessive pollution will be banned from the construction site.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>l) Workers safety</i>	Provide workers with safety instructions and protective equipment; safe organization of bypassing traffic.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
	<i>m) Archeological Chance finds</i>	All archeological property found during works should be dealt with according to the local rules and regulations. In the event of the unexpected		Contractor	CSC/field engineer FiA CMU Provincial DoE

		discovery of archeological objects the Contractor should immediately inform the CSC/field engineer and the local and archeological authorities and follow their directions.			
<b>Construction</b>	<b>Worker's camp site conditions</b>				
	a) Cleanliness, solid waste handling and disposal facilities, drainage conditions	Provide workers with (a) clean water, (b) mobile toilets, and (c) garbage bins; Avoid ponding at construction sites as mosquito habitats; Avoid blocking water flows by designing appropriate culverts; and Apply environmentally sound measures to control mosquitos, rats, flies and other pests.	Construction cost	Contractor	CSC/field engineer FiA CMU Provincial DoE
<b>Operation</b>					
	Quality of source water (i.e. Sekong river) - The quality of source water can also have a major effect on the viability of an aquaculture operation	Water quality will be tested and further treatment may be required to ensure that the quality meets specific purposes of the hatchery operation and is in accordance with national technical regulation (i.e. Sub-decree on Water Pollution Control (No.27 ANK/BK))	Operation cost	Provincial FiA	FiA
	Protection of the genetic integrity of wild populations of fish.	For each species, a brood stock comprising at least 50 individuals will be maintained and any type of hybridization will be prohibited. Furthermore, brood stock will be replenished annually from local sources.	Operation cost	Provincial FiA	FiA
	Fish escapement (Hatchery)	All pond and canal inlets and outlets should be screened with synthetic netting. The hatchery RAS design will further reduce the risk of fish escapement.		Provincial FiA	FiA

	Fish escapement (Grow-out systems)	Non-native species will be grown-out (raised) only in confined, low water exchange ‘closed systems’ i.e. concrete tanks or artificial earth ponds with no hydrological connection to the river system. Furthermore, only tanks and ponds located outside of the flood zone and not in close proximity to water courses of the river system will be permitted to grow-out non-native species. As an additional precaution, all inlets and outlets will be screened with appropriate size mesh screens.	Operation cost	Provincial FiA	FiA
	Fish escapement (During transportation between hatchery, grow-out systems and markets)	Education and awareness-raising among local communities and during farmer training programmes will be undertaken to reduce the risk of stocking fish into open waters or into inappropriate grow-out systems.	Operation cost	Provincial FiA	FiA
	Control of diseases and parasites	Broodstock and progeny will be monitored daily for signs of disease and parasites and treated only when necessary with approved drugs and treatments. Movements of fish will be controlled if signs of disease or parasites exist.  The use of antibiotics and pesticides is strictly prohibited. Parasites can be controlled with only Sodium Chloride (NaCl). The use of toxic chemicals is strictly prohibited.	Operation cost	Provincial FiA	FiA Provincial DoE
	Wastewater	To prevent the problem of aquaculture wastewater, the hatchery has been designed with a water treatment pond. This pond will receive water from hatchery, cement tanks, brood stock ponds and nursing ponds. The capacity of this pond is 1,956 m <sup>3</sup> , equivalent to 4 nursing ponds.	Operation cost	Provincial FiA	FiA Provincial DoE

		The remaining nutrients will be stripped off the water through the natural food web or wet land system. Afterwards the water will be sent back into the reservoir for recycling. On the other hand, all wastewater from house and office should be treated using the water treatment tank (septic tank). A monthly monitoring of wastewater quality is necessary to ensure that wastewater discharge meets national standard requirements.			
	Solid waste	As the staff will stay in the hatchery (8 people) household waste will generate during the operation of the hatchery. Since the solid waste collection does not cover the hatchery area, the hatchery staff will establish a dust bin and the collected solid waste will be carried to the nearest collection point every week.	Operation cost	Provincial FiA	FiA Provincial DoE
	Sediment disposal	During the operational period, sediment will accumulate and the hatchery needs to be cleaned from time to time (semi-annually) by operation unit under FiA. The amount of the sediments is not large (less than 1 cubic meter per year) and can be disposed in a temporary designated area within the hatchery. A large part of the nutrients accumulate into the sediments. Therefore, the sediment periodically removed from the bottom could be spread on the embankment of the ponds and used for gardening. The sediment could be also spread as fertilizer onto the paddy fields. FiA will conduct a sample analysis every year to confirm no toxic materials.	Operation cost	Provincial FiA	FiA Provincial DoE
	Occupational health	Staff and workers operating the hatchery station	Operation	Provincial FiA	FiA

	and safety	<p>should be (i) annually trained in labour safety rules and first aid and (ii) provided with labour safety tools;</p> <p>The Hatchery manager should follow Cambodia law on Labour;</p> <p>The hatchery station should be provided with qualified first-aid kits and fire-extinguishers at all times;</p> <p>Unauthorized persons are prohibited to enter the hatchery station;</p> <p>Dangerous area, if any, should be provided with a warning signboard</p>	cost		
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## **8. Annex 3: Monitoring Plan**

Environmental monitoring during subproject implementation would provide information about key environmental aspects of the subproject, particularly the environmental impacts of the subproject and the effectiveness of mitigation measures. Such information enables the FiA and the Bank to evaluate the success of mitigation as part of subproject supervision, and allows corrective action to be taken when needed.

The monitoring plan will be undertaken by FiA to (i) ensure that construction contractors are compliant with this EMP. FiA may also hire an environmental consultant to assist to monitor and supervise the EMP implementation. Field engineers and/or construction supervision consultants will help FiA to monitor contractor's compliance with environmental covenants. Local authorities and communities are encouraged to participate in monitoring program.

Ministry of Environment will also undertake the responsibility for monitoring in accordance with the Law on Environmental Protection and Natural Resources Management.

Monitoring of ambient environmental quality is developed based on foreseen environmental impacts that may cause changes in noise level, air and water quality in the subproject site. These results would help FiA and MoE to evaluate the degree of impacts due to the subproject implementation and effectiveness of implementation of mitigation measures.

Details about the monitoring program are given in the following table.

**Table 3: Monitoring Plan**

<b>Phase</b>	<b>What parameter to be monitored?</b>	<b>Where parameter to be monitored?</b>	<b>How parameter to be monitored?/type of monitoring equipment</b>	<b>When parameter to be monitored? (frequency of measurement or continuous)</b>	<b>Cost</b>	<b>Responsibility for monitoring</b>
<b>Pre-construction</b>						
<i>a) Detailed design</i>	Technical specifications		Review and appraisal by the panel of experts	Before commencement of construction	Subproject preparation cost	FiA CMU
<b>Construction</b>						
<i>a) Noise disturbance and vibrations</i>	a) noise levels (dB); sonometer	a) At and near work site	a) Inspection and supervision; according to Cambodia noise standards	a) once a month or on complaint	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>b) Dust/air quality<sup>4</sup></i>	- TSP (24 hours average) - CO, NO <sub>2</sub> and SO <sub>2</sub> (1 hour average)	b) At and near work site	b) inspection	b) once every 3 months; unannounced inspections during material delivery and construction	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>c) Traffic disruption during construction activity</i>	c) existence of traffic management plan; traffic patterns	c) At and near work site	c) inspection; observation	c) before works start; once per month at peak and non-peak periods	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>d) Vehicle and pedestrian safety when there is no</i>	d) visibility and appropriateness	d) At and near work site	d) observation	d) once per month in the evening	Included in subproject cost	CSC/field engineer FiA CMU MoE

<sup>4</sup> Technique and standard applicable to monitoring plan is in accordance with Sub-decree on the Control of Air Pollution and Noise Disturbance (No.42 ANK/BK)

<b>Phase</b>	<b>What parameter to be monitored?</b>	<b>Where parameter to be monitored?</b>	<b>How parameter to be monitored?/type of monitoring equipment</b>	<b>When parameter to be monitored? (frequency of measurement or continuous)</b>	<b>Cost</b>	<b>Responsibility for monitoring</b>
<i>construction activity</i>						
<i>e) Soil erosion</i>	e) Turbidity	e) At work site	e) Visual observation by Supervisor	e) Construction stage	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>f) Quarries, sand &amp; borrow pits</i>	f) Possession of official approval or valid operation license	f) Quarry, sand & gravel borrow pits	f) inspection	f) Before work begins	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>g) Drainage and flood hazard</i>	g) Execution of work according to design	g) At work site	g) inspection	g) During construction	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>h) Water and soil pollution from improper material storage, management and usage</i>	h) water and soil quality (suspended solids, oils, pH value, heavy metals)	h) runoff from site, material storage areas; wash down areas of equipment	h) inspection; observation	h) during material delivery and construction, especially during precipitation (rain, , etc.)	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>i) Water and soil pollution from improper disposal of waste materials</i>	i) water and soil quality (suspended solids, oils, pH value)	i) depository site	i) inspection; observation	i) once every 3 months during construction and on complaint	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>j) Potential contamination of soil and water from improper</i>	j) water and soil quality (suspended solids, oil, lubricants, fuel, pH	j) At work site; construction equipment place	j) unannounced inspection	j) once every three months during construction,	Included in subproject cost	CSC/field engineer FiA CMU MoE

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
<i>maintenance of equipment</i>	value			on complaint, and in case of spillage		
<i>k) Air pollution from improper maintenance of equipment (asphalt plant and machinery)</i>	k) Exhaust fumes, dust	k) At work site	k) Visual inspection during work	k) During work	Included in subproject cost	CSC/field engineer FiA CMU MoE
<i>l) Staff safety</i>	l) protective equipment; organization of bypassing traffic	l) At work site	l) inspection	l) unannounced inspections during work	Included in subproject cost	CSC/field engineer FiA CMU MoE
Construction	Worker's camp site conditions					
<i>a) Overall workers' camp site conditions</i>	a) Cleanliness, solid waste handling and disposal facilities, drainage conditions	a) On the camp site during construction activities	a) Unannounced inspection	f) According to the existing regulations	Included in subproject cost	CSC/field engineer FiA CMU MoE
<b>Operation</b>						
Wastewater <sup>5</sup>	pH, BOD <sub>5</sub> , COD, TSS, <sup>6</sup> NO <sub>3</sub> <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , NH <sub>3</sub>	water outlet of the hatchery station	Inspection	Once every three months	Operation cost	FiA MoE
Surface water (Sekong River)	pH, BOD <sub>5</sub> , Suspended Solid	Water intake	Inspection	Once every three months	Operation cost	Provincial FiA

<sup>5</sup> Technique and standard applicable to monitoring plan is in accordance with Sub-decree on Water Pollution Control (No.27 ANK/BK)

<sup>6</sup> TSS – Total Suspended Solids; BOD – Biochemical Oxygen Demand; COD – Chemical Oxygen Demand

<b>Phase</b>	<b>What parameter to be monitored?</b>	<b>Where parameter to be monitored?</b>	<b>How parameter to be monitored?/type of monitoring equipment</b>	<b>When parameter to be monitored? (frequency of measurement or continuous)</b>	<b>Cost</b>	<b>Responsibility for monitoring</b>
water)	(SS), Dissolved Oxygen (DO), Coliform					
Protection of the genetic integrity of wild populations of fish.	Broodstock records including number of individuals by sex, age, maturity, condition, health, source (origin) ...etc.	The hatchery station	Visual observation and record keeping (reporting).	Annually.		
Fish escapement prevention (Hatchery)	Ensure all pond and canal inlets and outlets screens are intact and in place.	Hatchery station	Observation	Daily		Hatchery manager
Fish escapement Prevention (Grow-out systems)	Ensure that non-native species are grown-out (raised) only in confined, low water exchange 'closed systems' i.e. concrete tanks or artificial earth ponds with no hydrological connection to the	Participating CFi employing aquaculture as an alternative livelihood.	Field Observation	Monthly		PFiA

<b>Phase</b>	<b>What parameter to be monitored?</b>	<b>Where parameter to be monitored?</b>	<b>How parameter to be monitored?/type of monitoring equipment</b>	<b>When parameter to be monitored? (frequency of measurement or continuous)</b>	<b>Cost</b>	<b>Responsibility for monitoring</b>
	river system. Ensure that tanks and ponds are located outside of the flood zone and not in close proximity (100 m) to water courses of the river system. Ensure all inlets and outlets are screened with appropriate size mesh screens.					
Fish escapement prevention (During transportation between hatchery, grow-out systems and markets)	Monitor fish releases or stocking activities in open waterbodies.	Waterbodies and river courses	Field observations	Continuous		PFiA
Control of diseases and parasites at the hatchery and at grow-out facilities.	Brood stock and progeny, and cultured fish monitored for signs of disease and parasites.	The hatchery station.  Grow-out facilities	Visual observations in the field and lab. Further testing if necessary.	Daily	Operation cost	Hatchery manager Fish farmer

<b>Phase</b>	<b>What parameter to be monitored?</b>	<b>Where parameter to be monitored?</b>	<b>How parameter to be monitored?/type of monitoring equipment</b>	<b>When parameter to be monitored? (frequency of measurement or continuous)</b>	<b>Cost</b>	<b>Responsibility for monitoring</b>
Chemicals management	List of chemicals used for control of diseases and parasites.	The hatchery station	Review the list and check	Once every six months	Operation cost	Hatchery manager FiA MoE
Solid waste	Proper collection and disposal	The hatchery station	Observation	Once every six months	Operation cost	FiA MoE
Sediment disposal	Proper collection and disposal	The hatchery station	Observation	Once every six months	Operation cost	FiA MoE
Occupational health and safety	Training and awareness	The hatchery station	Interview of staff and workers and overseeing practice	Once a year	Operation cost	FiA

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