

TECHNICAL OPTIONS

A. Introduction

1. Technical diligence for the project was conducted to assess the appropriateness of the technologies and the sub-project components proposed. Site visits were made to the proposed sub-project locations in Kampong Chhnang (KCH) and Pursat (PST) to assess the situation at each sub-project location and review the technical options proposed for each.

B. Kampong Chhnang - Flood Protection

2. The existing embankment does not provide sufficient protection from high water levels in the river. The embankment is breached annually in numerous locations, due to the varying embankment elevations. The Project will provide a new earth embankment, about in 15 kilometers (km) length, constructed predominantly along the existing embankment alignment to minimize social, resettlement, and environmental issues. The embankment will have a continuous elevation of 13.00 meters (m) (12.50 m design flood level plus 0.50 m freeboard) affording protection against high water levels of at least 50 years return period along its entire length, protecting the town and significant areas of agricultural land. Where insufficient space is available in the town areas, the embankment will utilize reinforced concrete walls to minimize any impacts.

3. The proposed freeboard of 0.50 m, above the design flood level, will provide additional protection to cater for the potential effects of climate change and resulting higher flood levels. Current analysis estimates the total level of protection at 1 in 200 years, including the freeboard.

4. Protection of the agricultural land will provide the opportunity to farm this land year round. To avoid future drainage issues, development of the agricultural areas within the protected area behind the embankment, should be avoided and the local government should take any necessary steps to protect this land from urban development. Should further development be necessary at a later date, through an approved change in land-use, careful planning and appropriate urban drainage design and infrastructure works will be necessary.

5. The proposal to maintain the existing embankment alignment, as much as possible, is an appropriate solution to avoid significant social and environmental safeguard issues. However, construction of the short section (D-D1), adjacent to the French weir, initially excluded the households on the water side of the embankment. At the request of the Ministry of Public Works and Transport (Executing Agency [EA]) the embankment alignment was adjusted to include all households at this location. Due to the location of the river navigation at this point and the existing weir, it will not be possible to provide an earth embankment, so reinforced concrete walls construction will be provided. This is more expensive but assures the same level of flood protection for the non-transient households and/or businesses in this area.

6. Site visits were conducted to all sections of the existing embankment that were accessible during the missions. Low water levels were experienced on the first mission and on the second the impact of the high water levels, which had reached their peak only a few days earlier, was observed. The alignment and design of the embankment appear to be appropriate and fit for purpose; and during project implementation the design will be refined accordingly.

C. Pursat - Riverbank Protection

7. The Project will provide riverbank protection at two locations where erosion has been identified as a potential problem for the existing road if not adequately addressed soon. The

protection will be provided by groins, constructed in the river channel, to prevent erosion and encourage sedimentation. This solution is relatively low-cost and should prove effective. The Mission visited both sites and concurred that the groins would provide a cost-effective solution.

D. Pursat – Urban Drainage Improvements

8. The urban drainage improvements to be provided by the Project will significantly improve flood protection in the town and transport stormwater flows away from the town to discharge to an existing disused irrigation channel. The system has been design to provide protection from a 20-year design storm return period, based on an assessment of the catchment conditions and available historical rainfall records

9. There is no formal wastewater collection or sewerage system in PST. As such, the drainage system will be used to collect wastewater flows from each property along its length, creating a combined sewer system. To minimize potential pollution, the existing but disused wastewater treatment facility, previously constructed by the Ministry of Water Resources and Meteorology (MOWRAM), will be rehabilitated and improved to provide better treatment performance within the same areal footprint.

10. Site visits were conducted to assess the applicability of the proposed urban drainage improvements in PST. The drainage system has been designed to provide for the development needs of the town and follows the natural contours of the land, utilizing the pipe sizes available locally. While some limited drainage works are ongoing, they do not appear to have been designed to meet the development needs of the town and there are some quality concerns with respect to the pipes and the construction. Construction of these drainage works will be curtailed after completion of the current sections, which have been incorporated into the design of the new drainage system.

11. The new drainage system is designed to provide protection from a 20-year design storm return period, offering significantly improved levels of protection for the town. In locations where the new drains will be laid, paved roads and footpaths will also be provided to improve access and environmental conditions. As the only conduits for liquid wastes, the drainage system currently receives sewage from households and businesses. While a separate sewerage system would be an ideal solution, sewage flows are low and until water supply coverage is increased significantly, there is little point in constructing a separate system. Instead, the drainage system will be designed to carry these relatively small waste flows as a combined system, with dry-weather flow channel, where needed, to ensure self-cleansing velocities are maintained to minimize potential siltation.

12. To provide some level of sewage treatment, particularly during the dry season, waste stabilization ponds are proposed for the improved wastewater treatment facility, which is an appropriate solution for the local conditions. This facility will be upgraded to treat the wastewater flows from the proposed drainage system and the future wastewater flows from the town. The design of the treatment facility will include screening and anaerobic ponds, the latter having the ability to accept septage from septic tanks, when collected by the local government or private contractor. As the town develops a future wastewater initiative could be small diameter separate sewer system, to intercept the waste connections to the drainage system and transport the wastewater directly to the treatment facility.

13. The drainage and wastewater solutions proposed are appropriate for the situation and will be considered in more detail during detailed engineering design. Operation and maintenance of the drainage system requires only low-tech manual equipment, since the size of

the system does not justify more expensive mechanical equipment. In addition, the wastewater treatment facility requires only simple operation and maintenance and no electro-mechanical equipment, except for the pumps needed to lift the wastewater from the drainage system to the inlet works.

E. Kampong Chhnang and Pursat - Solid Waste Management

14. The Project will provide two new controlled landfill facilities, one at KCH and one at PST. The two new sites selected are close to the towns to minimize transportation costs, and are located on unused scrub land located away from any developments.

15. Site visits were conducted to the existing waste disposal facilities, two in KCH and two in PST:¹

- (i) Kampong Chhnang:
 - a. Kul Kuk village, Sre Thmei commune, Rolea district; and
 - b. Trok village in Sre Thmei commune, Rolea district.
- (ii) Pursat
 - a. Toul Mkak village, Roleap commune, Pursat city; and Sras Srang village, Prey Gny commune, Pursat city.

16. The facilities are privately operated dumpsites, which are poorly managed and are simply sites with borrow pits, used to supply fill materials for local construction projects, which are being filled with municipal solid waste. There appears to be no controlled dumping and waste is dumped into unlined cells (the borrow pits) or simply tipped onto the site close to and along the unsurfaced access roads. It was noted on one site visit that a small number of informal waste pickers operate on the sites.

17. The government has agreed to decommission, cap and close the four existing open dumpsites. Steps and procedures are included in each of the initial environmental examination plans and appropriate environmental mitigation measures are included. A loan covenant ensuring this step has been included in the project.

18. The Project will oversee the decommissioning, capping and closing of the four existing open dump sites; if necessary, the Project may be requested to assist during implementation to ensure proper closure. The dumpsites will be closed when the new controlled landfill sites become operational. Fortunately, the quantities of waste at the existing dumpsites are small, so cleaning up the sites should be a relatively simple operation, ideally using the mechanical equipment to be procured for the new facilities under the Project. It is recommended that the existing wastes be removed from the cells (borrow pits) and the cells lined. The waste could then be collected from across each site, allowed to dry-out, dumped into the cells, and the cells capped appropriately. If consolidated in this manner, the quantity of land required will be relatively small. Installation of an observation well to periodically monitor the impact on groundwater is also recommended.

19. The choice of landfill technology is appropriate for the locations and capabilities of the local government units that will be responsible for the new facilities. To ensure efficient operation during the rainy season, paved access roads are included in the design of the sites.

¹ The open dumpsite in Phnom Tauch village has been decommissioned and closed by the private sector stone crushing company.