Initial Environmental Examination

PUBLIC

Project Number: 55197-001

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Cambodia: Integrated Water Resources Management Project

Prepared by Ministry of Water Resources and Meteorology for the Asian Development Bank (ADB).

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	Biochemical Oxygen Demand
C-EHS	–	Contractor Environmental Health and Safety Officer
CEMP	–	Construction Environmental Management Plan
COD	–	Chemical Oxygen Demand
EA	–	Executing Agency
EHS		Environmental Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
FC	–	Feeder Canal
FWUC	–	Farmer Water Users Community
GRM	–	Grievance Redress Mechanism
IA	–	Implementing Agency
IDF		Intensity-duration-frequency
IEE	–	Initial Environmental Examination
IESIA	–	Initial Environmental and Social Impact Assessment
IFC		International Finance Corporation
ILO		International Labor Organisation
IS	–	Irrigation Scheme
IUCN		International Union for the Conservation of Nature
MC	–	Main Canal
MD		Main Drain
MLVT		Ministry of Labor and Vocational Training
MoE	–	Ministry of Environment
MOWRAM	–	Ministry of Water Resources and Meteorology
OHS		Occupational and Community Safety and Health
PDoE	–	Provincial Department of Environment
PIU	–	Project Implementation Unit
PIU-SFP	–	PIU Safeguards Focal Point
PMC	–	Project Management Consultant
PMC-I/NES	–	International and National Environment Specialist
PMU	–	Project Management Unit
PMU-ESO	–	PMU Environmental Safeguards Officer
PSC	–	Project Steering Committee
PWSSAP		Provincial Water Supply and Sanitation Project
RBC	–	River Basin Committee
RBMP	–	River Basin Management Plans
SPS	–	Safeguards Policy Statement
TSBR	–	Tonle Sap Biosphere Reserve
TSBR		Tonle Sap Biosphere Reserve
TSS	–	Total Suspended Solid
UNDP	–	United Nations Development Programme
UXO		Unexploded Ordinance
WHO	–	World Health Organisation
WRM	–	Water Resources Management
WWTP		Waste Water Treatment Plant

CURRENCY EQUIVALENTS

as of 30 August 2024

Currency unit	–	riel (KR)
KR 1.00	=	$ 0.000246
$1.00	=	KR 4,063.35

WEIGHTS AND MEASURES

dB(A)	–	A-weighted Decibel
km	–	Kilometre
km2	–	Square kilometre
LAeq	–	Equivalent Continuous Level ‘A weighting’ - ‘A’-weighting = correction by factors that weight sound to correlate with the sensitivity of the human ear to sounds at different frequencies
m	–	Metre
oC	–	Degree Celsius
PM10	–	Particulate Matter 10 micrometres or less
PM2.5	–	Particulate Matter 2.5 micrometres or less
µg/m3	–	Microgram per cubic metre

GLOSSARY

District	–	Sub-divisions of the 24 provinces in Cambodia
Commune	–	Sub-divisions of districts, referred to as Sangkats in urban areas

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I. DESCRIPTION OF THE PROJECT

A. Background

1. The overall aim of the Integrated Water Resources Management Project is to make Cambodia's water resource management more integrated, climate-adaptive and sustainable in order to support social and economic growth and protect the ecosystem. Its objectives are to:

(i) Strengthen planning, coordination, and climate change adaptation capacities of water resources management in the project area (Output 1);
(ii) Increase water supply capacity during the dry season (Output 2); and
(iii) Reduce flood risks during the wet season (Output 3).

2. To achieve the objectives set out above, the following outputs are to be produced:

3. Output 1: *Planning, coordination, and climate change adaptation capacities of water resources management strengthened*. The project will help provinces (i) strengthen river basin committees (RBCs); (ii) develop climate-adaptive river basin management plans (RBMPs); (iii) develop climate-adaptive reservoir operation plans to optimize the benefits from water storage and release; and, (iv) update river flow management plans with water allocation rules.1 These plans will be updated or developed in consultation with key water user stakeholders. The project will help the National River Basin Management Committee provide RBCs with necessary support, particularly on the climate change adaptation aspects.[2] The project will also (i) upgrade existing and install additional hydrometeorological monitoring stations with remote monitoring and data transmission systems; and, (ii) develop and operate drought and flood forecasting and warning systems with drought and flood risk maps. Output 1 will also provide training to RBCs to increase their climate-adaptive WRM capacities and enable them to fulfill their function in their duties. Further, the project will also help MOWRAM, and two provinces develop sustainable WRM operation and management strategies to ensure sustainable operation of the developed plans and sustainable operation and maintenance for developed/upgraded WRM infrastructure under outputs 2 and 3.

4. Output 2: *Water supply capacity increased*. The project will modernize two irrigation systems and efficiently provide reliable irrigation water increasing resilience to climate change risks for 17,020 ha command areas in Battambang Province and 11,650 ha command areas in Pursat Province. This will enable farmers to crop: (i) rice in 32,330 ha during wet season, and rice and other crops in 7,190 ha during dry season in Battambang Province; and, (ii) rice in 22,100 ha ha during the wet season, and rice and other crops in 3,890 ha during the dry season in Pursat Province, with expected increase in crop yields. The modernizations will include main, secondary, and tertiary canals, with flood discharge drainage structures, gates and other regulated structures, including farm turnouts. An existing barrage in the irrigation system in Pursat Province will also be remodeled for stable water intake.

5. Output 3: *Flood risks during wet season reduced*. The project will: (i) update operation rules of existing reservoirs with an increase in flood protection capacity during the wet season to adapt to climate-induced flood risks as well as an increase in storage capacity during the dry season to provide more water for irrigation; (ii) modernize an old river channel in each of Pursat

[1] The sub-decree of river basin management was issued by MOWRAM in 2015 to provide the basis for RBCs and operationalize the Law on Water Resources Management which set a framework of IWRM and river basin planning.
[2] The National River Basin Management Committee was established in 2015, chaired by MOWRAM minister, with members from the ministries of Planning; Agriculture, Forestry and Fisheries; Environment; and Mines and Energy.

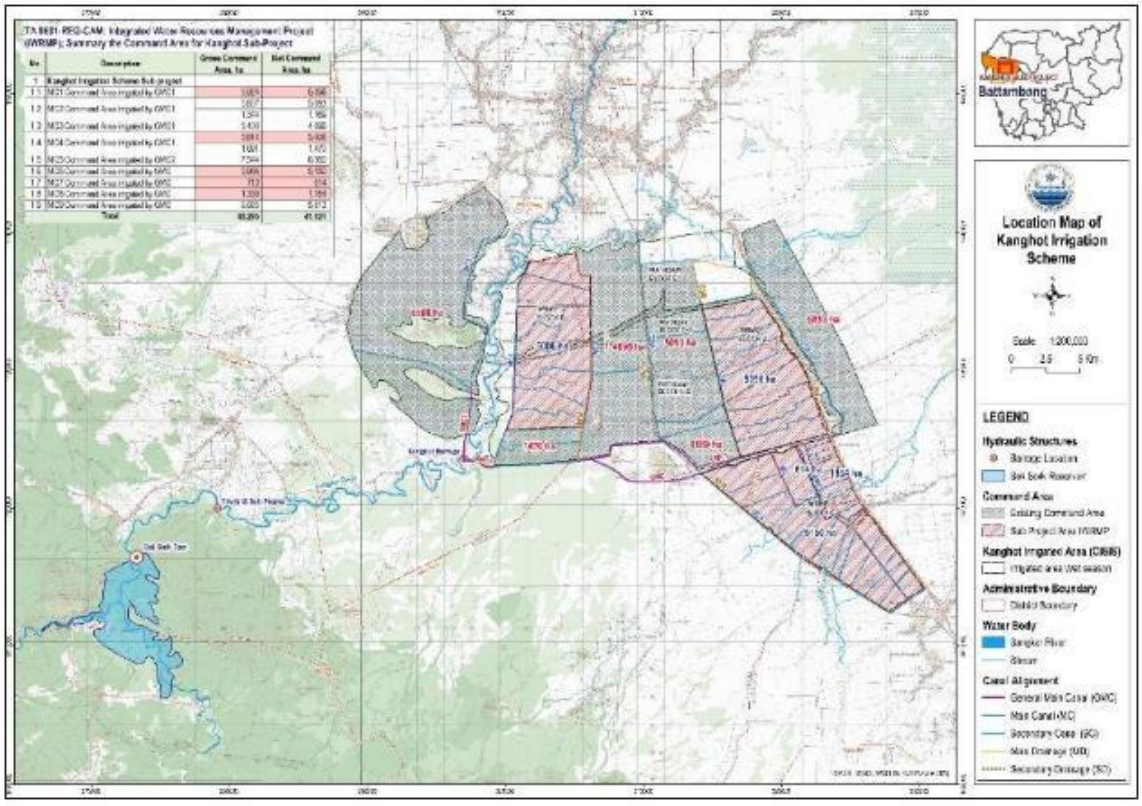
and Battambang provinces to divert the flood flow from the Pursat River in Pursat Province and Sangker River in Battambang Province with nature-based solutions; and, (iii) develop flood risk maps and operate gender-responsive community flood preparedness plans.

6. **Objective.** The IEE for the entire project, covering the Kbal Hong Irrigation Scheme (IS) subproject and Kanghot Irrigation Scheme subproject and two flood schemes has been prepared in conjunction with feasibility studies. Based on the impacts assessment, the environmental management plan (EMP) was developed as one chapter to mitigate these impacts.

B. Battambang Subproject: Kanghot Irrigation Scheme

7. The original Kanghot Irrigation Scheme was constructed during the Pol Pot regime in 1976. The rehabilitation of this scheme was initiated by MOWRAM in 2009 with Chinese Government support. In the first phase, construction of the Sek Sork multipurpose dam, and some canals, was completed in 2018. The Sek Sork Multipurpose Dam is located 53km upstream from the Kanghot Diversion Barrage, which has 193M m^3 total storage capacity of which 119M m^3 is regulating storage capacity. It has a 13MW hydropower station. However, this is not connected to the national grid and only 1.5MW is generated, and this supports local supply only. Therefore, there are opportunities to develop the Kanghot irrigation systems and provide the under-used water in Sek Sork reservoir for irrigation purposes.

Figure I-1: Kanghot Irrigation Scheme (Blocks under IWRM Project Shown in Red)



Source: Kanghot Feasibility Study Report (2024).

Figure I-2: Kanghot Irrigation Diversion Barrage

Source: Kanghot Feasibility Study Report (2024).

8. A summary of the construction at Kanghot for ADB funding are presented in Table I-1. The main canal infrastructure of the Kanghot scheme was developed in two phases, phase 1 was completed in 2014 with 2 'general/link' canals to 5 main canals, the second phase included the construction of the Sek Sork reservoir one further link/general main canal, and two more main canals and incorporation of the existing Sork canal system, making 8 main canals in total. However the distribution system below main canal level is sparse and thus farmers have difficulty to access water and water use efficiency is low with high pumping costs for the farmers. The project addresses the need for more secondary and tertiary canals to improve the water distribution and drainage system to smallholder farms in four blocks of the Kanghot system. The IWRM project will construct a number of new secondary canals with appropriate offtake and regulators on the main canals, improve the tertiary canal and drainage system and create and strengthen Farm Water User Groups to operate and maintain the secondary/tertiary systems.

Table 1-1: Canal Works for Kanghot Irrigation Subproject in Battambang

Investment in Kanghot subproject	Scale or capacity and key features
Main canals MC1, MC4, MC6, MC7 and MC8.	No new main canals or change in width of the existing 5 main canals, total length 61.3km
Secondary canals 6 connecting to MC1. 8 connecting to MC4. 3 connect to MC6.	Total length 133km; unlined option selected. The dimension of the secondary canals varies significantly, as capacity varies between 2.65 m^3/s to 0.18m^3/s
Regulators on MC1, MC4, M6	Gated regulating structures on the main canals at 9 locations on MC1, at 5 locations on MC4, and at 9 locations on MC6. 2 or 3 gates width 1.7m height 1.7m-2.5m
Check structures on MC1, MC4, MC6, MC7 and MC8	The check structures at 3 locations on MC1, at 3 locations on MC4, at 3 locations on MC6, at 4 locations on MC7 and 3 locations on MC8. Similar size to regulators above
Check structures (box and pipe types) on the secondary canals in the command area of MC1, MC4, MC6, MC7 and MC8	MC1 command at 32 locations, MC4 at 43 locations, MC6 at 33 locations, Typically 1.0m-1.4m box culverts with capacity varied from 0.18 m^3/s to 2.65.m^3/s.

Investment in Kanghot subproject	Scale or capacity and key features
3 new access bridges across the main canal and one across a secondary drain.	The road-crossing bridge on MC6 at 3 locations, and SD2 at 1 location. Single track length according to bed width.
Build Box culverts on the secondary canals in the command area of MC1, MC4, MC6, MC7 and MC8	MC1 command area at 16 locations, MC4 at 60 locations, MC6 at 5 locations, MC7 and MC8 at 10 locations. Similar to check structures.
Build Pipe culverts on the secondary canals in the command area of MC1, MC4, MC6, MC7 and MC8	in the command area of MC1 at 20 locations, MC4 at 47 locations, MC6 at 28 locations, MC7 and MC8 at 15 locations.
Tail structures in SCs	8 locations width as canal bed at tail (0.5-1.0m)
Construction of small offtake structures on the secondary canals in the command area of MC1, MC4, MC6, MC7 and MC8 connecting to the tertiary canals	MC1 command area at 135 locations, with capacity varied from 0.04 m^3/s to 0.38m^3/s MC4 area at 120 locations, capacity 0.03m^3/s to 0.26 m^3/s. MC6 area at 147 locations, with capacity 0.02 m^3/s to 0.38 m^3/s MC7 & MC8 at 41 locations, with capacity from 0.09 cu.m^3/s to 0.21 m^3/s. small farmer operated gated structures
Tertiary Canals (TC) in the command area of MC1, MC4, MC6, MC7 and MC8	
Unlined Tertiary canals	110km
Check structures in TCs	51 Units, 0.5m to 1m bed width
Pipe culvert in TCs	38 Units, 0.5m to 1m bed diameter
Outlet Structures in TCs	1373 Units, small gated structures 0.3-0.5m
Oxcart Bridge in TCs	808 Units, 0.5m to 1m bed width
Tail structures in TCs	414 Units – width as the TC. Typically 0.5m
FWUC Buildings	3 units typically 16m by 8m.

9. Criteria for selecting the sites for borrow pit and spoil disposal can be found in the section dealing with Mitigation Measures. The bulk of any borrow material required for canal banks will be sourced locally by agreement with local stakeholders during the detailed design and layout stage and may form areas where fish ponds are requested. Laterite for road surfacing, however, must be imported from sources outside of the immediate project areas. Existing quarry sites such as Thippadei in Kanghot are suggested, and these will be selected and agreed during detailed design and contract award. The existing quarries are sited in mountains that are already developed, devoid of forests, not in wetlands, are not agriculturally productive land, and do not have spiritual, cultural or historical value. They are not located on unstable slopes, and not where groundwater emerges or where a thick organic layer is present.

10. Laterite for maintenance works at Kanghot is currently taken from the Thippadei Mountain in the Thippadei Commune, Koas Kralor District, Battambang Province. If the same quarries are used then the hauling distance would be approximately 30 Km from the Kanghot IS. The quantity of laterite required for Kanghot IS and Ou Sralau canal is estimated to be approximately 268,203 m^3. If new borrow sites are required, the criteria applied will be those outlined in the proposed Spoil Disposal and Borrow Site Management Plan.

C. Pursat Subproject: Kbal Hong Irrigation Scheme

11. The Kbal Hong sub-project is located in Phteas Prey and Prey Nhy communes, Pursat

Town, Pursat Province. The sub-project is approximately 2.5 km north-west from the bridge across the National Road 5. The headwork of this subproject, as proposed by MoWRAM, is on the Pursat River, just downstream from Pursat Town, by Kbal Hong Weir. The Kbal Hong Irrigation Scheme and the head regulator across the Pursat River were built during the Pol Pot regime in 1976. This scheme was rehabilitated by UNDP in 1995-96.

Figure I-3: Kbal Hong Weir (constructed 2018 replacing the old gated regulator)

Figure I-4: Intake regulators for Kbal Hong MC1 (left) and MC2 (right)

12. Presently, about 8,200ha is cultivated with supplementary irrigation within the Kbal Hong command area during the wet season. The existing left-hand side command area is approximately 7,000ha and right-hand side command is approximately 1,200ha. Farmers cultivate rice twice a year, with approximately 8,200 ha cultivated in the wet season, and about 1,250 ha in the dry season. The main canal left (MC1) is 34km in length and the main canal right (MC2) is 14 km long. The scheme and irrigation canals are not yet rehabilitated and need to be modernized.

13. At present, the major problem for the Kbal Hong Irrigation scheme is the lack of enough head to enable water to flow in canals to irrigate potential command areas. Options for siting a new regulator in the Pursat River were examined but eventually a site close to the existing run-of-water weir in the downtown part of Pursat was proposed. This is the best site to control water into the existing MC1 and MC2.

14. The proposed works for the Kbal Hong IS are outlined in the Tables below. There will be no widening of existing canals, just rehabilitation of the canals, construction of a number of additional secondary and tertiary canals and drain, improvement of the access roads, construction of fishways, river crossings and control structures. Most work will be excavation in the dry season and will not involve dredging of the canals. If suitable, the soil removed during excavation can be used to form road embankments, or for nearby secondary roads. There is also a high demand in expanding urban areas such as Pursat for fill to build up land levels for residential or commercial use. The new regulator will be constructed in the dry season over two or three years behind a coffer dam which will be removed during the rainy season.

Table I-1: Works for the Kbal Hong Irrigation Scheme Left

Interventions for Kbal Hong Irrigation Scheme at Left hand side (Feasibility level design only)		Scale or capacity and key features
1.	Construction of the New Pursat Regulator	1 Regulator with 5 gates capacity to pass extreme floods of 1,834 m^3/s about 100m wide
2.	Construction of the New Intake MC1	One, with capacity of 25 cu.m/s
3.	Modernizing of the Main Canal No.1 (MC1)	15 km bed width 12m
4.	Modernize of the secondary canals in the command area MC1 (18 lines)	90.18 km with varying width
5.	Modernize of the sub-secondary canals and tertiary canals in the command area MC1 (241 lines)	250 km size varies approx. 1m bed width
6.	Construction of the cross regulators/ check structures on MC1	The cross regulators at seven locations, will give road crossing access and water level control. Each structure will have three or four gates to give a capacity of 25 m^3/s. The type of gate will be determined at detailed design
8.	Construction of the canal syphon under the Svay At drainage canal	One location. The key feature is to allow free flow of the Svay At stream unimpeded by the banks of MC1. The length of the canal syphon is 70m, width of syphon is 7m.
9.	Construction of the road-crossing bridge/ box culvert on the MC1	19 in total; 28 meters long, about 10.3 meters wide, reinforced concrete (or iron bridge)
10.	Construction of the head regulator on MC1 connect to the secondary canals	19 in total, capacity range from 0.3 cu.m/s to 7 cu.m/s one or two gates
11.	Construction of the head regulator on MC1 connect to the tertiary canals	21 Nos. small single gate structures
12.	Construction of the drain inlet structures on the left embankment of the MC1	32 Nos. pipe inlets
13.	Construction of the drain outlet structures on the right embankment of the MC1	12 Nos.
14.	Laterite pavement on the crest of the MC1's embankments (6m both side)	15 km, about 12m meters wide at top, 3.35 meters high,
15.	Laterite pavement on the crest of the secondary canals's embankments (18 Lines)	90 km, about 3 meters wide at top, 2.0m high
16.	Construction of an offtake from the secondary canals to the tertiary canals	217 Nos. small-gated structures

Interventions for Kbal Hong Irrigation Scheme at Left hand side (Feasibility level design only)		Scale or capacity and key features
17.	Construction of the cross regulators/ check/ tail structures on the secondary canals	58 Nos.
18.	Construction of the drain inlet/outlet structures on the embankments of the secondary canals	246 Nos. (circa 0.5m)
19.	Construction of the road-crossing/ box culvert on the secondary canals	77 Nos. Size varies according to canal size
20.	Construction of the syphon on Secondary canals under the Svay At and another drainage canals	3 Nos. Siphon only 40-50m
21.	Construction of the outlet structures on the tertiary canals	724 Nos. Small concrete structures about 0.5m bed
22.	Construction of the check structures on the tertiary canals	411 Nos. 0.5m-1.0 width
23.	Construction of the tail structures on the tertiary canals	239 Nos. small structures with capacity range from 0.1cu.m/s to 0.5 cu.m/s.
24	Construction of New FWUC building	Typical provincial building with one meeting area and office

Table I-2: Command Areas

Item	Description	Gross Command Area	Net Command Area	Canal Line	Length	Ancillary Structures
		(ha)	(ha)	(Line)	(km)	(Nos.)
A.	**Left Block**	10,813.00	9,311.00			
1	Construction of the New Pursat Regulator					1
2	Main Canal MC1			1	16.00	112
3	Secondary Canals of MC1 Left Block			20	106.00	601
4	Tertiary Canals of MC1 Left Block			241	250.00	1,374
5	Building of the Farmer Water User Office					1
	Sub-Total No.1	**10,813.00**	**9,311.00**	**262**	**372.00**	**2,089**
B.	**Right Block**	2,752.00	2,335.00			
1	Main Canal MC2			1	10.00	73
2	Secondary Canals, SS and MD of MC2 Right Block			17	52.00	233
3	Tertiary Canals of MC2 Right Block			95	72.00	404
4	Building of the Farmer Water User Community Office					1
	Sub-Total No. 2	**2,752.00**	**2,335.00**	**113**	**139.20**	**711**
	Total	**13,565.00**	**11,646.00**	**375**	**511.20**	**2,800**

Table I-3: Scope of works for the Kbal Hong Irrigation Scheme Right Bank

For Kbal Hong Irrigation at Right hand side		Scale, capacity and key features
1.	Construction of the New Intake MC2	1 No. with capacity of 10 cu.m/s
2.	Modernization of the Main Canal No.2 (MC2)	10 km
3.	Modernize of the secondary canals, FC and MDs in the command area MC2 (12 lines)	39.46 km
4.	Rehabilitation and construction of the sub-secondary canals, and tertiary canals in the command area MC2 (92 lines)	39.46 km
5.	Construction of the cross regulators/ check structures on MC2	3 Nos, capacity is 10 cu.m/s
6.	Construction of the pumping station	1 No., capacity is 2.48 cu.m/s
7.	Construction of the road-crossing bridge/ box culvert on the MC2	15 Nos.
8.	Construction of the canal syphon under drainage canal at 1+450	1 No.
9.	Construction of the Regulator on Left embankment MC2 crossing Srong Creeks (Srang Touch and Srang Thom)	2 Nos. Capacity of the regulators Srong Touch is 70 cu.m/s and Srang Thom is 100 cu.m/s, respectively.
10.	Construction of an offtakes on MC2 connect to the secondary canals	7 Nos. capacity range from 0.41cu.m/s to 2.02 cu.m/s.
11.	Construction of an offtakes on MC2 connect to the tertiary canals	8 Nos. capacity range from 0.02 cu.m/s to 0.42 cu.m/s
12.	Construction of the drain inlet structures on the right embankment of the MC2	26 Nos.
13.	Construction of the drain outlet structures on the outlet embankment of the MC2	9 Nos.
14.	Laterite pavement on the crest of the MC2's embankments	10 km, about 8m meters wide at top, 3.30 meters high
15.	Laterite pavement on the crest of the secondary canals, sub-secondary canals and Feeder canals' embankments (17 Lines)	52.48 km, for the secondary canals about 3m wide at top, 2.06 meters high.
16.	Construction of an offtake from the secondary canals to the tertiary canals	87 Nos.
17.	Construction of the cross regulators/ check/ tail structures on the secondary canals and sub-secondary canals	28 Nos.
18.	Construction of the drain inlet/outlet structures on the embankments of the secondary canals	82 Nos.
19.	Construction of the road-crossing/ box culvert on the secondary canals	30 Nos.
20.	Construction of the syphon under the drainage canals	5 Nos.
21.	Construction of the outlet structures on the tertiary canls	204 Nos.
22.	Construction of the check structures on the tertiary canls	110 Nos.
23.	Construction of the tail structures on the tertiary canls	90 Nos.
24.	Construction of the aqueduct on FC2 over Srang Touch creek	1 No.

15. The environmental considerations are similar for both design options. It is proposed to

install a vertical slot fishway, which is the only feasible design for the provision of a fish passage considering the 4m headwater range. This fishway can operate over a wide range of headwaters, whereas a cone fishway would only be able to operate over around 1.00m of headwater variation. The vertical slot fishway design with pools measuring 3.0m in length, 2.0m in width, and minimum 1.0m in depth is recommended.

D. Flood Management subproject in Battambang

16. The Flood Risk Management sub-project for Sangker River, Battambang will reduce flood risks in the Battambang urban area and the Kanghot IS. Flood peaks in the Sangker river will be reduced through improvement of the operation of the Sek Sork Dam and some additional relief to the urban area will be provided through restoration of the first 9km of the existing Ou Sralau channel which branches from the Sangker upstream of the town.

17. A new offtake structure and access bridges will be constructed but channel restoration will be limited to the first 9km of channel. Flow in the Ou Sralau joins with the drainage system of Kanghot and eventually drains directly to the Tonle Sap Lake without rejoining the Sangker. Restoring a greater length of the river (43km) was also considered, but would require replacement of a large number of bridges (30) with little extra benefit for flood relief and was thus rejected.

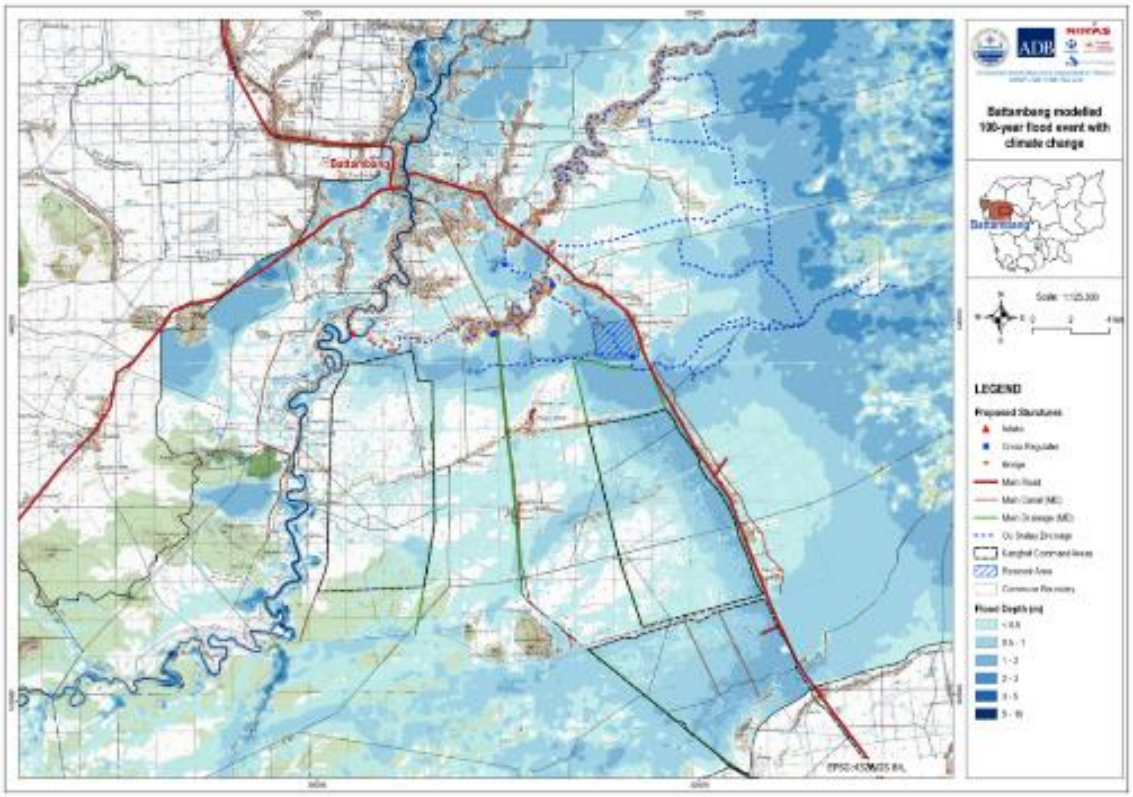
18. Table 1-5 below outlines major features on the Sangker Flood Management sub-project or specifically, works for the Ou Sralao channel restoration. The offtake structure is needed to increase the capacity to release up to 100 m^3/s from the Sanker to the Ou Sralau and to maintain capacity two bridges are needed, replacing small box culverts. The Ou Sralau channel has a very variable size, near the Sangker is of limited capacity but increases further downstream with the exception of some small road crossings. The channel improvements are thus mostly near the offtake. The location map of the Sangker Flood Management sub-project is shown in Figure I-6.

Table I-4: Major Features on Sangker flood sub-project/ Ou Sralao restoration

No.	Description	Option 1	Option 2
		Quantity/scale	Quantity/scale
A.	**Structures**		
1	New Gated Intake Structure	1	1
2	Cross Regulator	1	4
3	Build new Bridges (Width= 6m, Length= 36m)	2	30
4	Demolition of the existing box culverts	4	35
B.	**Earthworks**		
1	Restoration of the Ou Sralau channel: Bed width 20m, ROW 48m, 5.5m depth.	9 km no adjustment of alignment.	42.84km no adjustment of alignment.
	Conclusion	**Preferred**	

Source: Flood modelling report for Battambang and Pursat.

Figure I-5: Location Map of Sangker Flood Management Sub-project



Source: Flood modelling report for Battambang and Pursat.

E. Svay At flood Management subproject in Pursat

19. The Pursat Flood Risk Management Project also has as its main component the restoration of the Svay At river. The existing Svay At channel (an old course of the Pursat River) has declined and will need to be restored to carry significant flows of up to 300 m^3/s.

20. The course of the restored river will follow that of the current channel with little disturbance along much of the length. At the existing offtake from the Pursat River, however, the area is congested with an important Pagoda (Wat Luong) and associated development including new roads which currently crosses the existing channel obliquely limiting flow capacity.

21. It is thus proposed that a new control structure and a linking canal (2.8km long) will be built downstream to minimize impact in the area of the Pagoda. The offtake structure from the Sangker River may be a fixed weir with bypass gate or with larger gates and full control of flows. As the bed of the gated structure and link canal will be below the design pond level of the Kbal Hong Regulator, a small flow may be diverted into the channel when it is available in the Pursat River. The restoration of the capacity of the Svay At channel may be done to minimize the impact on existing riparian trees and will follow the natural meandering course. The restoration will ensure that there is adequate provision for spill from the Pursat River to the Svay At and across the floodplain during higher flood flows, by diverting up to $300m^3/s$ around Pursat town. Table 1-7 below shows the major features of the Pursat Flood Management project or specifically, the restoration works for Svay At river.

22. Along the length of the channel and river there are a number of bridges or culverts (8) that need to be replaced with wider bridges to maintain capacity. The main Highway 5 bridge is of adequate width but the bed will need to be lowered.

23. At the crossing of the Kbal Hong Main Canal, there is currently a small weir across the Svay At. This will be replaced by putting the canal in a siphon below the Svay At maintaining the river channel capacity. Work on the river is all in the current bankline or right of way. Although new access roads will be built along the link channel, elsewhere existing tracks and roads will be followed. It is not envisaged that any large embankments will be included in the scheme as excess flows will be accommodated in floodplain flows as presently occurs.

Table I-5 Major Features of Pursat Flood Sub-Project/ Svay At Restoration

No.	Description	- Scale	Option 1	Option 2
A.	**Structures**			
1	Gated Intake Structure from Pursat River to Link Channel (new)	6 Gates 4.8m width capacity 300 m^3/s	Capacity 100 m^3/s	Capacity 300 m^3/s
2	Link Channel (new)	2.8km	20m bed width	45m bed width
3	Svay At River Restoration Remove blockages and recreate meandering channel with perennial flow	10.2km	Typical 20-30m	Typical width 40m
4	Build new Bridges (Width= 6m, Length= 36m)	Minimal	8	11
B.	**Earthworks**			
1	Restoration of channel 13km channel including 2.8km link (the total length of channel is 13km equal to Svay At River restoration 10.2km + link channel 2.8km)	Preliminary estimates	470,000m^3 excavation	2,370,000 m^3
	Conclusion in FS			**Preferred**

24. The four communes associated with Pursat town, Bakan district and Kandieng district will benefit from access to the improved Svay At channel through the potential for a perennial flow which will improve water quality, fisheries and potentially water supply for domestic or farm use. The availability of water in the diversion channel could also assist with the cultivation of rice and other diversified crops along the Svay At link channel.

25. The excavated material from the Svay At link channel will form the bank required for access roads. The contractor may haul the spoil materials to provide landfill for local farmers if suitable, or as required for urban development land raising, whichever is agreed with the local landowners. The location map of the Pursat Flood sub-project is shown in **Error! Reference s ource not found.**.

Figure I-6: Location Map of Svay At (in Pursat) flood diversion Sub-project

F. Fish Passage

26. Four streams are integral to this project: Stung Sangker, Stung Dountri, Stung Svay Donkeo, and Stung Pursat. These streams are essential tributaries to the Tonlé Sap, contributing to its seasonal variations in water volume. Their flow patterns are markedly influenced by the annual monsoon cycle, with increased flow during the wet season and reduced flow in the dry season. This dynamic significantly impacts the water levels and ecological characteristics of the Tonlé Sap which has a significant role in migration of fish in the Mekong system as a whole. Therefore, fish passes are planned on tribuataries where the fish movement is blocked by weirs or regulators. These locations were selected working closely with the Fisheries Administration, Ministry of Agriculture, at each there are existing blockages, some of which have existing fishways requiring improvements (Table I-7).

27. Fish passage methods enable migrations of fish in rivers and floodplains both upstream and downstream, often involving structures that regulate river and floodplain flow. In irrigation systems, barriers to fish migration are common, occurring longitudinally along rivers through diversion weirs and reservoirs, and laterally between rivers, floodplains, and irrigated areas at regulators or floodgates.

Figure I-7: Location of all proposed fish passes between Pursat and Battambang (indicated by blue triangles)

Source: Fish passage report for IWRM project (2023).

Table I-6: Basic features and location of Fish passages for all sub-projects

Existing river-cross structure	Description	Best Remediation Option	Current situation
Stung Sangker (Stung means river**)**			
1.Kanghot Regulator	The Kanghot Regulator is located approximately 27 kilometres south of the city of Battambang on the Stung Sangkae on the southwestern side of the Tonle Sap.	A vertical slot fishway	No existing fish pass
2. Sala Ta On Regulator	The Sala Ta On Regulator is located approximately 73 km south-west of the city of Siem Reap on the Stung Sangkae on southwestern side of the Tonle Sap.	Converting the existing fish lock to automated operation	Fish lock exists but not functioning
Stung Dountri			
3. Prey Chik Weir	The Prey Chik Weir is located approximately 56 km southeast of the city of Battambang on the Stung Dountri on the southwestern side of the Tonle Sap.	The installation of a Vertical slot fishway which covers 3m of headwater and 3m of tailwater is the best	No existing fish pass

		design option for this site	
4. Ream Kon Regulator	The Ream Kon Regulator is located approximately 46 km southeast of the city of Battambang on the Stung Dountri on the southwestern side of Tonle Sap	Vertical slot fishway within the existing channel which covers 2m of headwater and 3m of tailwater is the best design option for this site	Existing fishway not functioning
Stung Pursat			
5. Damnak Chheu Krom Regulator	Damnak Chheu Krom Regulator is located approximately 32 km south of the city of Pursat on the Stung Pursat on the southern side of the Tonle Sap.	Ensuring the weir pool is kept within the operating window for the existing fishway is the best design option for this site	Existing fish pass of a suitable type but needs minor rectification work.
6. Santrae Weir	Santrae Weir is located approximately 28 km south of the city of Pursat on the Stung Prey Khlong River on the southern side of the Tonle Sap.	Construction of a new vertical slot fishway is the best design option for this site.	No existing fish pass
7. Prey Khlong Bridge	Prey Khlong Bridge is located about 28 km southwest of the city of Pursat on the Stung Prey Khlong River on the southern side of the Tonle Sap	Construction of a full width rock ramp fishway is the best design option for this site.	No existing fish pass. identified by MAF as a blockage to fish.
8. Damnak Ompil Regulator and Fishway	Damnak Ampil Regulator and Fishway is located approximately 13 km southwest of the city of Purast on the Stung Pursat on the southern side of the Tonle Sap	A vertical slot fish built within the exiting fishway channel is the best design option for this site.	Existing fishway is not functioning.
9. Kbal Hong Weir/New Regulator	Kbal Hong Weir is within the main city area of Pursat on the Stung Pursat. A new regulator to be constructed by the IWRM Project requires new fish pass	Construction of a new vertical slot fishway is the best design option for this site.	Existing weir has fishway but new fish pass required when rebuilt as a regulator.
10. Charek Regulator	The Charek Regulator is located approximately 12 kilometres northeast of the city of Pursat on the Stung Pursat on the southern side of the Tonle Sap	Construction of a new vertical slot fishway is the best design option for this site	No existing fishpass
Stung Svay Donkeo (Doun Kaev)			
11. Kampang Weir	The Kampang Weir is located approximately 76 km south-southwest of the city of Siem Reap on the Stung Svay Doun Kaev on the southern side of the Tonle Sap.	The installation of a cone fishway on the left abutment is the best design option for this site.	No existing fish pass
12. Roneam Prayol Regulator	The Roneam Prayol Regulator is located approximately 32km northwest of the city of Pursat on the Stung Svay Doun Keo on the southern side of the Tonle Sap	The installation of a bridge to replace the culverts is the best design option for this site.	No existing fish pass
13. Anlong Svay Weir and Fishway	The Anlong Svay Weir is located approximately 32 km west of the city of Pursat on the Stung Svay Doun Kaev on the southern side of the Tonle Sap	The remediation of the existing fishway and installation of a second fishway on the far bank is the best design option for this.	Existing fishway not fully functioning

28. Additional survey was carried out for three of the major fish pass locations, Charek which forms the most downstream barrier to migration between the Pursat River and the Tonle Sap Lake, Kbal Hong also on the Pursat River where the existing weir will be rebuilt as a new regulator and at Kanghot regulator on the Sangker River which has a high head drop (around 10m). The proposed designs were considered in more detail at these sites as described below.

1. Charek Regulator in Pursat

29. The recommended design for the Charek Regulator features a vertical slot fishway. This design is specifically chosen to facilitate the migration of various fish species commonly found in the area. The vertical slot fishway is characterized by a series of pools, each separated by vertical slots that allow fish to pass through. These pools are designed to be 3.0 meters in length, ensuring enough space for the fish to navigate, and 2.0 meters in width to maintain a turbulence level below 30 W m^3, which is vital for the safe passage of smaller fish species. The depth of each pool is set a minimum of 1.0m, accommodating the maximum size of the fish expected to use the fishway. These dimensions, which have been employed in several fishways throughout the region, have proven their effectiveness in facilitating the migration of a diverse array of fish species and size classes

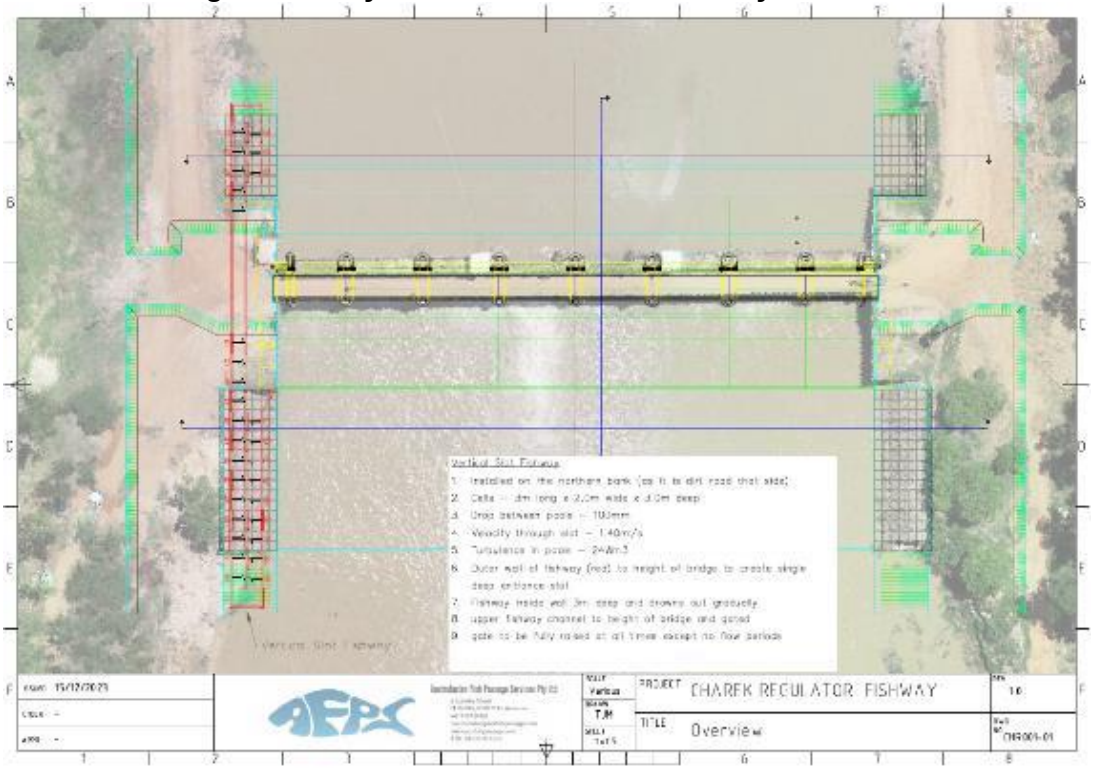
2. Kbal Hong Regulator in Pursat

30. The original gated regulator for maintaining water levels in the Pursat River at Pursat town centre was demolished in 2018 and replaced with a weir and fishway. This weir will be demolished and replaced by a new regulator several hundrend meters downstream under the project. The new regulator will have fish passage that would need to adhere to specific dimensions to guarantee the passage of most fish species native to this area similar to Charek 14km downstream. Vertical slot or a cone design similar to the existing fishpass will be chosen at detailed design.

Table I-7: Proposed Fishway Design Options for New Kbal Hong Regulator

Fishway Dimensions		
Physical	Vslot	Cone
Pool length	3.0m	1.5m
Channel width (internal)	2.0m	2.4m
Pool depth (minimum operating)	1.0m	0.7m
Pool step height	100mm	100mm
Slot Size	0.15m	0.1-0.3m
Hydraulics		
Maximum velocity	1.4 m/s	1.4 m/s
Average turbulence	29 Wm^3	20Wm3
Discharge	Min – 12.7 ML/day Max – 21.7 ML/day	Min – 6 ML/day Max – 52 ML/day
Tailwater operating range	3.0m	3.0m
Headwater operating range	3.0m	0.6m

Figure I-9: Layout of a vertical slot fishway at Charek



Source: Fish passage report for IWRM project (2023).

3. Kanghot Regulator in Battambang

31. This existing regulator has a high head drop around 10 meters and no existing fish pass, forming a blockage to upstream and downstream migration. It is proposed to retrofit a vertical slot fishway, with its design tailored to facilitate fish migration of all species at the site, comprising a series of pools each measuring a minimum of 3.0m in length. The internal channel width of these pools is set at minimum 2.0m, with pools having a minimum operating depth of 1.0m. This pool size provides ample space for largest fish to navigate through the structure. In total, the fishway, including the necessary turning pools and a larger resting pool, occupies an approximate footprint of 1466 square meters.

32. The pools are interconnected through vertical slots, each slot measuring 150mm in width, with pool water step heights of 100mm between each. In terms of hydraulics, the fishway is engineered to maintain a maximum water velocity of 1.4 m/s, ensuring that the flow is strong enough to attract fish but not so powerful as to hinder their progress. The average turbulence within the fishway is calculated at 29 Wm^3, providing condition suitable to pass small fish. To cover the range of flows in the river, the fishway would have a tailwater operating range of 7.5m and a headwater operating range of 4.0m.

Table I-8: Proposed Fishway Design for Kanghot Regulator

	Single vertical-slot
Physical	
Gradient	1:30
Pool length	3.0m
Channel width (internal)	2.0m
Pool depth (minimum operating)	1.0m
Approximate footprint (with turning pools and large resting pool)	126m^2
Pool step height	100mm
Slot size	150mm
Hydraulics	
Maximum velocity	1.4 m/s
Average turbulence	29 Wm^3
Discharge	Min – 12.7 ML/day Max – 21.7 ML/day
Tailwater operating range	7.5m
Headwater operating range	4.0m
Predicted Fish Passage	
Fish attraction to fishway entrance (based on discharge and location)	Low Flow – High High Flow - Moderate
20-100 mm fish	Moderate
100-600 mm fish (priority)	High
600-1500 mm fish	Moderate

II. LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Domestic Legal and Policy Framework for Environmental Protection

33. In 1993, the Royal Government of Cambodia confirmed a new Constitution in which environmental considerations were included for the first time. Specifically, Article 59 requires the State to protect the environment and balance of abundant natural resources and to establish a precise plan for the management of land, water, air, wind, geology, ecological systems, mines, energy, petrol and gas, rock and sand, gems, forests and forestry products, wildlife, and fish and aquatic resources. It was within this constitutional context that the Ministry of Environment (MOE) was established.

34. The hierarchy of legislation in Cambodia is:

(i) Royal Decree signed by the King;

(ii) Sub-decree signed by the Prime Minister;

(iii) Ministerial Decision signed by a Minister; and

(iv) Regulation issued by Ministry.

35. A Royal Decree ratifies laws passed by parliament. These can be supplemented by "Prakas" or ministerial decisions. These laws allow sub-decrees and regulations to be passed which can stipulate procedures and standards to be met in order to ensure compliance with the law. Many sub-decrees and standards have been drafted but not yet ratified by parliament.

1. Laws/Sub-Decrees relevant to Environment and Natural Resources Management

36. The Government of Cambodia has established laws and regulations for forests, protected areas, and land management to ensure sustainable development that are relevant to environmental protection and natural resources management. The key elements of the legal and policy framework for the project are summarized in Table II-1 below.

Table II-1: National Laws, Legislative and Policy Related to Environmental Protection and Natural Resources Management and Cultural Resources

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
Royal Decree on the Protection of Natural Areas	1993	Classified 23 protected areas in Cambodia into four categories: (i) natural parks; (ii) wildlife sanctuaries; (iii) protected landscapes; and (iv) multiple-use areas. Designated the Tonle Sap (316,250 ha) as a multiple-use area or area necessary for the stability of the water, forestry, wildlife and fishery resources, for tourism, and for conservation of long-term existing natural resources with a view to assure sustainable economic development.
Law on Environmental Protection and Natural Resources Management	1996	The Law was enacted by the National Assembly and launched by the Preah Reach Kram/NS-RKM-1296/36. It was enacted on 24 December 1996. This law has the following objectives: i. To protect and promote environment quality and public health through prevention, reduction and control of pollution; ii. To assess the environmental impacts of all proposed projects prior to the

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
		issuance of a decision by the government; iii. To ensure the rational and sustainable conservation, development, management and use of the natural resources of the Kingdom of Cambodia; iv. To encourage and provide possibilities for the public to participate in the protection of environment and the management of the natural resources; and v. To suppress any acts that cause harm to the environment.
Law on Land (NS/RKM/0801/14)	2001	Provides that: (i) unless it is in the public interest, no person may be deprived of ownership of his immovable property; and (ii) ownership deprivation shall be carried out according to legal forms and procedures and after an advanced payment of fair and just compensation. (Article 5)
Law on the Protection of Cultural Heritage (NS/RKM/0196/26)	1996	Regulates the protection of national cultural heritage and cultural property in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation. Its Article 37 stipulates that in case of chance find of a cultural property during construction, work should be stopped and the person who found the property should immediately make a declaration to the local police, who shall, in turn, transmit the property to the Provincial Governor without delay.
Law on Forestry	2002	Article 1: This law defines the framework for management, harvesting, use, development and conservation of the forests in the Kingdom of Cambodia. The objective of this law is to ensure the sustainable management of these forests for their social, economic and environmental benefits, including conservation of biological diversity and cultural heritage.
Law on Water Resources Management (NS/RKM/0607/016)	2007	Requires license/permit/written authorization for the: (i) abstraction & use of water resources other than for domestic purposes, watering for animal husbandry, fishing & irrigation of domestic gardens and orchards; (ii) extraction of sand, soil & gravel from the beds & banks of water courses, lakes, canals & reservoirs; (iii) filling of river, tributary, stream, natural lakes, canal & reservoir; and (iv) discharge, disposal or deposit of polluting substances that are likely to deteriorate water quality and to endanger human, animal and plant health. (Articles 12 & 22) Its Article 24 stipulates that Ministry of Water Resources and Meteorology (MOWRAM), in collaboration with other concerned agencies, may designate a floodplain area as flood retention area.
Law on the Management of Pesticides and Fertilizers	2012	The Law on the Management of Pesticides and Fertilizers was enacted on 14 January 2012. This law has the following objectives: i. To support a policy promoting the effectiveness potentiality of agriculture sector, for the development of social and national economy; ii. To ensure the safe and effective control of pesticides and fertilizers, whether in consistent with the international standards; iii. To enhance public awareness on the implementation of standard requirements of pesticides and fertilizers for all relevant activities related to these products; and iv. To reduce risks caused by the use of pesticides and fertilizers, for beneficiary of farmers and people in the nationwide, by ensuring food security, food safety, public health, and the sustainability of environment. The scope of the law shall apply to the management and the implementation of standard requirements for:

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
		i. All type of pesticides and fertilizers, raw materials or active ingredients and other compositions of pesticides and fertilizers which are used as inputs in agricultural production. ii. All activities of natural persons or legal entities who are traders, formulators, pests control services operators, advertisers, donors, and users of all types of pesticides and fertilizers.
Sub-decree No. 72 on Environmental Impact Assessment Process	1999	The Sub-decree No. 72 ANRK.BK in the Law on Environmental Impact Assessment Process dated 11 August 1999 sets out EIA procedures. The main objectives of this subdecree are: i. To determine an EIA for every private and public project or activity, through review by the MOE, prior to the submission for a decision from the government; ii. To determine the type and size of the proposed project(s) and activities, including existing and ongoing activities in both private and public sector prior to undertaking the process of EIA; and iii. To encourage public participation in the implementation of the EIA process and take into account their input and suggestions for reconsideration prior to the implementation of any project.
Sub-decree No. 36 ANK/BK on Solid Waste Management	1999	Article 1: Regulates solid waste management to ensure the protection of human health and the conservation of biodiversity through using appropriate technical approaches. Article 2: This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste. Article 4: The Ministry of Environment shall establish guidelines on disposal, collection, transport, storage, recycling, minimizing, and dumping of household waste in provinces and cities in order to ensure the safe management of household waste. The authorities of the provinces and cities shall establish the waste management plan in their province and city for short, medium and long-term.
Sub-decree No. 27 ANRK/BK on Water Pollution Control	1999	Regulates activities that cause pollution in public water areas in order to sustain good water quality so that the protection of human health and the conservation of biodiversity are ensured. Annex 2 contains effluent standards. Discharge of wastewater from campsite shall comply with the effluent standards for discharge of wastewater to public water area and sewer. Annex 4 contains ambient water quality standards for biodiversity conservation, and annex 5 includes ambient water quality standards for public health.
Sub-decree No. 42 ANK/BK on Control of Air Pollution and Noise Disturbance	2000	Regulates air and noise pollution from mobile and fixed sources through monitoring, curb and mitigation activities to protect the environmental quality and public health. It contains the following relevant standards: (i)) ambient air quality standard (Annex 1); and (ii) maximum allowable noise level in public and residential areas (Annex 6). Article 3 A. “Source of pollution” is defined and separates mobile sources (including transport) and fixed sources such as factories and construction sites.

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
		Article 3 B. “Pollutant” is defined as smoke, dust, ash particle substance, gas, vapour, fog, odour, radio-active substance.
Royal Decree on the Establishment and Management of Tonle Sap Biosphere Reserve (Royal Decree No. NS/RKT/0401/070)	2001	Establishes the Tonle Sap Biosphere Reserve (TSBR) in accordance with the statutory framework of the World Network of Biosphere Reserves. Divides the TSBR into 3 zones: (i) core areas; (ii) buffer zone and (iii) flexible transition zone. Core area: set aside for long term protection, human activity is limited to monitoring and research. Buffer zone: area surrounding the core areas helping to protect the environment. It may accommodate education and training activities. Transition area: may contain a variety of agricultural activities and human settlements. Here all stakeholders have to cooperate to achieve sustainable development.
Sub-decree on Garbage and Urban Solid Waste Management	2015	The goal of this sub-decree is to enhance the management of garbage and solid waste of downtowns with effectiveness, transparency and accountability, referring to ensure aesthetics, public health and environmental protection. This sub-decree covers separating, storing, cleaning, collecting, transporting, recycling and management of landfills of garbage and solid waste of downtowns in the Kingdom of Cambodia.
Sub-decree N0. 235 on Management of Drainage and Wastewater Treatment System	2017	Aims to improve the management of drainage and wastewater treatment systems in term of efficiency, transparency, and accountability to ensure safety, public health, and biodiversity conservation. The scope of this Sub-Decree applies to the management of drainage and wastewater treatment systems in capital, provincial, district, khan and resorts or recreation centers in the Kingdom of Cambodia. Its annexes 1 and 2 provide Effluent Discharge Standards from Commercial Building, Borey, Satellite City and Resort or Recreation Center Discharges Directly to the Drainage/Sewerage System connected to Centralized Wastewater Treatment Plant, and to the Public Waterbody or Drainage/ Sewerage System.
Royal Decree No. NS/RKM/0208/007 on Protected Areas	2008	Defines the framework of management, conservation & development of protected areas to ensure the conservation of biodiversity, & sustainable use of natural resources in protected areas. The Law gives the Royal Government of Cambodia the authority to establish or modify Protected Areas (Article 9 and 10). A Protected Area shall be established by sub-decree. Article 11 divides the protected area into 4 zones namely, core zone, conservation zone, sustainable use zone & community zone. Article 36 strictly prohibits all types of public infrastructure in the Core Zone & Conservation Zone; & allows development of public infrastructures in the Sustainable Use Zone & Community Zone with approval from the Royal Government at MoE’s request. Article 41 provides for the protection of each protected area against

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
		destructive/harmful practices, such as destroying water quality in all forms, poisoning, using of chemical substances, disposing of solid and liquid wastes into water or on land. Article 44 requires all proposals & investments within or adjacent to protected area boundary an Environmental and Social Impact Assessment. The law defines Protected Area as **"***An area of the State's public properties in land or water territories, including coasts and sea, located in the area established by a Royal Decree or a new area established in the jurisdiction of the Ministry of Environment. These areas are of physical and biological importance which requires management by law with the purpose of protecting and maintaining biological, natural and cultural resources, and shall be sustainably managed in every generation for environmental, social and economic benefits*". Each protected area shall be divided into four (4) management zoning systems: **1. Core zone:** management area(s) of high conservation value containing threatened and critically endangered species, and fragile ecosystems. Access to the zone is prohibited except for the Nature Conservation and Protection Administration's officials and researchers who, with prior permission from the Ministry of Environment, conduct nature and scientific studies for the purpose of preservation and protection of biological resources and natural environment with the exception of national security and defence sectors. **2. Conservation zone:** management area(s) of high conservation value containing natural resources, ecosystems, watershed areas, and Natural landscape located adjacent to the core zone. Access to the zone is allowed only with prior consent of the Nature Conservation and Protection Administration at the area with the exception of national security and defense sectors. Small-scale community uses of Non-Timber Forest Products to support local ethnic minorities' livelihood may be allowed under strict control, provided that they do not present serious adverse impacts on biodiversity within the zone. **3. Sustainable use zone:** management area(s) of high economic value for national economic development and management, and conservation of the protected area(s) itself thus contributing to the local community, and indigenous ethnic minorities' livelihood improvement. After consulting with relevant ministries and institutions, local authorities, and local communities in accordance with relevant laws and procedures, the Royal Government of Cambodia may permit development and investment activities in this zone in accordance with the request from the Ministry of Environment. **4. Community zone:** management area(s) for socio-economic development of the local communities and indigenous ethnic minorities and may contain existing residential lands, paddy field and field garden or swidden (Chamkar).
Sub-decree No.144 on Bakan	2023	The establishment of of Bakan landscape or grassland protected area is to protect the ecosystem in the area and ensure the sustainable use of the area. Basically, there is no restriction in Cambodia on types of activities that can be

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
landscape or protected area		allowed in Community zone
Sub-decree No.197 on boundary establishment of flooded forest site surrounding Tonle Sap lake in 6 provinces	2011	The Sub-decree No.197 on boundary establishment of flooded forest site surrounding Tonle Sap lake in 6 provinces, including Kampong Chhnang province, Pursat province, Battambang province, Banteay Meanchey province, Siem Reap province and Kampong Thom Province with total land area of 647, 406, it aims to protect the flooded forest around the Tonle Sap lake
Prakas on the Launch of Standards of Toxins or Hazardous Substances Allowed to be Disposed	2015	This Parkas includes the standards of the quantity of toxic chemicals or hazardous substances contained in hazardous waste which is allowed to be disposed in sanitary landfills and standards of the quantity of toxic chemicals or hazardous substances allowed in soils. Any disposal of chemical waste or hazardous substances as stipulated in the Parkas out of sites determined by the ministry and competent institutions shall be absolutely prohibited and deemed as the infringement of law.
Environmental Guidelines on Solid Waste Management	2006	Contains a Landfill Ordinance that regulates landfill requirements to: (i) reduce as far as possible the adverse effects of waste disposal on the environment; (ii) preserve groundwater, surface water & air quality & to reduce emissions of greenhouse gases (iii) ensure waste is not harmful to human, natural & animal health during operation & decommissioning; and (iv) provide information and technical recommendation on the construction, operation, closure and aftercare management of landfills to ensure public health and safety and environmental protection.
Technical Guideline on Garbage and Urban Solid Waste Management	2016	The technical guideline provides standards for all activities related to disposal, storage, collection, transportation, recycling, dumping of municipal and hazardous waste as well as management of final dumpsite (closing Landfill) and continued management. The technical guidelines list the requirements to be implemented within 90 days for landfill closing (e.g. monitoring, gas management).
Prakas on Environmental Impact Assessment Classification for Development Projects No. 21 PRK.BST	2020	The Prakas determines the types and sizes of projects that are required to prepare environmental impact assessments. Projects having minor environmental impacts are required to prepare an Environmental Protection Agreement together with an Environmental Management Plan. Projects having medium impacts shall prepare an Initial Environmental Impact Assessment report, and projects with significant impacts are required to prepare a full EIA. All sizes of rubbish disposal sites are required to undertake an IESIA and all sizes of industrial waste disposal sites are required to undertake an EIA.
National Integrated Pest Management Program		The Integrated Pest Management (IPM) Program in Cambodia was established in 1993 after conducting national workshop on “Environment and IPM”. The overall goal of National IPM Program is to promote food security in Cambodia by enhancing the sustainability of intensified crop production system through the promotion of integrated crop management (ICM) skills at farm level.

Environmental Law/Regulation/Guideline		
Title	**Year**	**Summary**
		The objectives of this program are: i. to reduce dependence on agricultural chemical, especially pesticides, in agricultural production and to minimize hazards to the human health, animals and environment; ii. to develop the capacity of farmers and agricultural technical officers in conducting training and experiments so that they are able to identify problems occurring in agricultural production and find appropriate solution to deal with the problem by themselves; and iii. Educate farmers on agricultural technology by enhancing their knowledge on field ecology and by developing skills among farmers in monitoring and analyzing field situations that enable them to manage crops properly. At the national level the position of the IPM program was strengthened by a Prakas (Ministerial Declaration) in July 2002, recognizing the National IPM Program as coordinating body for all IPM related activities in Cambodia. The Prakas also established a steering committee and a deputy director to act as the national coordinator.

Table II-2: National Laws, Legislative and Policy Related to Health and Safety

Health and safety related Law/Regulation/Guideline		
Title	**Year**	**Summary**
Labour Law (1997) Decree No. CS/RKM/0397/01	1997	This law governs relations between employers and workers resulting from employment contracts to be performed within Cambodia. The key sections relevant to this project include: **<u>Chapter VIII Health and Safety of Worker</u>** The key provisions relate to the quality of the premises; cleaning and hygiene; lodging of personnel, if applicable (such as workers camps); ventilation and sanitation; individual protective instruments and work clothes; lighting and noise levels in the workplace. Article 230: Workplaces must guarantee the safety of workers. However, the only specific occupational health and safety Prakas relates to the garment industry and brick manufacture. **<u>Chapter IX Work-Related Accidents</u>** Article 248: All occupational illness, as defined by law, shall be considered a work-related accident. The law sets out how accidents should be managed in terms of compensation.
The **Law on Road Traffic (2015)**	2015	The law is intended to ensure road traffic safety and order, and protection of human and animal health and lives, properties and environment. Its establishment a requirement for all motor vehicles, trailers, and semi-trailers moving on the road to obtain a technical inspection certificate. It also outlines road safety requirements.
National Policy on the Development of Indigenous Peoples		The guiding document to address Indigenous Peoples' issues in Cambodia is the **National Policy on the Development of Indigenous Peoples**. The Policy, prepared starting in 1994, was approved by the Council of Ministers on April 24, 2009 and sets out government policies related to indigenous peoples concerning culture, education, vocational training, health, environment, land, agriculture, water resources, infrastructure, justice,

		tourism, industry and mines and energy. The Policy provides principles for formal registration of indigenous communities as legal entities with their own bylaws and enables their participation in economic development that affects their lives and cultures. It states: "Indigenous Peoples shall be fully entitled to express their comments and opinions and to make any decisions on the development of the economy, society and their cultures towards growth in the society.

2. EIA Classification

37. In order to provide guidelines on effective implementation of sub-decree No 72 ANRK.BK on environmental impact assessment Procedures for development projects, MoE promulgated sub-decree No. 21 on Environmental Impact Assessment Classification for Development Projects.

38. According to this sub-decree, environmental impact assessment for projects is classified into three categories.

(i) Appendix 1: Projects requiring full environmental impact assessment (full ESIA), equivalent to ADB's environmental category A.

(ii) Appendix 2: Projects that require initial environmental impact assessment (IEIA), equivalent to ADB's environmental category B.

(iii) Appendix 3: Projects requiring the Contract on Environmental Protection (EPC), equivalent to ADB's environmental category C plus simple analysis and EMP.

39. The sub-decree includes an annex listing projects under various sectors and their categorization on the basis of their nature, type and size. The sector and EIA classification for irrigation project is summarized in Table II-3 below.

Table II-3: ESIA Classification for Development Projects relevant

No.	Project Type	ESIA (Equiv. to ADB's A	IESIA (Equiv. to ADB's B	Env. Protection Contract	Apply to IWRM subprojects
142	Irrigation systems		≥5000ha	1000-5000ha	The IWRM project consists of irrigation systems. There are two IESIA reports. One IESIA report is for sub-projects in Battambang and another report is for sub-projects in Pursat, required by the government.
143	Water diversion systems		≥5000ha	1000-5000ha	
176	All building construction	>45000m^2	15000 – 45000m^2	3000-15000m^2	
179	Road construction (new)	>100km	≥30 – 100km	10-<30km	
180	Railroad and road expansion	>100km	≥50 – 100km	10-<50km	
181	Road in protected areas	>30km	≥ 10-30 Km	10km	
182	Road widen or rehabilitation in protected area	>50km	≥ 10-50 km	10km	

Source: Prakas No. 021 PRK.BST dated 03 February 2020.

3. Occupational and Community Safety and Health

40. Government Occupational and Community Safety and Health (OHS) guidelines follow the

OHS Program for Cambodia (2010-2013) that was developed by the International Labor Organization (ILO). The draft guidelines provide the framework for instituting OHS at the workplace and in the community. The OHS guidelines for Cambodia will likely need to be supplemented with the international the IFC EHS/OHS Guidelines for Construction and Decommissioning, Waste Management Facilities, and Toll Roads.

41. The Ministry of Labor and Vocational Training (MLVT) has the following guidelines which will be implemented during the construction phase of the Project:

(i) MLVT Prakas No. 075/11 K.B/BR.K (March 2011) - Sanitation at the Construction Site: The Prakas sets to ensure that the sanitation and safety conditions are fulfilled for workers at construction sites by owners, directors, contractors or sub-contractors of construction establishments or construction companies. Articles 3 and 4 ensure that workers are provided with shelter, sanitation facilities and safe potable water for drinking and washing.

(ii) MLVT Prakas No. 076/11 K.B/BR.K (March 2011) - The Protection of Risk Resulting From Climate Change at Construction Sites. Articles of this Prakas require safety measures and break times for workers at the construction site during extreme weather events.

(iii) MLVT Prakas No. 077/11 K.B/BR.K (March 2011) - Providing of Information at the Construction Site. This Prakas states requirements for owners or responsible persons of a construction site to provide information, i.e. name and address of the owner of enterprise, construction establishment, Construction Company, name and address of architect, nature of construction, date for the start of the construction, estimated time to finish the construction works, and estimated number of workers to be employed for construction activities.

(iv) MLVT Prakas No. 078/11 K.B/BR.K (March 2011) - Stock of Materials, Waste Disposal and Clearance at Construction Site. This Prakas provides safety guidelines and requirements for the safe storage of construction of materials and hazardous substances/objects that can pose health and safety risks to workers.

42. The key national environmental quality standards applied to the subprojects are listed in Table II-4 below together with relevant international guidelines.

Table II-4: Key National and International Environmental Standards and Guidelines

Environmental Issue	National Standards	International Guidelines
Ambient air quality	Annex 1, Ambient Air Quality Standard, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	WHO Air Quality Guidelines (2021)
Noise	Annex 6, Max. Standard of Noise Level Allowable in the Public and Residential Areas, of Sub-decree on Control of Air Pollution and Noise Disturbance, 2000	IFC EHS Guidelines for Noise levels (2007)
Surface water quality	Sub-decree No. 27 ANRK/BK 1999 on Water Pollution Control: Annex 4, Water Quality Standards for Public Waters for the Purpose of Biodiversity Conservation, and Annex 5, Water Quality Standards for Public	US EPA National Recommended Water Quality Criteria Mekong River Commission (MRC)_ Technical Guidelines for the Protection of Aquatic Life

Environmental Issue	National Standards	International Guidelines
	Waters and Health	MRC Technical Guidelines for the Protection of Human Health
Drinking Water Quality	Cambodian Drinking Water Quality Standard, 2004	WHO Guideline on Drinking Water Quality (2022)

4. Applicable Ambient Quality Standards

43. Water quality standards for public health protection are shown in Table II-5.

Table II-5: Water quality standard in public water areas for public health protection

No.	Parameter	Unit	Surface water Standard
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1

Source: Annex 5 of Sub-decree No 27 ANRK.BK on Water Pollution Control, 2009.

44. Water quality standards in public water areas for biodiversity conservation are shown in Table II-6 below. These are applied as the national standards on surface water quality, supplemented by the table above. Ambient Air Quality Standards are presented in Table II-8. Maximum permitted noise levels in public and residential areas are shown in Table II-9.

Table II-6: Water quality standards in public water areas for bio-diversity conservation

No.	Parameter	Unit	Standard*	
			River	Lake etc
1	pH	-	6.5-8.5	6.5-8.5
2	Total suspended solids (TSS)	mg/l	25-100	1-15
3	Dissolved oxygen (DO)	mg/l	7.5-2.0	7.5-2.0
4	Biochemical oxygen demand (BOD5)	mg/l	1 - 10	<30
5	Chemical oxygen demand (COD)	mg/l	<50	1-8
6	Total Nitrate (TN)	mg/l	0.1-0.6	0.1-0.6
7	Total phosphorous (TP)	mg/l	0.005-0.05	0.005-0.05
8	Arsenic (As)	mg/l	<0.01	<0.01

No.	Parameter	Unit	Standard*	
			River	Lake etc
9	Iron (Fe)	mg/l	<1	<1
10	Total Coliform	MPN/100ml	<5,000	<1,000

Note: Standard* = Surface water quality standards for lake, reservoirs and river of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018*).*

45. The Royal Government of Cambodia has established a comprehensive policy on National Water Supply and Sanitation for both urban and rural water supplies. Based on this policy, and to ensure access to safe drinking water to all people, quality standards for both drinking water and groundwater are developed by an inter-ministerial process initiated by the Ministry of Industry, the Mines and Energy, and other concerned ministries with support from the World Health Organization.

Table II-7: Groundwater and Drinking Water Quality Standards

No.	Parameter[a]	Unit	Groundwater	Drinking Water Quality[a]
1	pH	-	6.5-8.5	6.5-8.5
2	Electrical Conductivity (EC)	µs/cm	500-1500	NV
3	Total Dissolved Solid (TDS)	mg/l	<800	800
4	Turbidity	NTU	<5.0	5
5	*Total Hardness (as CaCO3)*	*mg/l*	*<300*	300
6	Chloride (Cl^-)	mg/l	<250	250
7	Fluoride (F^-)	mg/l	<1.5	1.5
8	Nitrate (NO3)	mg/l	<50	50
9	Sulphate (SO_4^{-2})	mg/l	<250	250
10	Aluminum (Al)	mg/l	<0.2	0.2
11	Arsenic (As)	mg/l	<0.05	0.05
12	Cadmium (Cd)	mg/l	<0.003	0.003
13	Chromium (Cr-total)	mg/l	<0.05	0.05
14	Iron (Fe)	mg/l	<0.3	0.3
15	Manganese (Mn)	mg/l	<0.1	0.1
16	Mercury (Hg-total)	mg/l	<0.001	0.001
17	Thermo tolerant Coli form (E-Coli)	MPN/100ml	0	0
18	Total Coliform	MPN/100ml	0	0

MPN = Most Probable Number, NV = No value.
[a] Parameters are partially listed here and to be used for this IEE.
Source: Cambodian Drinking Water Quality Standard, 2004 adopted from WHO standard.

Table II-8: Ambient Air Quality Standards

Parameters	Cambodia[a]				WHO Air Quality Guideline 2021[b]
	Period 1h Average mg/ m^3	Period 8h Average mg/ m^3	Period 24h Average mg/ m^3	Period 1year Average mg/ m^3	
Carbon monoxide (CO)	40	20	-	-	4mg/m3 (24h Average)
Nitrogen dioxide (NO2)	0.3	-	0.1	-	10 ug/m3(1 year average) 25 ug/ m^3 (24h average)

Sulfur dioxide (SO2)	0.5	-	0.3	0.1	40 ug/ m^3 (24 h average)
Ozone (O3)	0.2	-	-	-	100 ug/ m^3 (8h average)
Lead (Pb)	-	-	0.005	-	-
Particulates	-	-	0.33	0.1	5 ug/ m^3 (PM2.5, 1year) 15 ug/ m^3 (PM2.5, 24h average)

Note: 1. Sub-decree N0 42 ANRK.BK on Air Pollution Control and Noise Disturbance.
Source: https://www.who.int/news-room/feature-stories/detail/what-are-the-who-air-quality-guidelines.

Table II-9: Maximum permitted noise levels in public and residential areas (dB (A))

Location	Cambodian Standard			IFC-EHS Guidelines	
	06:00 to 18:00	18:00 to 22:00	22 to 6:00	Day 7:00 to 22:00	22:00 to 7:00
Silence Area Hospital; Library, School, Nursery	45	40	35	55	45
Resident Area Hotel; Administration place, House	60	50	45		
Commercial, Services Areas and mix	70	65	50	70	70
Small Industrial factories intermingling in residential areas	75	70	50		

Note: This is permitted noise level of any source of activity at the public and residential areas.
Source: Annex 6 of Sub-Decree on Air Pollution Control and Noise Disturbance, 2000.

5. Applicable Discharge Standards

46. Sub-decree No. 235 on the Management of Drainage and Wastewater Treatment System (2017) includes two annexes that stipulate wastewater discharged into public sewer systems connected into centralized wastewater treatment plant (WWTP), and wastewater pre-treated on-site before being discharged into public sewer system, respectively.

Table II-10: National and International Effluent Discharge Standards

Parameter	Unit	Permissible Standard[a]		EHS guidelines' Standard[b]
		to Sewer [c]	to Water body[c]	for Treated Sewage Discharge
1. pH		5–9	6–8	6–9
2. TSS		<150	<80	50
3. Oil or Grease	mg/l	<20	<5	10
4. BOD5	mg/l	<80	<30	30
4. COD ($Cr_2O_7^{2-}$)	mg/l	<120	<50	125
5. detergents-LAS	mg/l	<15	<7	-
6. Total Nitrogen	mg/l	<10	<6	10
7. Total Phosphorus	mg/l	<1	<0.5	2
8. Ammonia (NH_3)	mg/l	<8	<5	-
9. Total coliform	MPN[a] /100 m	NV	500~2500	400

WWTP = wastewater treatment plant.
[a] Source: Annex 1&2 of Sub-decree No. 235 on The Management of Drainage and Wastewater Treatment System, Prime Minister, 2017. NV=No Value, a MPN = Most Probable Number.
[b] Since Cambodia doesn't have relevant sectoral discharge standards, the IFC General Environmental, Health and

Safety Guidelines (2007) islisted.

[c] Annex 1 of Sub-decree No. 235: This applies to wastewater from Commercial Buildings, Borey, Satellite City and Resort or Recreation to the Drainage/Sewerage that are connected to Centralized Wastewater Treatment Plant.

47. Regulation of hazardous wastes in Cambodia is defined in the Sub-Decree on Pollution Control and the Sub-Decree on Solid Waste Management (27 April 1999).

(i) Hazardous Substances: according to the Sub-decree on Pollution Control, hazardous substances are defined as "any substances that cause danger to living organisms, damage or break down any objects or building or adversely impact and damage the environment". Types of hazardous substances include organic compounds, heavy metals and their compounds, carcinogenic substances, persistent synthetic compounds, phosphorous and its compounds, Substances which may have an adverse effect on the oxygen balance, particularly ammonia, and nitrites, etc.

(ii) Hazardous Waste: according to Sub-Decree on Solid Waste Management, hazardous wastes are defined as: radioactivity substances, explosive substances, toxic substances, inflammable substances, pathogenic substances, irritating substances, corrosive substances, oxidizing substances, or other chemical substances which may cause the danger to human (health) and animal or damage plants, public property and the environment".

48. Under Article 7 of the Sub-Decree on Solid Waste Management: "the disposal of waste in public sites or anywhere that is not allowed by authorities shall be strictly prohibited". There are no quantitative parameters given but good sensible practice is expected including;

(i) All general waste and food waste should be removed to a government approved landfill;

(ii) All demolition waste must be removed to a government-approved location;

(iii) All waste oil and grease should be disposed by a registered sub-contractor. The final destination of the oily wastes should be established.

B. ADB Safeguards Policy (2009)

49. Safeguards requirements for all projects funded by ADB are defined in SPS 2009 which establishes an environmental review and assessment process to ensure that projects funded through ADB loans are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause significant environmental, health, or safety hazards. SPS 2009 is underpinned by the ADB Operations Manual, Bank Policy (OM Section F1/BP, October 2013). The policy also promotes adoption of international good practice as reflected the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. This IEE is intended to meet SPS 2009 requirements.

50. ADB environmental safeguards and requirements and International Finance Corporation's (IFC) environmental, health and safety (EHS) are set out in the following:

(i) Environment Policy, 2002;
(ii) Safeguards Policy Statement (SPS), 2009;
(iii) SPS Operations Manual, 2013;

(iv) Access to Information Policy, 2018; and,
(v) Guidelines for international best practice will also be drawn from IFC General Environmental, Health and Safety Guidelines (2007)

C. International Conventions

51. Cambodia is a signatory to many international environmental treaties and conventions which provide a comprehensive legal framework. These include:

(i) Biodiversity Convention (1994);
(ii) Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (1997);
(iii) Ramsar Convention (1999);
(iv) United Nations Framework Convention on Climate Change (UNFCC), 1992, entered into force on 21 March 1994 (Cambodia ratified on 18 December 1995);
(v) Kyoto Protocol 1997, entered into force on 16 February 2005 (Cambodia accessed 2002);
(vi) Vienna Convention for the Protection of the Ozone Layer, entered into force on 22 September 1988 (Cambodia accessed on 27 June 2001);
(vii) Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, entered into force on 1 January 1989 (Cambodia accessed on 27 June 2001);
(viii) The International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto “MARPOL 73/78”, fully entered into force on 2 October 1983 (Cambodia ratified in 1994);
(ix) Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, entered into force on 5 May 1992 (Cambodia accessed on 02 March 2001);
(x) United Nations Convention to Combat Desertification, entered into force on 26 December 1996 (Cambodia ratified on 18 August 1997);
(xi) Convention on International Trade in Endangered Species of Wild Fauna and Flora, entered into force on 01 July 1975 (Cambodia ratified on 04 July 1997);
(xii) Cambodia joined the UNESCO Network of Biosphere Reserves in 1997. It committed to the Millennium Development Goals and subsequently endorsed the Sustainable Development Goals at the UN General Assembly in 2015;
(xiii) At the regional level, Cambodia has ratified the following ASEAN Agreements: (a) on Transboundary Haze Pollution in 2006; and (b) on Disaster Management and Emergency Response, which entered into force in 2009; and
(xiv) At the subregional level, Cambodia, along with Lao PDR, Thailand and Viet Nam, signed the “Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin” (or the Mekong Agreement) in April 1995.

III. ENVIRONMENTAL AND SOCIAL BASELINE

52. The project's area of influence covers borrow pits, excavated material and spoil disposal sites that are beyond the command area. The scope of the baseline survey and of the impact assessment is approximately 100-200 meters beyond both sides of the linear structures and from the boundary of non-linear ones. With regard to biodiversity, the scope is several kilometers.

53. The command area for Battambang IS sub-project can be found in Figure I-1, while Figure I-6 shows the command area for the Sangker flood sub-project. For Pursat, the irrigation sub-project command area is shown in Figure III-4, and Figure I-7 for the flood sub-project. No associated facilities defined in SPS 2009 are found or anticipated so far for this project.

A. Battambang

1. Geology and Soils

54. The area is dominated by the Tonle Sap Lake, and this has affected the soil characteristics. According to the Feasibility Report of Kanghot Irrigation Scheme, the geology is categorized as old colluvial-alluvial plains where soils have developed from previously weathered material that has been transported and deposited to its current location. These areas form the wide, slightly undulating plains that form most of the Cambodian rice growing areas. Within the sub-project area, the Toul Samroung, Prateah Lang and Bakan soils are encountered in this region.

2. Climate, Hydrology and Water

55. Climate: Cambodia is situated in a tropical zone, between 10 and 14-degree latitude north of the equator. The climate is dominated by the monsoon cycle, with a distinct dry season and wet season. The northeast monsoon brings in the dry season from November to April. The dry season is cooler from November to January when cool air from Siberia flows in and is dry and hot from February to April. The wet season is from May to October, as the southwest monsoon brings in moisture and rains from the Indian Ocean. Average temperature has minimal variations regionally and seasonally (Table III-1 below).

Table III-1: Temperature in Battambang (2018-2022)

Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2018	14.7	17.9	23.1	22.4	24.1	25.1	24.4	23.8	23.5	23.3	22.1	17.9
2019	17.2	18.2	23.8	23.5	25.4	23.5	22.7	23.2	22.8	22.5	21.5	17.9
2020	15.9	17.5	22.0	24.4	23.9	23.5	23.2	22.0	22.4	23.1	21.6	18.5
2021	19.1	20.0	21.8	24.0	23.0	22.8	23.0	22.9	22.5	23.2	20.3	18.7
2022	16.4	19.5	23.1	14.4	24.0	24.3	23.2	23.0	22.4	22.0	21.2	20.1

Source: Meteorological Department, MOWRAM, 2024.

56. Table III-2 summarizes rainfall data for Battambang between 2018 to 2022. Table III-3 summarizes wind direction and speed in Battambang province form 2018-2022. The cooler, drier season is characterized by winds from the Southwest bringing warmer air.

Table III-2: Rainfall Data in Battambang from 2018-2022 (mm)

	Month											
Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2018	0.5	4	7	0.7	52.2	82.5	142.2	136.6	150.5	228.7	59.3	15.7
2019	0.7	0	5	10.5	51.1	131	101	144.1	271.	121.3	62	25
2020	0.7	0	4	7.4	83	128.2	147.9	124.9	177	197.2	33.1	10.2
2021	14.2	0	6.4	20107.2	128.4	172.2	124.1	215.5	168.3	221.8	70.8	8.2

2022	8	10	85	90	167	138.5	140.2	162.2	206.4	176.3	70.7	33.2

Source: Meteorological Department, MOWRAM, 2024.

Table III-3: The wind direction and wind speed data in Battambang Province from 2018-2022

Year / Month		Jan	Feb	Mar	Aril	May	June	July	Aug	Sept	Oct	Nov	Dec
2018	Wind direction	NE	E	S	SE	S	W	SW	SW	W/SE	N	N	N
	Wind speed	5	4	4.5	4	5	5	7	8	9	10	8	6
2019	Wind direction	NE	ESE	WSW	NW	SSW	WSW	SW	WSW	SW	NE/SW	NE	N
	Wind speed	6	5	5	4	4	5	6	7	8	8	7	6
2020	Wind direction	E	S	SW	SE	SW	SW	WSW	WSW	W	SSW	SW	NE
	Wind speed		5	4	4	5	6	7	7	8	9	7	5
2021	Wind direction	SE	SE	S	SSW	SW	SW	SW	SSW	WSW	SE	E	NE
	Wind speed	6	5.5	4	4	5	5.2	7.1	9	9	9	7	6
2022	Wind direction	ENE	E	NE	NE	SSW	SW	SSW	SSW	W	WSW	NE	E
	Wind speed	5	4	4	3	5	6	8	8	10	10	9	9

Note**:** N: North; S: South; E: East; W: West Climate Change Projections.
Source: Meteorological Department, MOWRAM, 2024.

3. Surface Water status

57. The Sangker River is the main water source for Battambang Town. Raw water is extracted upstream of the city and treated for potable supply. The ADB project on Provincial Water Supply and Sanitation (PWSSP) is constructing an additional raw water pump station and Water Treatment Plant. As part of the Environmental Monitoring the project takes water quality samples and the 2023 data is published on the ADB website. The river flows in a north easterly direction through Battambang town and receives surface water drainage at various outfalls. Water quality samples were also taken downstream of the city in 2020 for the same project in connection with the waste water collection and treatment as shown in **Table III-4** below.

58. Based on the samples analyzed as part of the 2023 sampling, the water quality of Sangker River is generally good with high dissolved oxygen and low BOD/COD. Upstream of the city, the nutrient loads (nitrogen and phosphorus) are within acceptable standard maximums. The moderately high level of coliforms reflect human activity and possibly farm animals close to the river. The high concentration of iron and significant levels of other heavy metals is possibly due to the suspension of fine clay particles which are in abundance in the region. This is supported by the moderate level of suspended and dissolved solids in the samples.

Table III-4: Surface Water Quality Sangker River

No.	Parameter	Unit	MOE Standard	21 October 2023		11 March 2024	
				Sample SW1 Upstream City	Sample SW2 Upstream of city	S1 Upstream of City	S2 Downstream of city
1	pH		6.5-8.5	6.79	6.73	7.07	7.2
2	Total dissolved solid (TDS)	mg/L	-	61	63	-	-
3	Total suspended solid (TSS)	mg/L	25-100	27	23	6 (NTU)	4 (NTU)
4	Dissolved oxygen (DO)	mg/L	2.0-7.5	7.3	7.6	-	-
5	Biochemical oxygen demand (BOD)	mg/L	1-10	1.2	1.1	1.04	0.98
6	Chemical oxygen demand (COD)	mg/L	-	4.45	3.32	2.35	1.96
7	Oil and grease	mg/L	-	3	1.6	ND	0.66
9	Sulfate (SO4)	mg/L	-	6.1	5.64	-	-
10	Total nitrogen (TN)	mg/L	<3	1.04	1.15	-	-
11	Total phosphorus (TP)	mg/L	<0.25	0.06	0.07	-	-
12	Lead (pb)	ug/L	<10	ND	ND	-	-
13	Arsenic (As)	ug/L	<10	36	25	-	-
14	Cadmium (Cd)	ug/L	<1	70	70	-	-
15	Iron (Fe)	mg/L	-	20	ND	-	-
16	Mercury (Hg)	ug/L	<0.5	ND	ND	-	-
17	Copper (Cu)	ug/L	-	3	3	-	-
19	Zinc (Zn)	ug/L	-	ND	ND	-	-
21	Total coliform	MPN/ 100mL	<5000	24000	4600	-	-

Notes:
1. Grab samples taken on a) 21 October 2023 upstream and downstream of Battambang city. .Applicable standard: Sub-decree 27 (1999) Annex 4, general receiving waters, and Annex 5, public health protection (for heavy metals).
2. “ND” means Not Detected “-” means “no data”.
Sources:
[a] Environmental Monitoring report Cambodia Provincial Water Supply and Sanitation Project Semestral Report (July to December 2023) February 2024, ADB.
[b] Environmental Monitoring report Cambodia Provincial Water Supply and Sanitation Project Semestral Report (January to June 2024) July 2024, ADB.

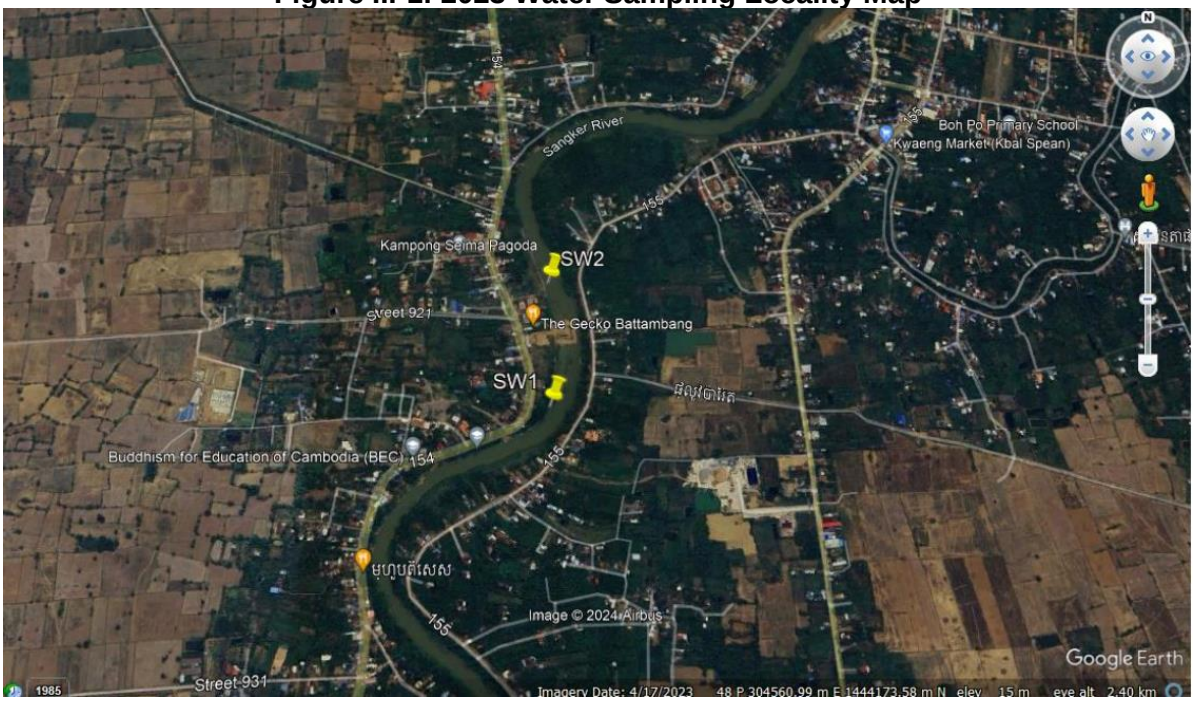
59. The water quality tests conducted in 2023 and 2024 for the ADB ongoing water supply and sewerage project[3] for Battambang indicate key parameters for water such as BOD and TSS are within the applicable surface water standards, indicating a generally good water quality suitable for irrigation. As the arsenic, iron and heavy metal concentrations are relatively high, this supports the conclusion that these constituents are derived from suspension and runoff from the catchment. In other words, these concentrations are ‘background’ heavy metals. Pollution from waste is borderline downstream of the city but can be expected to improve once the treatment plant is in operation. Pollution of the river from factories has been reported including some fish kills and enforcement of environmental standards has been improved by the provincial authorities.[4]

60. The IWRM sub-projects (Kanghot IS and the Ou Sralao channel) are both upstream of the urban area of Battambang and the testing points. Given the recent satisfactory water quality

[3] The 2023 Environmental monitoring for new WTP intake upstream of the city are appropriate for conditions in the Sangker at Kanghot and the Ou Sralao works.
[4] https://www.khmertimeskh.com/501339094/ministry-suspends-factory-over-waste-pollution/

downstream of the proposed IWRM interventions, it is expected that current water quality in IWRM subprojects located upsteam of Battambang city will be the same or even better.

Figure III-1: 2023 Water Sampling Locality Map



Source: Environmental Monitoring Report Provincial Water Supply and Sanitation Project July 2024

4. Air Quality

61. Field visits indicate that air quality in the project sites is good, as the project areas are located in rural areas without significant industrial/commercial activity. Typically, in Cambodia, outside Phnom Penh or town centers there are few industrial pollution sources and the volume of vehicular traffic is relatively low. The air quality results from the wastewater treatment plant of an ADB Project[5] is referenced as the baseline for the sub-projects in Battambang because the surrounding environment of these two subprojects are very similar (paddy rice field). Further air quality tests can be conducted during the preparation of the domestic EIA.

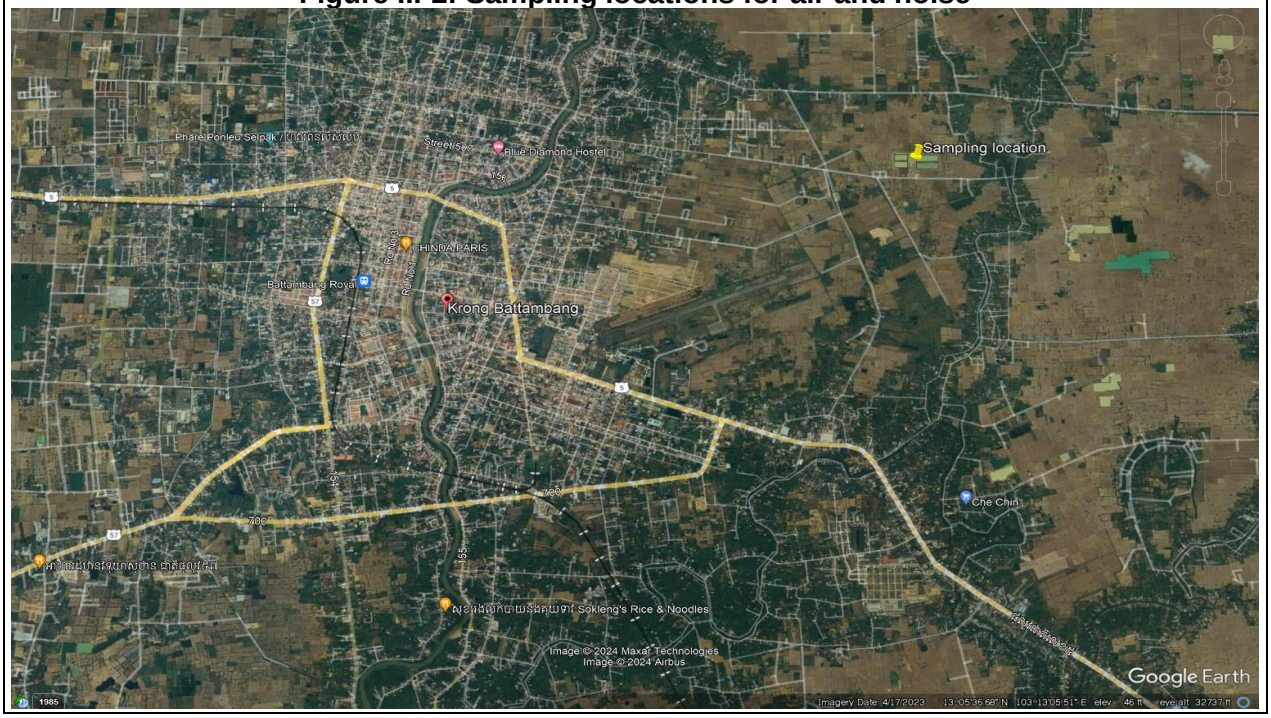
62. **Table III-5: Air quality baseline and standards at Battambang subproject**

No	Parameter	Unit	National Standards	Result
1	Carbon Monoxide (CO)	mg/m^3	20 (8 hours)	0.12
2	Nitrogen Dioxide (NO2)	mg/m^3	0.1 (24 hours)	0.010
3	Sulphur Dioxide (SO2)	mg/m^3	0.3 (24 hours)	0.005
4	O_3	mg/m^3	0.5	0.06
5	Total Suspended Particles (TSP)	mg/m^3	0.33 (24 hours)	0.068
6	(Pb)	mg/m^3	0.005	ND
7	Methane (CH_4)	mg/m^3	-	ND
8	PM 10	mg/m^3	0.05	0.021
9	PM 2.5	mg/m^3	0.025	0.009

Source: MoE Laboratory for IESIA report, SBK January 2020.

[5] Second Urban Environmental Management Plan in Tonle Sap basin project

Figure III-2: Sampling locations for air and noise



5. Noise

63. Field visits and observations indicate that noise levels at the subproject site are not significant, due to project being located in a rural area without significant industrial/commercial noise sources (see Table III-6 below). The sub-project is in an urban area which is subject to increased noise levels primarily due to traffic volume. The noise quality results from the wastewater treatment plant of ADB Project[6] is referred as baseline for the sub-project in Battambang because the surrounding environment of these two subprojects are very similar (paddy rice field). Further noise quality tests can be conducted during preparation of the IESIA report (during project implementation).

Table III-6: Noise Level at the Site (X:309292 and Y:1449786)

Period	Survey time	Noise Level dB(A)			Standards dB(A)
		LAeq	LAmax	LAmin	
Day	6:00 - 7:00	51.6	68.6	35.5	70
	7:00 - 8:00	44.5	62.9	35.7	
	8:00 - 9:00	41.5	53.4	35.4	
	9:00 - 10:00	38.3	47.0	36.5	
	10:00 - 11:00	40.2	57.9	37.0	
	11:00 - 12:00	38.8	43.7	35.3	
	12:00 - 13:00	40.0	49.3	34.7	
	13:00 - 14:00	40.7	52.1	35.4	
	14:00 - 15:00	42.4	56.9	38.1	
	15:00 - 16:00	42.3	55.5	36.0	
	16:00 - 17:00	42.7	55.0	35.2	

[6] Second Urban Environmental Management Plan in Tonle Sap basin project

Period	Survey time	Noise Level dB(A)			Standards dB(A)
		LAeq	LAmax	LAmin	
	17:00 - 18:00	42.2	55.4	36.3	
Evening	18:00 - 19:00	43.5	56.3	35.2	65
	19:00 - 20:00	44.1	59.4	34.8	
	20:00 - 21:00	41.8	59.7	35.9	
	21:00 - 22:00	42.4	52.1	37.4	
Night	22:00 - 23:00	36.5	55.8	27.5	50
	23:00 - 00:00	38.5	58.7	27.9	
	00:00 - 1:00	38.4	46.9	29.9	
	1:00 - 2:00	36.2	48.8	25.5	
	2:00 - 3:00	40.9	52.3	35.0	
	3:00 - 4:00	41.2	51.5	35.8	
	4:00 - 5:00	42.7	53.5	37.2	
	5:00 - 6:00	43.3	52.6	35.4	
Average for 24 hours		**14.4**	**54.4**	**34.5**	

Source: MoE Laboratory and IESIA report, SBK, January 2020.

6. Natural Hazards

64. Storms and typhoons are not usually considered a major problem in Cambodia as the country is protected by surrounding mountain ranges. Storms do occasionally affect the country, with most storm-related damage being caused by localized floods associated with heavy rain. Tropical storms can also affect the level of Mekong River flooding. The greatest damage generally occurs when these storms arrive during September and October when the seasonal discharge of the Mekong River is already high and a second significant peak to the annual flood is generated. Wind damage to property, agricultural produce and ecological systems is also often experienced. Table III-7 presents existing data on Natural Disasters over the past 10 years. Due to its location in the flood plain, Battambang is susceptible to both local flooding from rainfall and also backwater effects from the Tonle Sap Lake, and indirectly from high water levels in the Mekong River.

Table III-7: Natural Disasters 2011-2021

Year	Affected Households		Affected agro-land (ha)	Notes
	Flood/Storm	Drought		
2021	40	N/A	N/A	Flash flood
2020	66,088	N/A	164,116	Series of 6 cyclones, tropical storms
2019	1,169	N/A	1,533	Heavy rainfall
2015	735	N/A	N/A	Heavy rainfall
2014	50	7	N/A	N/A
2013	150,000	N/A	136,183	Largest flood in over 20 years
2012	21	N/A	N/A	N/A
2011	37	N/A	N/A	Heavy flood, Mekong River overflow

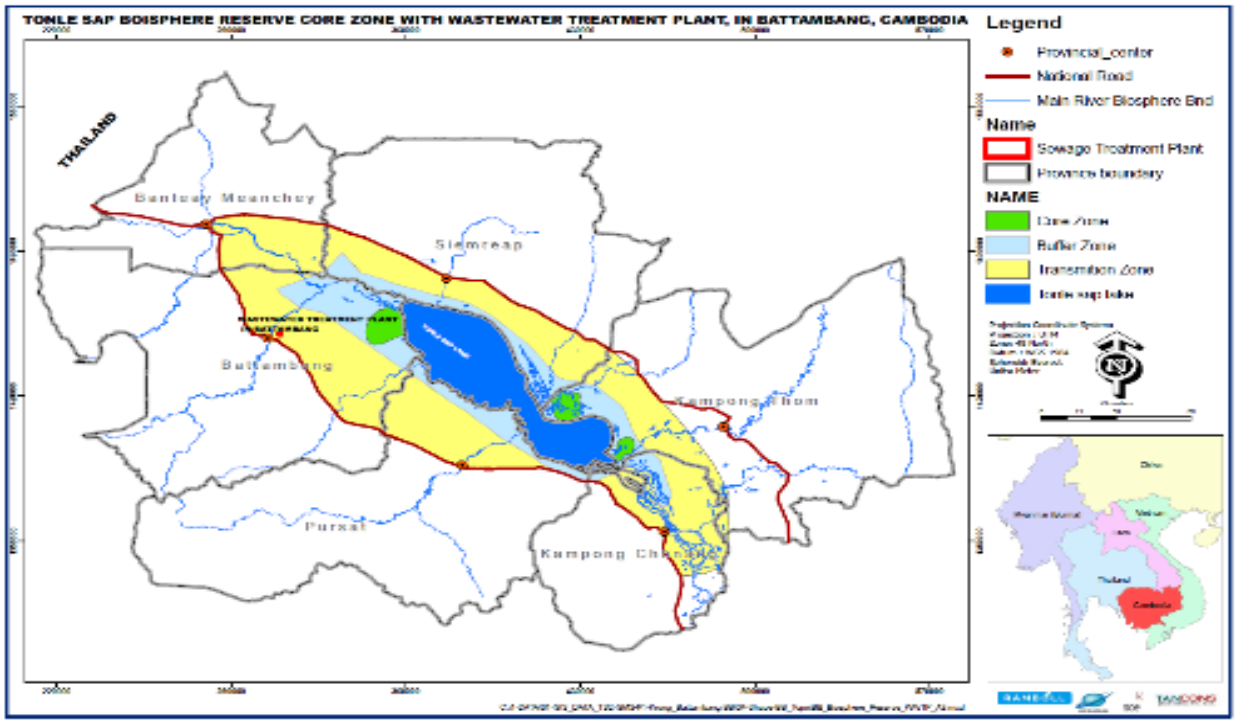
Note: N/A = Not Applicable.
Source: https://reliefweb.int/map/cambodia/cambodia-flood-extent-maps-20092019.

7. Biological Environment

65. The proximity of the Kanghot Irrigation scheme site to any protected areas has been

analysed using the Integrated Biodiversity Assessment Tool (IBAT). The IBAT Proximity Report shows that there is one Protected Area (the Tonle Sap) within a buffer of 1km. However, the nearest command area of Kanghot is about 10km from the boundary of the flooded forest conservation area,[7] and about 25.6km from the boundary of the Tonle Sap Biosphere Reserve (TSBR),[8] and about 23.3km from the Prek Tuol Important Bird area as shown in Figure III-3. Additionally, there is about 25km from the edge of Ou Sralau canal to the boundary of TSBR. This sub-project is located in highly disturbed environments dominated by agricultural land use with scattered trees. There are however limited specific areas where trees are present within the command area. Tree species include a number of common species such as rattan (Calamus sp), acacia (Acacia Auriculiformis) bamboo (Bambusa Arundinacea), and snowy orchid (Bauhinia Acuminata). The species observed are not threatened, critical or endangered.

Figure III3: Tonle Sap Biosphere Reserve (TSBR)



Source: IEE, Second Urban Environmental Management in Tonle Sap, 2021.

Table III-8: Overview of Protected Areas in Kanghot Subproject and Ou Sralau Canal

Name of Protected Area	Designated by	Main target and requirement	Distance (km) to IWRM subproject
Kanghot subproejct			
Tonle Sap Biosphere Reserve (TSBR)	Royal Government of Cambodia	Main target aims to protect multiple use zone surrounding the Tonle Sap lake	25.6km
Flooded forest preservation	Royal Government of Cambodia	Main target aims to protect the flooded forest around the Tonle Sap lake	10km
Prek Tuol Important	Royal Government	Main target aims to protect bird	23.3km

[7] Sub-decree 197 on protecting flooded forest around Tonle Sap lake.

[8] There are 23 Protected Areas in Cambodia, the nearest to the project site is the Tonle Sap Biosphere Reserve (TSBR) which is located in Kampong Chhnang, Pursat, Battambang, Siem Reap, Banteay Meanchey, and Kampong Thom provinces. The TSBR is classified as a multiple use zone and covers an area of 316,250 ha.

Bird Area	of Cambodia	and its habitat	
Ou Sralau canal flood management subproject			
Tonle Sap Biosphere Reserve (ISBR)	Royal Government of Cambodia	Main target aims to protect multiple use zone surrounding the Tonle Sap lake	25km
Flooded forest preservation	Royal Government of Cambodia	Main target aims to protect the flooded forest around the Tonle Sap lake	13km
Prek Tuol Important Bird Area	Royal Government of Cambodia	Main target aims to protect bird and its habitat	33.5km

Figure III-4: Kanghot and Flood sub-project relative to protected areas

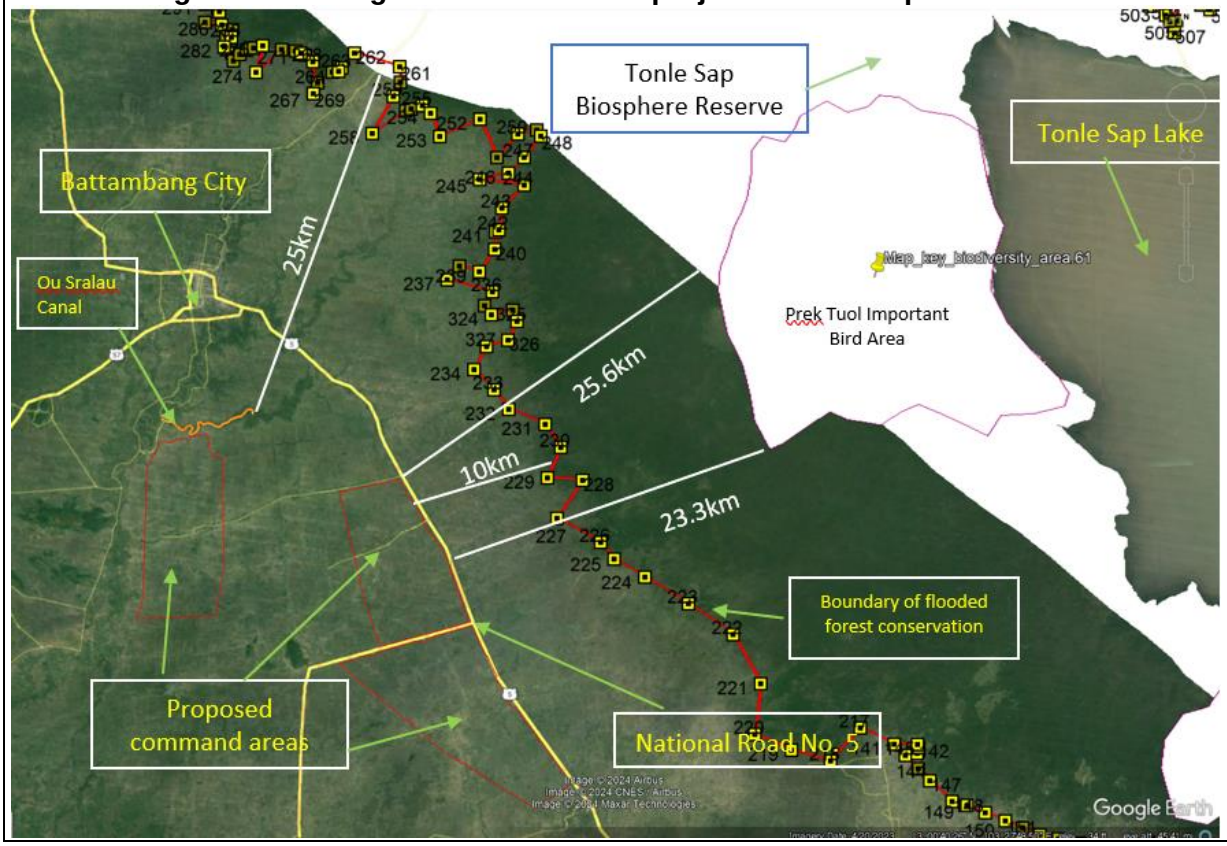


Figure III-5: Irrigation Command Area of Block A Main Canal 1, block B MC4 and block C MC6 MC7 and MC8 in Kanghot sub-project

8. Fisheries

66. Fish catches are primarily for domestic consumption. Table III-9 shows the local fish species at the main canal, notably no migratory fish species were identified in this survey. The information was gathered from local people during the site assessment held in early 2023.

Table III-9: List of Fish Caught in Main Canal

Local Name	Scientific Name	Conservation status (IUCN Red List 27/12/2018)
Trei Ros/ Ptuok	Anabas testudineus	Data Deficient
Trei Andeng Tun	Clarias macrocephalus	Data Deficient
Trei Kranh	Anabas testudineus	Data Deficient

67. Fish species likely to occur in the major southern catchments flowing into the Tonle Sap with the maximum and minimum size at migration (provided by MAFF 2023, compiled from catch data in the Stung Sangker and the Stung Pursat) are listed in Annex 5. Although none of the species identified in the main canal are of conservation concern per the IUCN Red List, there are three species in Stung Sangker and Stung Pursat which are listed as near threatened, vulnerable or endangered. However, these three species are not present in the canal. In addition, all fish passages will be designed to consider all fish species.

9. Birds

68. A field visit was conducted in February 2023 to obtain information about sensitive bird habitats in the proposed command area and canal networks in Kanghot in Battambang. Based on field visits and interviews with local people, it was confirmed that the proposed command areas and canal networks are rice fields and there are no bird habitat conservation areas or biodiversity protected areas currently in place. Some common birds were observed during the field visit and

these are generally found at any rice fields in the country as shown in Table III-10. These birds are classified as of “Least Concern” by IUCN.

Table III-10: List of Birds Observing During Field Survey

Nº	Khmer Name	Scientific Name	English Name	Family	IUCN
1	ចាបស្រុក	Passer montanus	Eurasian Tree Sparrow	Passeridae	LC
2	ក្អែក	Corvus macrohynchos	Large-billed Crow	Corvidae	LC
3	កុកក្រោងតូច	Egretta garzetta	Little Egret	Ardeidae	LC
4	ក្រសាចំពុះធំ	Ardea sumatrana	Great-billed Heron	Ardeidae	LC
5	លលកដីឬ លលកបង្គង់	Geopelia striata	Zebra dove	Columbidae	LC
6	ក្រចៀកកាំផ្ទះ	Apus affinis	House Swift	Apodidae	LC
7	សារិកាកែវគោ	Acridotheres tristis	Common Myna	Sturnidae	LC
8	ក្រូចអិនវាលស្រែ	Anthus rufulus	Paddyfield Pipit	Motacillidae	LC
9	ចាបដូនតាចិញ្ចើមស	Lanius cristatus	Brown Shrike	Laniidae	LC

10. Physical Cultural resources

69. Within the project area of influence, the pagodas around Battambang town are the only known cultural resources present. There are no known physical cultural resources that will be affected by the proposed sub-projects.

11. Socio-Economic Conditions

70. The command area of Kanghot Irrigation scheme is located in Trapeang Chorng, Boeng Bat Kandaol, Snam Preah, Kaoh Chum, Svay Luong, Anlong Vil, Banteay Dei, Phteah Prey, Veal communes, Bakan district, Kandieng district, Krakor district and Pursat Province. The main annual income source of surveyed households was from framing (54%).[9] The second and third major sources of income for HHs were from wage/salaried work (13%) and causal work as farm labor, construction workers (9.8%).

71. The average annual income of Kbal Hong HHs is USD 3,316.8.The primary sources of income for both poor and non-poor HHs in Kbal Hong subproject from farming are 41.7% and56.75%, respectively. Voat Ta Muem, Bay Damram, Kantueu Pir, Kantueu Muoy, Reang Kesei, Kampong Pring, Thipakdei, Prey Touch, Kakaoh, and Moung Russei communes, Banan district, Sangkae district, Moung Russei district, Koas Krala district as shown in Figure III-6 below. Sensitive receptors for this subproject are described in Table III-11 below.

[9] Feasibility Study Report for Kbal Hong irrigation Scheme, April 2024

Table III-11: List of sensitive receptors for this subproject

Name	Location	How far
Koh Char Primary School	12°48'04.72"N; 103°22'08.39"E;	Inside the command area of Block C near MC6
Roluos Primary School	12°47'30.79"N; 103°23'57.23"E;	Inside the command area of Block C
Moung Russei district	12°46'38.99"N; 103°26'48.14"E;	1km from the command area of Block C
Chork Touch Primary School	12°49'18.74"N; 103°21'46.47"E;	Inside the command area of Block C
Chak Thom Primary School	12°50'33.29"N; 103°22'40.17"E;	Inside the command area of Block C
Koun Klong Pagoda	12°55'07.41"N; 103°21'31.17"E;	Inside the command area of Block A
Boeung Chhouk Pagoda	12°58'12.00"N; 103°19'08.89"E;	Inside the command area of Block A
Ondoung Svay Pagoda	12°55'24.91"N; 103°11'43.21"E;	Inside the command area of Block B
Prey Toteung Pagoda	12°56'35.26"N; 103°10'54.44"E;	Inside the command area of Block B
Prey Toteung Primary School	12°56'57.28"N; 103°12'06.08"E;	Inside the command area of Block B
Battambang Provincial Referral Hospital	13°05'15.00"N; 103°11'20.74"E;	10km away from the Block B
Ou Sralau village (the nearest)	13°0'40.83"N; 103°11'33.07"E;	1km away from the Block B
Dob Krasang village (the nearest)	12°52'49.42"N; 103°22'36.95"E;	200m away from the Block C
Os Tuk village (the nearest)	12°56'56.38"N; 103°20'46.16"E;	200m away from the Block C

12. Unexploded Ordinance (UXO)

72. Unexploded Ordinance (UXO) is a high risk to human life, especially for workers on construction sites. During the public consultation with local authorities and local people, UXO has not been found from the rice fields inside the command area of the project. However, UXOs are still found in rice fields in Battambang province reported by local news[10]. Therefore, UXO still remains a high risk to workers.

B. Pursat

1. Geology and Soils

73. The area is dominated by the Tonle Sap Lake, and this has affected the soil characteristics. According to the Feasibility Study for the Kbal Hong Irrigation Scheme, the geology of Kbal Hong subproject is categorized into two, first as old colluvial-alluvial plains, and second, as active floodplains. The first is where soils have developed from previously weathered material that has been transported and deposited to its current location. These areas form the wide, slightly undulating plains that form most of the Cambodian rice-growing areas. Within the project area,

[10] Source: https://www.phnompenhpost.com/national/over-100-uxo-units-discovered-battambang

the Toul Samroung, Prateah Lang, and Bakan soils are encountered in this region. Meanwhile, the second is where soils have developed that are pedagogically young soils and receive annual deposits of fresh alluvium. Much of the irrigated and deep-water rice is cultivated on these soils. Within the project area, the Krakor soils are encountered in this region.

2. Climate

74. The tropical monsoon climate of Cambodia has two distinct seasons: (i) the dry season, which lasts approximately from November to April and is associated with the northeast monsoon, providing drier and cooler air; (ii) the wet season, lasting from May to October and during which rainfall mostly comes from the southwest monsoon, drawn inland from the Indian Ocean and providing hotter air. The wet season accounts for 90% of annual precipitation. The two prevailing wind directions are from the southwest and from the north-northeast.

75. In lowland areas, annual rainfall ranges from 1,000 mm to 1,700 mm[11]. Daily cumulated rainfall height measurements and intensity-duration-frequency (IDF) curves were acquired from the Ministry of Water Resources and Meteorology (MOWRAM) and show that every month from June to October, average rainfall height varies between 180 and 330 mm. For the rest of the year, the average monthly rainfall height stays below the 180 mm threshold.

76. The mean maximum temperature is 28°C, and the mean minimum temperature is 22°C. Maximum temperatures above 32°C are common before the start of the rainy season and may rise to more than 38°C. According to temperature data recorded at the meteorology station in Sisophon (2010-2012), which is approximately 45 km away, the average annual minimum temperature is 23.6°C, and the average annual maximum temperature is 32.3°C.

3. Water

77. In Pursat, the main surface water feature is Pursat River which has its catchment area in the upland and mountainous areas of the Cardamom Mountains in the West and empties into the Tonle Sap Lake in the east. It is about 250 km long. Downstream at Veal Commune (boundary of Pursat Town with Kandieng District), the flow is less than upstream at Bac Trakuon due to the water diversion at Damnak Ampil Weir for irrigation. Pursat River provides mainly amenity value for the Town, as well as the main source of drinking water and irrigation water for the surrounding agricultural areas. Figure III-8 below shows the existing water quality in the main canal adjacent to the Pursat river which is heavily contaminated with solid waste and sewage.

78. The initial 1.2 km of MC1 and MC2 are located in urban areas of Pursat town and are polluted in the dry season. The newly completed waste-water treatment plant (WWTP) by ADB loan project [12] is located next to MC1 about 1km west of its intake at Pursat river. Its sewer/drainage pipelines are built along the MC1 urban segment and main city streets (see figure 1-6). However, the WWTP is not in yet in full operation. There is no timeline as to when the WWTP will be operational. The WWTP was designed to comply with the Sub-decree on Water Pollution Control. Most Pursat sewage currently is drained into the WWTP and joins MC1.

[11] GSSD 2015. Cambodia's Second National Communication Under the United Nations Framework Convention on Climate Change. General Secretariat, National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh.

[12] The wastewater treatment plant was designed to comply with public water area and sewer in Annex 2 of sub-decree 27 on Water Pollution Control (1999).

Figure III-8: Untreated wastewater discharging form local resident into the Main Canal

Local people living along Main Cannal I

Local people living along Main Cannal I

79. Beyond the urban area, about 300m in length of MC1 has been restored by the Engineering Department of MOWRAM. There is no embankment road after 4.2 km in MC1 and after 1 km in MC2 and it is not possible to drive past these points. Due to lack of bridges, villagers have closed MC1 in several places to cross the canal. These temporary crossings will be replaced with access bridges at regulators and improved canal roads.

80. Water sampling was conducted in October 2023 for five sites as shown in Figure III-9. There were rainfall events for the last few nights before the sampling day. The results of the water sampling are shown in Table III-12. All parameters were within acceptable range, with the exception of total phosphorus, indicating diffuse pollution upstream most likely runoff from farm fields. Given the results for organic pollution parameters and heavy metals are a fraction of the maximum limits allowed by the standards, the dilution effect of the pre-sample rain events is considered to be negligible.

81. These water test results also suggest that sediment in these water bodies would not in general be contaminated. Site surveys undertaken during baseline investigation revealed that the subprojects area are largely sited in farming areas. There are no industries or mines within the sub-project area that would result in sediment contamination. It is therefore considered that the sediment to be excavated by the sub-project would not be contaminated.

Figure III-6: Water Quality Sampling Sites: October 2023

Table III-12: Results of Surface Water Sampling

Parameter	Unit	Standard*	Site 01	Site 02	Site 03	Site 04	Site 05
		River					
pH	-	6.5-8.5	6.51	6.35	6.38	6.37	6.35
TSS	mg/l	25-100	40.50	44.30	53.55	67	63.9
DO	mg/l	7.5-2.0	6.95	6.68	7.19	6.47	7.43
BOD5	mg/l	1 - 10	3.16	4.47	3.59	3.35	2.47
COD	mg/l	<50	4.55	5.75	3.98	4.38	3.30
TN	mg/l	0.1-0.6	0.271	0.325	0.253	0.278	0.288
TP	mg/l	0.005-0.05	0.203	0.247	0.197	0.224	0.218
Arsenic (As)	mg/l	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005
Iron (Fe)	mg/l	<1	0.175	0.235	0.255	0.323	0.353
Total Coliform	MPN/100ml	<5,000	2200	920	3200	680	930

4. Air Quality

82. Field visits indicate that air quality in the project sites is good, as the project is situated in rural areas without significant industrial/commercial zones to cause air quality degradation. Typically, in Cambodia, outside Phnom Penh or town centers there are few industrial pollution sources, and the volume of vehicular traffic is relatively low. According to Table III-13 the results of air quality in the project site in Pursat meet the national standard. It appears that the WHO standard is not met for Ozone in Location 1.

Table III-13: Air quality baseline and standards, Pursat subproject

No	Parameter	Unit	National Standard	WHO 2021 Air Quality Guideline (AQG)	Pursat
1	CO	mg/m^3	20 (8hr av)	4 (24 Av)	0.12
2	NO_2	mg/m^3	0.1 (24hr av)	25ug/m3 (24hr Av)	0.010
3	SO_2	mg/m^3	0.3(24hr av)	40 ug/m3 (24hr av)	0.005
4	Ozone (O_3)	mg/m^3	0.2 (1hr av)	100 ug/m3 (8hr av)	0.06
5	TSP	mg/m^3	0.33 (24hr av)	-	0.068
6	Pb	mg/m^3	0.005 (24hr av)	-	ND
7	CH_4	mg/m^3	-	-	-
8	PM_{10}	mg/m^3	-	0.05 (24hr av)	0.036
9	$PM_{2.5}$	mg/m^3	-	15ug/m3 (24hr av)	0.021

5. Natural Hazards: Flooding

83. There are two major types of floods in Cambodia: (i) Mekong River flood and (ii) flash floods. Mekong River flood occurs with cumulative rainfall in the upper catchments throughout the rainy season, causing a slow but steady rise in water levels lasting for several days. This causes the Tonle Sap River to reverse its flow, expanding the Tonle Sap Lake to six times its dry season size[13]. This event is increased with heavy rains around the Tonle Sap Lake, affecting the provinces around the lake and the southern provinces. This event is most severe when heavy rains coincide with a tropical depression and storm.

84. Flash floods come about as a result of repeated heavy rainfall in mountainous areas. Flash floods general last for only a few days but often cause severe damage to crops and infrastructure, particularly in tributaries around the Tonle Sap Lake. Pursat is one of the provinces that is prone to flash floods. According to the most recent Strategic National Action Plan for Disaster Risk Reduction (2008-2013), the flood-prone Pursat communes along Tonle Sap Lake are among the priority flood-prone communes.

Table III-14: Natural Hazards in Pursat Town (1996-2018)

Hazards	Deaths	Injured	Houses Destroyed	House Damaged	Victims	Affected	Evacuated
Flood	0	0	0	0	2669	0	2669
Fire	0	0	3	7	0	0	0
Storm	0	0	1	2	14	0	0
Drought	0	0	0	0	4113	0	0
Lightening	7	3	0	0	0	16	0
Total	7	3	4	9	6796	16	2669

Source: National Committee for Disaster Management, 2018.

85. The proposed irrigated areas of both Kbal Hong and Kanghot sub-projects are affected by flooding due to backwater from the Tonle Sap Lake. The water floods out from the lake during an extreme flood event (most frequently in October) and flows overland into the command areas. From October the water level slowly recedes to back to the lake by which time the command area is again flood free.

[13] Source: https://archive.internationalrivers.org/resources/protecting-the-fisheries-of-tonle-sap-lake-1747

6. Biological Environment

a. Protected Areas

86. The IBAT Proximity Report shows that there is a domestic Protected Area called “Tonle Sap”[14] within a buffer of 1km, but there is no Key Biodiversity Area within a radius of 10 km from the scheme site. Bakan grassland is a protected area for birds designated by sub-decree No. 144 in 2023. The nearest command area is approximately about 6.6km from the Bakan Grassland, and about 13km from the boundary of Tonle Sap Biosphere Reserve (TBSR). The distance from the edge of Svay At canal to the Bakan grassland is about 14.5km as seen in Figure III-10.

Table III-15: Protected Areas

Name of Protected Area	Designated by	Main target and requirement	Distance (km) to IWRM subproject
Kbal Hong			
Tonle Sap Biosphere Reserve (ISBR)	Royal Government of Cambodia	Main target aims to protect multiple use zone surrounding the Tonle Sap lake	14.5km
Flooded forest preservation	Royal Government of Cambodia	Main target aims to protect the flooded forest around the Tonle Sap lake	13km
Bakan landscape protected area	Royal Government of Cambodia	Main target is to protect the ecosystem in the area and ensure the sustainable use of the area.	6.6km
Dei Roneat Important Bird Area	Royal Government of Cambodia	Main target aims to protect bird and its habitat	10.7km
Svay At canal flood management subproject			
Bakan landscape protected area	Royal Government of Cambodia	Main target is to protect the ecosystem in the area and ensure the sustainable use of the area.	15km

87. A field visit was conducted in the middle of February 2023. Based on field visits and interviewing local people, it was confirmed that the proposed command areas and canal networks are rice fields. Birds commonly observed during the field visit are listed in Table III-16. These birds are generally found in rice fields in the country and are classified as “Least Concern” by IUCN.

Table III-16: List of birds observed during field survey

No.	Khmer Name	Scientific Name	English Name	Family	IUCN
1	ចាបស្រុក	Passer montanus	Eurasian Tree Sparrow	Passeridae	LC
2	ក្អែក	Corvus macrohynchos	Large-billed Crow	Corvidae	LC
3	កុកក្រោងតូច	Egretta garzetta	Little Egret	Ardeidae	LC
4	ក្រសាចំពុះធំ	Ardea sumatrana	Great-billed Heron	Ardeidae	LC
5	លលកដីឬ	Geopelia striata	Zebra dove	Columbidae	LC

[14] Tonle Sap Biosphere protected area was established by the Royal Degree on establishment of natural protected area in 2008

	លលកបង្គង់				
6	ក្រចៀកកាំផ្នះ	Apus affinis	House Swift	Apodidae	LC
7	សារិកាកែវគោ	Acridotheres tristis	Common Myna	Sturnidae	LC
8	ក្រូចអិនវាលស្រែ	Anthus rufulus	Paddyfield Pipit	Motacillidae	LC
9	ចាបដូនតាចិញ្ចើមស	Lanius cristatus	Brown Shrike	Laniidae	LC

88. Pursat is a province in Cambodia through which the Tonle Sap River flows. During times of flooding, the Tonle Sap Lake acts as a massive reservoir, absorbing excess water from the Mekong River and its tributaries, including the Tonle Sap River. This can result in altered flow patterns in downstream areas, including Pursat.

89. The modeled results highlight that the proposed project intervention, the Svay At channel, does not appear to impact the Bakan Protected Area significantly. This is attributed to the Bakan area's location on the floodplain of the Tonle Sap Lake, which experiences annual flooding. Additionally, the Bakan area is situated far from the edge of the Svay At diversion channel, further reducing any potential impact on flood risk to the protected area.

90. Flooding of the Bakan area is primarily controlled by the flooding from the Tonle Sap. When the Lake is high there is no influence of the Pursat System, including the Svay At. The ecology of the Bakan grassland is related to flooding from the Lake and when this does not occur then fires and encroachment of the grassland accelerates. The influence of the Svay At restoration is only local downstream when the Lake is high.

b. Fisheries

91. Fish catches are primarily for domestic consumption. Based on the Initial Environmental and Social Impact Assessment report for Pursat Wastewater and Drainage sub-project of Integrated Urban Environmental Management in the Tonle Sap Basin Project (2019), Table III-17 below shows some local fish species at the Kbal Hong main canal while the detailed fish list is attached in Annex 5. Additionally, the new regulator at Pursat replaces an older one and impact on the river migratory species is alleviated through provision of a fish pass similar to the current one. All fish passes will be designed to consider all fish species.

Table III-17: List of fish caught in Main Canal

Local Name	Scientific Name	Conservation status (IUCN Red List 27/12/2018)
Trei Ros/ Ptuok	Anabas testudineus	Data Deficient
Trei Andeng Tun	Clarias macrocephalus	Data Deficient
Trei Kompleanh Plouk	Trichohodus mirolepis	Data Deficient
Trei Kompleanh Srea	Trichohodus trichopterus	Data Deficient
Trei Kanh Chos Bay	Mystus albolineatus	Least concern
Trei Kanh Chos	Mystus wolffi	Data Deficient
Trei Chongva Ronong	Lobocheilos melanotacnia	Data Deficient

Source: IESIA report for Integrated Urban Environmental Management in the Tonle Sap Basin Project 2019.

Figure III-7: Kbal Hong and Svay At sub-projects relative to protected areas

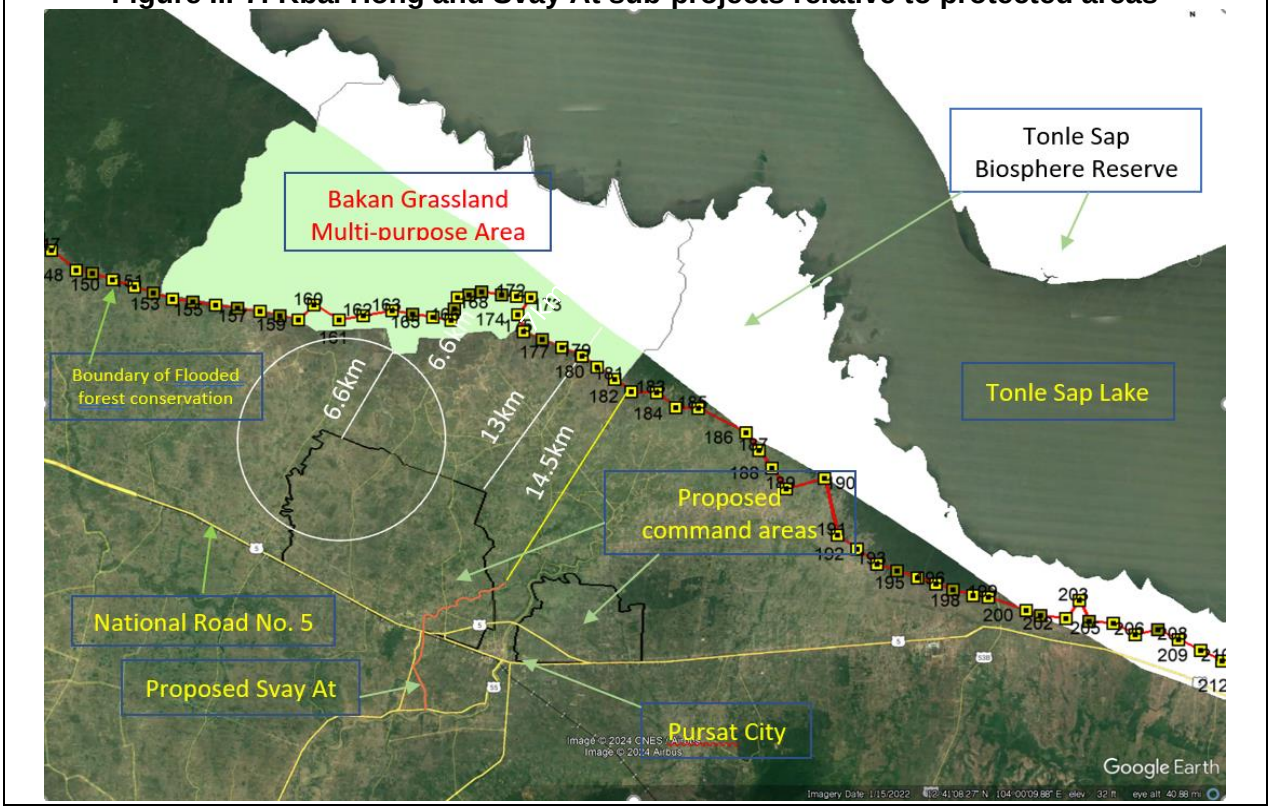
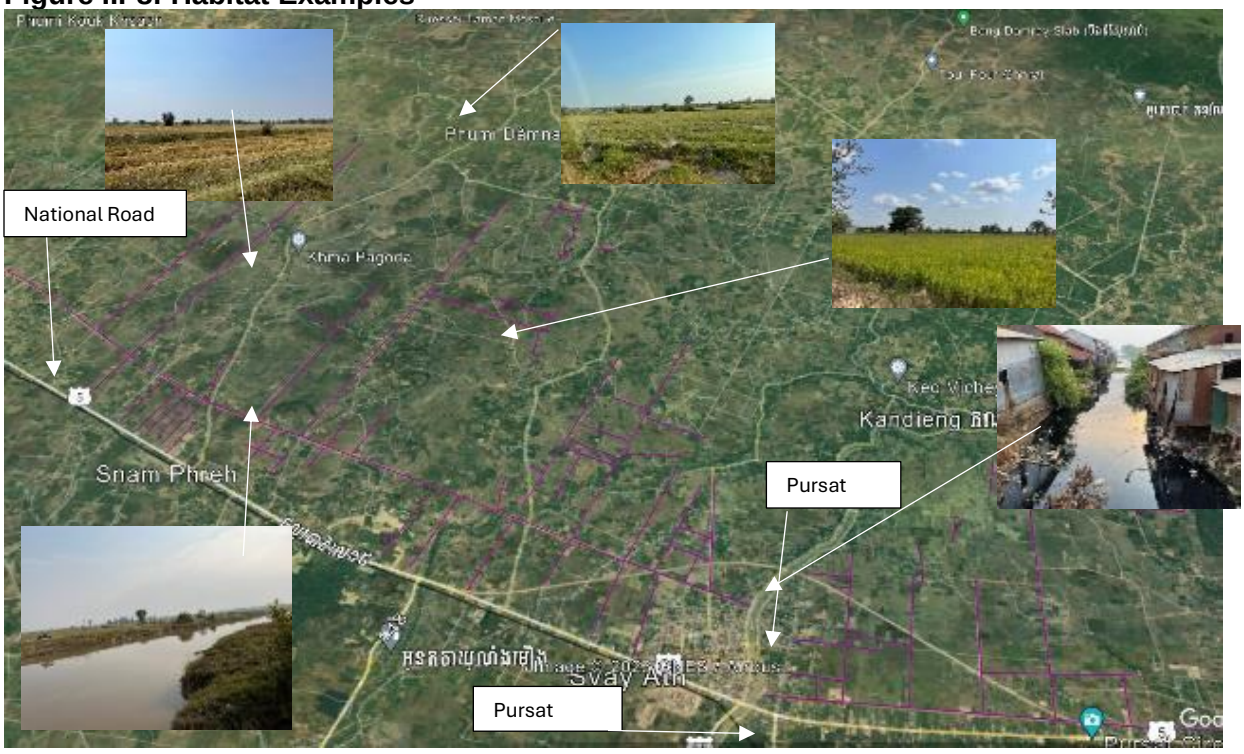


Figure III-8: Habitat Examples



7. Flora

92. Land use in the subproject area is agricultural, comprising actively farmed paddy fields or abandoned paddy fields. A mixture of natural and plantation-escaped trees and shrubs have established along the bonded boundaries of fields, along roadsides and along canal banks, some of the vegetation observed includes Diospyros Sp(ដើមខ្លាស់), Peltophorum pterocarpum (ដើមត្រសេក) and Azadirachta indica (ស្ដៅ).

8. Socio-Economic Conditions and Physical Cultural Resources

93. The command area of Kbal Hong Irrigation scheme is located in Trapeang Chorng, Boeng Bat Kandaol, Snam Preah, Kaoh Chum, Svay Luong, Anlong Vil, Banteay Dei, Phteah Prey, Veal communes, Bakan district, Kandieng district, Krakor district and Pursat province. The main annual income source of surveyed households was from farming (54%)[15]. The second and third major sources of income for HHs were from wage/salaried work (13%) and causal work as farm labor, construction workers (9.8%).

94. The average annual income of Kbal Hong HHs is USD 3,316.8. The primary sources of income for both poor and non-poor HHs in Kabl Hong subproject from farming are 41.7% and 56.75%, respectively.

95. The command area of Kanghot Irrigation schemes is Prey Touch, Kampong Preang, Kateur 1, Kateur 2, Bay Damram, Vaot Tamuem, Thippadei, Ko Koh, Moung, Prey Touch communes, Sangker, Banan, Moung Russey, Koas Kralor districts, Battambang Province. The main income sources was from farming (72.5%)16. The second and third major sources of income for HHs were from business enterprises or trade on their own (7.1%) and livestock (6.7%). Other sources of income were from fishing, selling fruits and vegetables, forest activities (charcoal-making) collecting and selling firewood etc.), income from rentals, remittance received from households members working abroad, driving taxis and tuk-tuks, and allowances received from the ID poor fund. Special monthly allowance are provided to households that are very poor and carry an equity card issued by the Royal Government of Cambodia (RGC).

96. The average annual income of Kanghot HHs is USD 3,961. The primary sources of income for both poor and non-poor HHs in Kanghot subproject from farming are 74.4% and 72.4%, of the total respectively. The second major source of income for poor HHs was wage/salaried work (8.4%), whereas for non-poor HHs it was business enterprises or trade by themselves (7.2%).

97. Physical cultural resources in the both subprojects are primarily based around the pagodas. Comparing the two subprojects, people in Kanghot have higher average annual incomes than those at Kbal Hong which currently has the poorer condition water infrastructure.

9. Sensitive Receptors and cultural resources

98. Key structures and features that have the potential to be affected by this project have been surveyed. Within the project area of influence, the pagodas inside and nearby the command area are the only known cultural resources present. These receptors are not close to target canals, as shown in Table III-19.

[15] Feasibility Study Report for Kanghot Irrigation Scheme, March 2024
[16] Feasibility Study Report for Kanghot Irrigation Scheme, March 2024

Table III-18: List of Sensitive Receptors for this Subproject

Name	Location	How far
Snam Preah Pagoda	12°34'16.44"N; 103°50'30.28"E;	Inside the command area and 1250m from the Main Canal I and 350m from the secondary canal
Khma Pagoda	12°37'39.54"N; 103°50'17.57"E;	3.8km from the Main Canal I and 1km from the secondary canal
Kuchchen Meanchey (Damrey Sar) Pagoda	12°38'30.04"N; 103°54'00.44"E;	600m from the secondary canal.
Koh Chum Primary School	12°35'26.97"N; 103°53'16.67"E;	2.7km from the Main Canal I and 950m from the secondary canal
Pursat High School	12°32'35.54"N; 103°54'56.64"E;	About 650m from the Main Canal I
Pursat River	12°32'52.15"N; 103°55'15.82"E;	Connecting with Main Canal I in Pursat city
Pursat city		Main Canal I connecting with Pursat river passes through Pursat city at North part
Keomony Pagoda	12°32'26.65"N; 103°58'51.54"E;	Inside the command area and about 1.5km from the Main Canal II
Snam Preah Health Center	12°34'8.78"N; 103°50'27.12"E;	800m from the Main Canal I

10. Unexploded Ordinance (UXO)

99. Unexploded Ordinance (UXO) are a high risk to human life, especial workers working at construction sites. During the public consultation with local authorities and local people, no UXO have been found from the rice fields inside the command area of the project.

IV. POTENTIAL ENVIRONMENTAL IMPACTS

100. The anticipated positive and negative environmental impacts of the proposed project were assessed based on feasibility studies and technical review; site visits conducted by technical consultants; water quality surveys; screenings utilizing the Integrated Biodiversity Assessment Tool (IBAT) developed by BirdLife International, Conservation International, IUCN and UN Environment's World Conservation Monitoring Centre; and consultations with key stakeholders and affected people.

101. The project's area of influence and the consequent possible environmental impacts on air, water, noise, wastes, covers the command areas and also borrow pits, dredged material and spoil disposal sites etc. In general, the scope of survey and assessment is about 100-200 meters beyond both sides of linear, and from the boundary of non-linear structures. For biodiversity, the scope is usually several kilometers beyond.

A. Design Phase Impacts/Alternatives Analysis

102. Various alternatives were analyzed in the draft feasibility study, and the outcomes have influenced the preliminary design of the sub-projects. The "No Project" option has been rejected, because the result of the sub-project irrigation and drainage work is expected to have the following positive benefits: an increase in certainty and control of existing irrigation areas; expansion of reliable irrigation into new areas; and longer cropping periods in areas previously unavailable for parts of the year due to flooding.

B. Comparison of concretized canal slope vs vegetated bank

103. Concretized Canal Slopes:

(i) Erosion Control: Concretized canal slopes provide strong erosion resistance, reducing sedimentation in water bodies downstream. This helps maintain water quality and prevents sediment-related ecological degradation.

(ii) Maintenance Needs: Concretized slopes generally require less maintenance compared to vegetated banks. They are easier to inspect and repair, reducing ongoing operational costs.

(iii) Habitat Impact: Concretized slopes typically offer limited habitat for aquatic organisms and vegetation compared to natural or vegetated banks. This can reduce biodiversity and ecological resilience in the waterway.

(iv) Heat Absorption: Concrete can absorb and retain heat, leading to higher water temperatures in the canal. This can affect aquatic life, especially sensitive species, and alter ecosystem dynamics.

(v) Aesthetics: Concretized slopes may be perceived as less visually appealing compared to natural or vegetated banks. This could impact recreational use and community engagement with the water resource.

104. Vegetated Banks:

(i) Erosion Control: Vegetated banks provide natural stabilization, reducing erosion by absorbing water, slowing runoff, and binding soil with root systems. They

contribute to maintaining soil structure and preventing sedimentation downstream.

(ii) Biodiversity: Vegetated banks offer diverse habitats for aquatic and terrestrial species, promoting biodiversity and supporting ecological balance. They can serve as wildlife corridors and provide nesting sites for birds.

(iii) Water Quality: Vegetated banks act as buffers, filtering pollutants, and absorbing excess nutrients from runoff. This improves water quality and supports healthier aquatic ecosystems.

(iv) Temperature Regulation: Vegetation provides shade, helping to regulate water temperature and mitigate thermal pollution. This is particularly important for species sensitive to temperature fluctuations.

(v) Community Benefits: Vegetated banks enhance the aesthetic value of the waterway, offering green spaces for recreation, relaxation, and cultural activities. They can also contribute to community engagement and ownership of the water resource.

105. While both concretized canal slopes and vegetated banks have their advantages and disadvantages, prioritizing environmental considerations and long-term sustainability would likely favor the implementation of vegetated banks for the proposed project infrastructure and this is what is chosen for the design option.

C. Comparing alternative fish pass designs

106. Vertical Slot Fish Passway:

(i) Biodiversity Risks:

a. Habitat Fragmentation: Vertical slot fish passways can contribute to habitat fragmentation by interrupting the natural flow of rivers. This interruption can create barriers to fish migration, leading to isolated populations and reduced gene flow between different sections of the river.

b. Species-Specific Challenges: Some fish species may face difficulties navigating through the narrow, vertical slots of the passway. Species with limited jumping abilities or specific habitat preferences may struggle to ascend or descend through the structure, limiting their access to essential spawning or feeding areas.

(ii) Environmental Risks:

a. Sedimentation: Improperly designed vertical slot fish passways can alter flow patterns, leading to increased sedimentation downstream. Changes in flow velocity and direction can cause erosion of riverbanks and streambeds, resulting in sediment accumulation in downstream habitats. Excessive sedimentation can degrade water quality, smother benthic habitats, and reduce oxygen levels, harming aquatic life.

b. Hydraulic Impacts: Vertical slot fish passways may create hydraulic conditions that are unsuitable for fish passage. High velocities and turbulent flows within the passway can impede fish movement and cause physical stress or injury.

Additionally, rapid changes in water level or flow rate can disorient fish and hinder their ability to navigate through the structure.

107. Cone Fishway:

(i) Biodiversity Risks:

a. Selective Passage: Cone fishways may not provide equal passage opportunities for all fish species. Some species may have difficulty navigating through the structure due to factors such as water depth, flow velocity, or hydraulic complexity. This selective passage can create barriers to migration for certain species, leading to reduced genetic exchange and population fragmentation.

b. Altered Hydrology: Cone fishways can modify natural flow patterns within river systems, potentially altering habitat availability and quality for aquatic organisms. Changes in flow velocity, turbulence, and water depth can influence the distribution and abundance of fish and other aquatic species, impacting ecosystem dynamics and biodiversity.

(ii) Environmental Risks:

a. Habitat Modification: Construction of cone fishways may require alterations to river channels and banks to accommodate the structure. Channel dredging, bank stabilization, and other habitat modifications can disrupt natural riverine habitats and alter ecosystem processes. Changes in habitat structure and composition can affect the distribution of aquatic flora and fauna, leading to shifts in community composition and trophic interactions.

b. Sediment Transport: Cone fishways can affect sediment transport dynamics within river systems, with potential implications for downstream habitats. Changes in flow velocity and turbulence induced by the structure can influence sediment deposition and erosion patterns, altering habitat availability and quality for benthic organisms and other aquatic life.

108. With the environmental considerations being similar between both design options, it is proposed to also install a vertical slot fishway which is the single design suitable for the provision of fish passage considering the 4m headwater range required for this fishway. This fishway is the only realistic option for use at the large headwater range found at the site, as it can operate over a wide range of headwaters, whereas the cone fishway would only be able to operate over around 1.00m of headwater. The vertical slot fishway design with pools measuring 3.0m in length, 2.0m in width, and minimum 1.0m in depth is recommended to be implemented tailored to local fish species.

D. Assessment of Construction Phase Impacts

109. Given the nature of a project dominated by civil works, most of the project's potential environmental impacts are associated with the construction of the irrigation scheme works including upgraded or new canals, and access roads. Overall, most physical works are small scale occurring within existing highly modified agricultural landscapes. Potential negative construction phase environmental impacts are typical for irrigation and agricultural works and include erosion; disposal of soil from canal construction; soil and water contamination from petroleum products and hazardous materials; construction and domestic wastes; air pollution from

fugitive dust; hydrology impacts; community disturbance and safety; health and safety risks to workers and residents; and impacts on PCRs. If applicable, these potential impacts are typically localized, short-term and low in magnitude, and can be effectively mitigated through the application of appropriate good international practice construction practices and compliance with international guidelines. The mitigation measures are presented in detail in the EMP.

1. Impacts on Water

110. Subproject construction activities such as excavation and filling activities may lead to surface erosion and sedimentation of adjacent water bodies. Run-off from machinery can also contaminate water bodies and soil. These issues are most serious during the wet season and high rainfall events, and for those works that are adjacent to water bodies. Erosion and sedimentation can negatively impact water quality in canals, and so affect fisheries and aquatic habitats:

(i) Suspended sediment decreases the penetration of light into the water. This affects fish feeding and schooling practices, and can lead to reduced survival. It also irritates the gills of fish and can cause death.

(ii) Sediment can destroy the protective mucous covering the eyes and scales of fish, making them more susceptible to infection and disease.

(iii) Sediment particles absorb warmth from the sun and thus increase water temperature. This can stress some species of fish.

(iv) Suspended sediment in high concentrations can dislodge plants, invertebrates, and insects in the stream bed. This affects the food source of fish and can result in smaller and fewer fish. Settling sediments can bury and suffocate fish eggs.

(v) Sediment particles can carry toxic agricultural and industrial compounds. If these are released they can cause abnormalities or death in the fish.

111. These potential impacts are localized to the construction sites and would be short-term during the construction period. As the canals have limited ecological value, and there are no known rare or endangered aquatic fauna or flora or significant commercial fisheries, potential impact are also low in significance.

112. Inappropriate disposal of domestic wastewater (from construction workers or worker camps) or construction wastewater (from drainage of excavation and drilling, washing aggregates, washing construction equipment and vehicles, pouring and curing concrete, and oil-containing wastewater from machinery repairs) may cause soil or surface or groundwater contamination. These impacts will be localized to the construction sites, and short-term during the construction period. They will be effectively mitigated through the EMP.

2. Solid Wastes and Disposal

113. Solid waste generated in the construction phase will include construction and domestic waste. Construction wastes include spoils, excavated material, various building materials such as steel, timbers, rubble, and other types of waste. There may also be small amounts of hazardous wastes typical generated in construction, such as used lubricating oil, batteries etc.

114. **Dredged material:** Work on canals and water bodies inevitably involves large scale

excavation resulting in potentially significant amounts of excavated sediment (or dredged material). For sediment (i.e. under the water most of the time), their excavation may be by dredging. With much higher moisture and nutrient than excavated material in fields (i.e. earth above water most of the time), the handling, reuse and disposal of dredged material are more demanding than spoil in general. Therefore, a special dredging subplan is developed in the EMP (chapter 6). The quantities of the excavation, and their destination are estimated for feasibility purposes in Table IV-1 but will be updated following survey at detailed design phase.

Table IV-1: Estimate of excavated and dredged material and their destination

Subproject	**Dredged material**	**Destination (m^3) of dredged material**		**Excavate channels**	**Destination of excavated material (m^3)**	
	(m^3)	**Reuse**	**disposal**	**(m^3)**	**Reuse**	**disposal**
Kanghot	53,498	32,099	21,399	303,153	181,891	121,261
Sangker	360,000	216,000	144,000	-	-	-
Subtotal in Battambang	413,498	248,099	**165,399**	303,153	181,892	**121,261**
Kbal Hong	331,164	198,699	132,466	1,982,172	1,189,303	792,869
Svay At	1,659,038	995,423	663,615	711,016	426,610	284,406
Subtotal in Pursat	1,990,202	1,194,121	**796,081**	2,693,188	1,615,913	**1,077,275**
Total	2,403,700	1,442,220	961,480	2,996,341	1,797,805	1,198,536

115. **For two sub-projects in Battambang**, Wet materials excavated or dredged from the two sub-projects that will need disposal is total 165,399 m^3. The dry spoil for disposal is 121,261 m^3, (see table IV-1). This will be brought to the approved location by the local authority and land owners and will be compliant with the site selection criteria for spoil disposal described earlier. Currently, there is no government regulation or requirement for determining spoil disposal sites. Subsequently, there is no government approved disposal site for the two sub-projects. The disposal sites will be identified during construction phase by the contractor, who will then seek approval from the land owner (if privately owned), and the local government authority prior to its use. These identified disposal sites must meet the site selection criteria as described in the EMP.

116. **For two subprojects in Pursat,** dredged material (wet) needing disposal is total about 796,081 m^3 and dry spoil needing disposal is about 1,077.275 m^3. Both are 5-8 times more than those in Battambang, posing a bigger challenge in finding and securing suitable sites for proper disposal. Similarly with Battambang, there are currently no existing government approved spoil disposal site in Pursat project area. Dredged material will be brought to the approved location by the local authority and land owners and will be compliant with the site selection criteria for spoil disposal.

117. **Domestic and hazardous wastes:** Domestic wastes include organic and inorganic matter, and an estimated 0.5 kg/day per worker of domestic waste will be generated from workers and worker camps. Inappropriate waste storage and disposal could affect soil, groundwater, and surface water resources, and hence, public health and sanitation.

118. Inappropriate transportation, storage, use and spills of petroleum products and hazardous materials during construction can cause soil, surface and groundwater contamination. Oil is toxic and harmful to plants and animals and oil pollution can have a devastating effect on the water environment. It spreads over the surface in a thin layer that stops oxygen getting to the plants and animals that live in the water. It harms animals and insects, prevents photosynthesis in plants, disrupts the food chain, and takes a long time to recover. Wildfowl are particularly vulnerable,

both through damage to the waterproofing of their plumage and through eating the oil as they preen. Freshwater mammals may also be affected. In the ground and soil, oils coat or kill the organisms which are necessary to maintain environmental balance.

119. Inappropriate disposal of hazardous wastes such as solvents, chemical, electronics, batteries and other wastes from construction sites and worker camps can have both short-term effects on surface and groundwater quality, and long-term effects in terms of mutations in animals, impacts on habitats, and even disease in humans.

3. Impacts on Biodiversity and trees

120. The sub-projects are not located in any protected areas. The sub-project areas have been intensively farmed and irrigated for generations. No natural terrestrial or aquatic habitats exist and natural biodiversity comprises only common birds living among humans in agricultural regions, domesticated animals and feral pests and rodents. The vegetation comprises cultivated crops, agricultural weeds and tree plantations along roads, canal banks and dyke walls. There is not expected to be any significant loss of native flora and fauna as a result of the sub-projects. Minor tree/grass clearance may be necessary during the construction of project infrastructure, however this will be limited and will follow the permitting requirements of the Government of Cambodia.

121. **Tree affected**. According to the demarcation result finding and Inventory of Loss/Social Economic Survey (IOL/SES) carried out in November 2023, results show that some trees will be lost along the river side, canals, and inside local people's land when it is close to boundaries. A number of locations were sampled to estimate possible loss of trees during construction as shown in Table IV-3. This estimate is indicative only until the full design is available and an inventory of loss is prepared.

122. With regard to the loss of economic trees (timber or fruit tree etc.), the government does not require replantation as cut trees inside land owner boundaries belong to the local people. The tree owners will receive cash compensation based on the Basic Resettlement Plan for the project. Presently, an estimate in Kbal Hong IS subprojects is presented in table below. Based on results of the digitalized Google map , most affected fruit trees are mango. Loss of non-economic trees such as roadside or canal side trees (shrubs) to provide shade or other functions will be minor, so there is no requirement for replantation according to government regulations. The exact number of the affected trees in the whole command area of the IWRMP will be better determined during the project implementation stage.

Table IV-3: Estimates of Tree loss in IWRM and their compensation

Subprojects	**Timber tree**	**Fruit trees**	**Other trees (Eucalyptus)**	**Remarks**
Kanghot	48	94	80	Exact numbers will be determined during project implementation**.**
Sangker (Ou Sralau channel)	0	40	0	
Subtotal in Battambang	**48**	**134**	**80**	
Kbal Hong	212	197	0	
Svay At	35	60	0	
Subtotal in Pursat	**247**	**257**	**0**	
Total	**295**	**391**	**80**	

4. Borrow pits and quarry

123. The fill needed and their major sources are identified and estimated in the FS (see Table IV-2). The first source for fill will be reusing spoil from nearby projects including IWRM. The second type of source are borrow pits for earth. So far, the borrow pit distance is less than 1km. The sources need to be taken from the area nearby the canals, the highland area, or the locations of the farmers/ FWUC where need ponds. For the borrow pit distance (1-5km), the earth fill soil needs to be taken from the high land area or the location, where farmers/FWUC need ponds. In addition, laterite and stones are also needed to meet specification of construction.

124. **For Battambang subprojects:** The borrow pit for the Laterite is expected to be taken from the Thippadei Mountain in the Thippadei Commune, Koas Kralor District. The hauling distance would be approximately 30 Km from the Kanghot IS. The quantity of laterite required for Kanghot and Ou Sralau is estimated to be approximately 268,203 cubic meters.

125. **For Pursat subprojects:** The required laterite is expected to be sourced from the Baktra Mountain in Pro Ngil commune, Phnom Kravanh district. There will be a hauling distance of approximately 35 Km to the Kbal Hong Sub-project. The quantity of laterite required for Kbal Hong and Svay At is estimated to be 301,802m^3.

Table IV-2: Estimate of fill (earth and other material) and their sources

Subproject	Earth Fill						Laterite		Stone etc.	
	M3	Reused Excavation	1) Borrow pit <1km	Potential Source	2) Borrow Pit (1-5km)	Potential Source	M3	Potential Source	m3	Potential Source
Kanghot	2,196,945	249,990	1,318,167	Nearby the canals or the high land area or the location farmers/ FWUC where need ponds and drainage canals.	628,787	The high land area, the location farmers/ FWUC where need ponds.	258,753	Existing Quarry, Thippadei Mountain. Koas Kralor district, Battambang Province. about 30km distance	18,272	Existing Quarry, Phnom Sampov commune, Banan district, Battambang Province. Transported about 50 km.
Sangker	175,500	259,200	-		-		9,450		2,870	
Battambang	**2,372,445**	**509,190**	**1,318,167**		**628,787**		**268,203**		**21,142**	
Kbal Hong	2,150,871	1,451,251	419,772	Near by the canals or the high land area or the location farmers/ FWUC where need ponds and drainage canals	279,848	The high land area, the location farmers/ FWUC where need ponds.	268,522	Existing Quarry Baktra Mountain, Phnom Kravanh district, Pursat Province. about 40km distance	107,405	Existing Quarry Phnom Takream mountain, Banan district, Battambang Province. Transport about 120 km.
Svay At	165,787	1,440,032	-		-		33,280		2,114	
Pursat	**2,316,658**	**2,891,284**	**419,772**		**279,848**		**301,802**		**109,519**	
Total	**4,689,103**	**3,400,474**	**1,737,939**		**908,635**		**570,006**		**130,661**	

5. Air Pollution

126. Earthworks and the operation of the heavy construction equipment like agitators, bulldozers, backhoes, tyre rollers, bucket loaders, diesel generators, truck cranes, and dump trucks to transport spoil and construction materials may generate particulate and gaseous pollutants in the construction area. Further, the winds on site could lead to dust/particulate emissions if the construction materials and spoils are not properly stored and contained. The concentration of dust can reach much higher than the national standard for short duration of time, particularly on the unpaved roadsides. This could impact the health of the people living nearby and workers at the construction sites causing respiratory issues and eye and throat irritation.

127. High levels of particulates/dust could: (i) corrode metals and masonry, soil structures and motor vehicles; (ii) increase costs for cleaning of clothes, windows, floors, repainting, etc.; and, (iii) dust accumulation on crops, trees and shrubs may injure or inhibit the growth of these valuable plants. Heavy equipment and trucks and vehicles may also emit pollutants like CO (carbon monoxide), oxides of nitrogen, oxides of sulfur, and very fine particles like PM2.5. However, in the absence of other sources for these pollutants, the slight increase in concentration of air pollutant levels for a short period of time will likely not have serious impacts on health. The potential impacts of air pollution in this context would be short-term and localized.

6. Noise and Vibration

128. Noise and vibration can be generated during construction due to construction machinery operation and transport activities. Construction activities will involve haulage vehicles, bulldozers, excavators, concrete-mixing plants, rollers, and other heavy machinery. Noise intensity from these large machines is typically in the range of 80–90 decibels at the site (at 5m from operating machinery). The transport of material, aggregate, concrete and waste material to and from sites will also cause noise impacts along the routes.

129. The construction sites are mainly in rural agricultural non-residential areas located at sufficient distance that noise is not expected to significantly impact sensitive receptors such as residences, schools and clinics. Overall, potential noise and vibration impacts will be localized, medium-term in duration and low in significance.

7. Occupational and Community Health and Safety

130. Project construction may cause physical hazards to workers from electrical shocks, welding, noise and vibration, dust and poor air quality, eye hazards, handling heavy materials, heavy equipment, industrial traffic, work on slippery surfaces, falls and falling objects, falling into water, fire hazards.

131. In addition to the above, construction workforce may also be exposed to risks posed by chemical hazards. These could include exposure to concrete additives such as accelerators, retarders, plasticizers, and curing compounds that are commonly used in the construction of water canals and irrigation systems. Workers may come into contact with these chemicals during concrete mixing, pouring, and finishing. Exposure to concrete additives can cause skin irritation, respiratory sensitization, and allergic reactions. Certain additives may contain hazardous substances such as formaldehyde, heavy metals, or volatile organic compounds (VOCs), which can have adverse health effects upon inhalation or skin contact.

132. These health and safety hazards pose a risk that will be present throughout the project construction period. However, these are also typical risks faced on construction projects

throughout Cambodia with standard measures for prevention

133. Project construction has the potential to cause public safety risks from injuries suffered as a consequence of authorized or unauthorized entry into work areas, including:

(i) Injuries suffered as a consequence of falls or contact with heavy equipment.

(ii) Injuries from construction site fires.

(iii) Drowning in canals or reservoirs.

(iv) Respiratory distress from dust, fumes, or noxious odors

(v) Exposure to hazardous materials, especially when the hazardous materials are spilled in water resources utilized by communities.

(vi) Traffic accidents associated with increased number fo construction-related vehicles.

134. There is also the potential for negative social interactions between workers and local community members, and the potential for transmission of sexually-transmitted diseases (STDs) such as HIV/AIDS, and other communicable diseases such as Covid-19. However, camps will be small and transitory, and will be located away from housing areas, so risks are relatively low. The existence of worker camps, may result in the use of common community resources. Further, there are OHS issues in worker camps including availability of drinking water, sanitation, etc. This will include impacts from latrines, waste and health and safety risks of workers' camp.

135. There is a risk related to UXOs where workers are operating vehicles and heavy equipment at construction sites. Therefore, the contractor will coordinate with the Cambodia Mine Action Centre to undertake UXO clearance in the project area of influence prior to civil works, as deemed necessary. UXO clearance will include surveys and explosive detection, removal, transport and destruction in accordance with the national regulations. During this process warning signs will be erected to warn households and communities. The UXO clearance certificate will be provided to ADB prior to construction.

8. Social Disturbance and Potential Impacts to Cultural Resources

136. Given the linear nature of the sub-projects, construction will cut cross many areas and thus has the potential to cause considerable social disturbance to affect local people's daily life and work, religious activities and their accessibility. Other impacts on traffic and roads are: (i) transport of construction materials and goods can result in congestion, temporary delays; and (ii) transportation of heavy equipment and loads may cause damage to roads, including surface damage and subsidence. Canal construction or rehabilitation may also disrupt traffic on local roads, and affect people's connectivity and access to business, schools, clinics, religious activities, etc. These impacts can be effectively mitigated through standard measures in the EMP.

137. There are no known physical cultural resources (PCRs) at or near the project sites. However, construction activities have the potential to disturb underground PCRs. A construction phase chance find procedure is included in the EMP.

E. Assessment of Operation Phase Impacts

138. While Negative impacts of this kind of projects have been primarily associated with the construction phase, there are operation phase longterm impacts most of which largely derived from the design.

1. Fisheries, Aquatic Health

139. Excessive water re-allocation or withdrawal has the potential to reduce water sources beyond seasonal norms, potentially impacting fisheries and ecological services. As a result, richness, abundance and density of aquatic plants, amphibians, invertebrates and fish may be negatively affected, including farmed fish. Excessive low flows can also impact water availability for downstream users such as farmers. The sub-projects have been selected and will be designed to ensure a minimum environmental flow in source rivers and streams in order to sustain basic ecosystem functions and prevent the shrinkage or discontinuity of project rivers.

140. A recent ADB study[17] outlined suggested minimum flowrates in the Tonle Sap basin rivers. The study proposed environmental flow be set at 30% of the mean annual flow during the wet season and 0.2 m^3/second per 100 km^2. The dry season minima cannot currently be met as the natural flow of the Pursat River is very low and demand for water is high, not only for irrigation but also domestic supplies and operation of fish passes. However minimum flows will be easier to maintain once Pursat 1 reservoir, and other future storages, are in place and increasing the dry season flow. MOWRAM does not currently have a formalized system for defining environmental flows so the project will support the River Basin Management Committees (RBMC) to derive environmental flow requirements which can be maintained by MOWRAM to an updated operation policy balancing the different water demands and supply available.

141. For the Kbal Hong sub-project the major regulators and weirs which block water flow in the river or canals are Damnak Cheukrom, Damnak Ampil, Kbal Hong, and Charek. Charek is only 12 kilometers from Kbal Hong, while Damnak Ampil, Kbal Hong and Charek have effectively the same catchment and thus natural flow. If e-flows are met downstream of Charek (after diversion), they are naturally also met at Kbal Hong and Damnak Ampil, which makes it necessary to have e-flows checked at Charek, in sequence from upstream to downstream, to Tonle Sap lake.

2. Solid Wastes and wastewater

142. Solid wastes generated in the project will mainly be domestic waste from the pumping stations or intercepted and collected at sluice gates or other irrigation structures. Toxic, hazardous, and harmful materials present in the operation of the project could include mineral oil in transformers and other electrical components, petroleum products, and spent solar panels. The amount is expected to be quite minor, however. Toxic chemicals and hazardous wastes can have negative impacts on human health and the environment if not appropriately managed. To mitigate these potential impacts, good practice hazardous and solid waste management practices will be implemented.

3. Occupational and Community Health and Safety

143. Project facility workers may face occupational health and safety risks, including electrical shock, noise, falls and drowning. Local people, especially farmers and children, also face risks

17 https://www.adb.org/sites/default/files/publication/689106/adb-brief-171-surface-water-resouces-rbgs-cambodia.pdf

with respect to falling into canals and reservoirs, especially during heavy rains or floods, or from inappropriately accessing PSs or pump intakes. These risks will be addressed through facility operation phase occupational health and safety and emergency response subplans in compliance with relevant workplace regulations.

4. Induced Impacts

144. Expansion of irrigated agricultural areas has the potential to result in induced environmental impacts, including: Increased use of agrochemicals and fertilizers and resultant water and soil pollution; soil degradation from waterlogging and associated salinization; erosion, and pesticide contamination. Additionally, potential CHS impacts include exposure to water-borne or water-related vector-borne diseases for community areas nearby canals which are poorly maintained.

145. In rural Cambodia, communities residing near poorly maintained canals face significant risks of exposure to water-borne and water-related vector-borne diseases. These canals, if not properly managed, can become breeding grounds for disease vectors such as mosquitoes and serve as sources of contamination for waterborne pathogens. Poorly maintained canals can become contaminated with pathogens such as bacteria, viruses, and parasites, leading to waterborne diseases such as:

(i) Cholera: Caused by the bacterium Vibrio cholerae, cholera can spread rapidly through contaminated water sources, leading to severe diarrhea and dehydration.

(ii) Dysentery: Bacterial or parasitic infections causing dysentery can result in bloody diarrhea, abdominal pain, and fever.

(iii) Typhoid Fever: Caused by the bacterium Salmonella typhi, typhoid fever can spread through contaminated water and food, leading to high fever, headache, and gastrointestinal symptoms.

(iv) Hepatitis: Viral hepatitis infections (such as hepatitis A and E) can occur through the ingestion of contaminated water, leading to liver inflammation and symptoms such as jaundice and fatigue.

146. Stagnant water in poorly maintained canals provides ideal breeding sites for mosquitoes, which can transmit various vector-borne diseases, including:

(i) Malaria: Transmitted by Anopheles mosquitoes, malaria can cause fever, chills, and flu-like symptoms and can be life-threatening if not treated promptly.

(ii) Dengue Fever: Transmitted by Aedes mosquitoes, dengue fever can cause severe flu-like symptoms, including high fever, severe headache, joint and muscle pain, and in severe cases, haemorrhagic fever or shock syndrome.

(iii) Chikungunya: Similar to dengue, chikungunya is transmitted by Aedes mosquitoes and causes fever, joint pain, rash, and other flu-like symptoms.

V. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Purposes

147. Meaningful consultation provides opportunities for the borrower to learn from the knowledge, experience and concerns of the affected communities. The objectives of meaningful public consultation are to: (i) fully disclose information on the proposed project, its components, and its activities with the beneficiary communities and stakeholders, (ii) obtain information about the opinions, needs and priorities of beneficiary communities and stakeholders; input and feedbacks e.g. on the quality and affordability of services, (iii) obtain the cooperation of beneficiary communities and stakeholders for activities required to be undertaken as part of project planning and operation, (v) establish clear monitoring and effective grievance redress mechanism; and (vi) ensure transparency in all project activities.

148. Meaningful consultation goes well beyond information disclosure. It involves two-way communication between the borrower and the affected communities and stakeholders, and active participation of affected communities and stakeholders at various stages in the project design and implementation.

149. Sufficient Disclosure of relevant information about a proposed project and its potential impacts is the prerequisite for meaningful consultation as it helps stakeholders to understand the impacts, risks and opportunities of the project. Relevant information, including those documented in environmental assessment reports, should be provided in a place, language and form that are accessible and understandable to affected people and other stakeholders. This process should commence early in the project cycle and continues throughout the life of the project.

B. Methodology and requirements

150. Based on both domestic and ADB policy requirements and under the guidance of the ADB team, the process and methods for the upcoming information disclosure and public consultation are specified below.

151. **Step 1**: Draft public announcements about the project and IEE related disclosure and consultation, which will include the following:

(i) Objective of the disclosure and consultation.
(ii) Production of a brief summary of the IEE/EMP, appropriate for public consumption.
(iii) The time, date and location of SP public consultation meetings.
(iv) Web links to soft copies of Cambodian language draft IEE/EMP.
(v) Addresses of relevant public offices for the public viewing of IEE hardcopies.
(vi) Deadline for public feedback (will be after the date of the last consultation meeting).
(vii) Contact information for sending feedback (names of contact persons, email, telephone number, postal address).

152. **Step 2**: Publicize announcements for IEE disclosure at least two weeks prior to any consultation meetings on the posted IEE/EMP:

(i) Announcements published in local newspapers (and possibly also radio/tv, to be determined).

(ii) Announcements posted on local government websites, in both Khmer and English.

(iii) Announcements will also be published on social media, such as Facebook pages

of local government offices.

(iv) Hard copy disclosure of the draft IEE/EMP at relevant local government offices.

153. **Step 3**. Consultation, usually a combination of typical methods below:

(i) Obtain feedback, with the deadline being the last consultation meeting.

(ii) Questionnaire or online surveys: anonymous, efficient, broader, less interactive.

(iii) The time, date and location of SP public consultation meetings.

(iv) Meetings or interviews etc: costlier, limited participants, afraid to speak out at meetings, but more interactive.

(v) Representativeness of project affected peoples and stakeholders: by age, gender, ethnicity, profession, education level, etc.

C. Initial Public Consultation and Information Disclosure

154. Project-related environmental assessment information was disclosed by the Provincial Department of Water Resources and Meteorology in Pursat and Battambang, prior to the start of public consultation meetings. The IWRM technical assistance team prepared a two-page information brochure in Khmer language (attached as Annex 6) outlining the project and the environmental assessment process was distributed to all target communes. The brochure was also distributed during the public consultation meetings at the early stage of the project preparation.

155. In developing the project, public consultation meetings were carried out by the technical assistance team from 31 August to 01 September 2023 for the Kanghot subproject in Battambang Province, and from 21-23 November 2023, for the Kbal Hong subproject in Pursat province. The list of communes and districts consulted is presented in Table V-1 below. Participants were local people, village chiefs and commune authorities, and local non-government organizations (NGO) representatives. Members of the IWRM technical assistance team Mr. Cheam Sar (Project Deputy Team Leader) and Mr. Socheat Penh (national Environmental Consultant) were in attendance to facilitate the discussions. The IWRM TA team requested the local authorities, specifically the commune committee and village chiefs, to engage local NGOs with an interest in agriculture to join the consultations. A detailed list of participants from these series of consultation meetings can be found in Annex 3.

156. During the consultation meetings, the proposed project was discussed, focused on: the project overview and its objectives; project location; project technical design; Cambodian and ADB Safeguards Policy (SPS, 2009); environmental impacts and project impact categorization; proposed mitigation measures; and, the Grievance Redress Mechanism (GRM). The Deputy Team Leader provided an overview of the project objectives and the planned sub-projects, while the national Environment Expert discussed the environmental issues likely to be caused by the project. The participants were asked a set of questions, centered on concerns of the community, and how the project may affect them. The TRTA team facilitated the discussions and provided answers to the questions and concerns raised. Ultimately, the communities were satisfied with the answers provided during the discussions and expressed their full support for the project. The list of communes from the two provinces of Battambang and Pursat which were included in the public consultations are summarized in Table V-1 below.

Table V-1: Public Consultation Meetings for Sub-Projects in Target Provinces

Subproject	District	Commune	No. of Participants	Male	Female
Subproject in Battambang province	Sangkae district	Vaot Ta Meum commune Kampong Preang commune	27	21	6
	Banan district	Bay Damram commune Kanteu Moy commune Kanteu Pir commune	24	20	4
	Moung Russei district	Kokoh commune Prey Touch commune Moung commune	16	14	2
	Koas Kralor district	Thippakdei commune	15	13	2
Subproject in Pursat province	Bakan district	Snam Preah commune Trepeang Chong commune Boeung Batkandorl commune	52	44	8
	Pursat Town	Prey Nhy commune Banteay Dey commune Preah Prey commune	27	21	6
	Kandieng district	Koh Chum commune Svay Luong commune	12	11	1
	Kandieng district	Anlong Vil commune Veal commune	35	22	13

157. The purpose of conducting public consultation meetings with local farmers and local authorities was to bring awareness to the community about the project, outline the anticipated environmental risks/impacts with mitigation measures, and to collect feedback and suggestions from local farmers and local authorities. In addition to the consultation meetings, brief interviews with local people living along the main canals were conducted during the team visits to the sites. These interviews provided a venue for the local people to freely express their views regarding the project.

158. The interviews were uniformly positive, with interviewees expressing happiness that their areas have been selected as project sites. These sentiments during the one-on-one interviews further validated the results from the larger consultation meetings.

159. Key points and issues gathered from the consultation meetings are summarized in Table V-2 for Battambang and in Table V-3 for Pursat. Current challenges faced by the farming communities were shared including low crop yields due to flood and drought, and rising fees for farming production input such as fuel and fertilizer. These issues, however, did not deter the enthusiasm of the communities to have new interventions that will address the current challenges faced. These only strengthened the support of the communities for the project as expressed during the consultation meetings.

Table V-2: Key Results from Consultations (Aug-Sep 2023)

Question/Suggestion	Response	Mitigation measures in EMP
Participants: Request project to	Consultant: Sure, the contractor requires to implement	Addressed in the EMP

manage workers during construction.	the Construction Environmental Management Plan (C-EMP) and Health and Safety Plan (HSP) properly to ensure good practice for traffic management and community health and safety.	
Participants: what the project can do if contractor damage our road	Consultant: The project already included this risk in the environmental management plan, so the contractor requires to reinstate the road to the pre-project condition if contractor damage the road.	Addressed in the EMP
During construction Can the water still be irrigated	During project implementation or construction, water can still be used to irrigate crops normally.	Addressed in the EMP
Consultant: Is there any protected area or community forestry or community fishery in this area?	Participants: There is no protected area or community forestry or community fishery in the area	Addressed in the EMP
Consultant: Is there any wild animal living in this area	Participants: There is no wild animal living in command area	Addressed in the EMP
Consultant: How is situation of UXO?	Participants: Recently, no UXO has been found.	Addressed in the EMP
Consultant: What are crops in the command area?	Participants: Command areas are used for rice field long time ago	Addressed in the EMP
Consultant: How many times per year for cropping? How is crop practice so far?	Participants: Mostly, we can do only one time crop per year due to lake of water and sometime less yield due to flood and drought and even worse the fuel fee, chemical fertilizer fee are getting high, while price of rice are not stable.	Addressed in the EMP
Consultant: Do you have any request to the project?	Participants: We request to have water availability all the time in the canal for irrigation and more branch canals.	Shared with the design team.
Consultant: Do you support the project?	Participants: We, local people and local authorities, are glad to know that the project will help to irrigate water for cropping, managing flood and there will be mitigation measures to manage anticipated environmental impacts during construction and operation. We will cooperate and support the project.	Noted
Consultant: Is there any further request?	Participants: We request to have project to be implemented on the ground as soon as possible	Noted

Table V-3: Key Results from Consultations in November 2023

Question/Suggestion	Response	Mitigation measures in EMP
Participants: What is the size of the sub-canal that the project plans to build?	Consultant: The size of the drainage sub-canal ranges from 17 to 20 meters the diameter of this canal may change when there are many impacts, and the project may reduce the diameter of some canals.	Addressed in the EMP
Participants: Will this irrigation project provide water for a whole year cropping, especially during dry season?	Consultant: Yes, it is one of the main purposes of the project to construct and improve the irrigation system to be functioning to ensure water availability for a whole year cropping, then local people can do cropping more than one time per year.	Addressed in the EMP
Participants: Will the project help to control the flood?	Consultant: Yes, it is one of the main purposes of the project to control or reduce flood risk on local people's crops	Addressed in the EMP
Do you have any request or suggestion to the project?	Suggestions for the project to expedite the study and start construction as soon as possible because it is flooding every year.	Noted
Do you support the project?	We, local people and local authorities, are glad to know that the project will help to irrigate water for cropping, managing flood and there will be mitigation measures to manage anticipated environmental impacts during construction and operation. We will cooperate and support the project.	Noted

Is there any further request?	Request for the project to pay with appropriate compensation because the people are all poor and have lived along rivers or canals.	Noted

D. Further consultation and results

160. Project consultations with other ministries including MAFF, MOE, MME and Tonle Sap Authority were conducted such as at the Kick-off and Wrap-up of the ADB-AIIB Fact Finding Mission in March 2024. Regional governors were also in attendance during the kick-off and wrap up meetings. The draft IEE report was translated into Khmer language in June-July 2024 and was posted on the MOWRAM website on July 25, 2024. The Screenshot of the posting is shown in Figure V-1 below. At the time of writing no comments nor questions had been received from the public since the posting date, nor request for revisions from the MoE which indicates their endorsement basically. Printed versions of the Khmer IEE report were also submitted by the MOWRAM PMU to the Ministry of Environment (MOE) in July. Following completion of the MOE review and site observation, the PMU will commission a company approved by MOE to carry out either an IESIA or full ESIA to the National Standard according to the MOE Instruction.

Figure V-1: Posting of Final Draft IEE Report (Khmer version) on MOWRAM Website

VI. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

162. The project Environmental Management Plan (EMP) is a set of actions and arrangements to mitigate the adverse impacts identified and assessed during the IEE process. It has been developed in line with applicable domestic and ADB guidelines and standards and has drawn on experience in the EMPs of similar projects, WB/IFC's EHS guidelines, and related international good practice. It includes the following components, which are crucial to effective environmental management within the project: (i) organizational responsibilities and arrangement; (ii) mitigation measures for impacts during design, construction and operation phases; (iii) an EMP training plan; and (iv) monitoring scheme and reporting requirements.

A. Implementation Arrangement and Responsibilities

163. The PMU/PIUs (to be established at MOWRAM and its provincial departments) as the owner will have overall responsibility for the project including environmental compliance with both domestic and ADB requirements. To this end, they will undertake regular inspections of the EMP implementation, assisted by its environmental staff and consultants. They will need to supervise onsite as DIRECT means to ensure the EMP implementation and environmental compliance, implement corrective actions, and follow-up the implementation of corrective actions.

164. According to FIDIC, international good practice on construction biding, contracting and managing, the Employer (i.e., PMU/PIUs as the project owners) will provide site reports as part of the bidding documents (BD) to potential bidders and encourage or even require bidders to visit sites so that they can prepare site-specific Construction management plan or called Methods to respond to the BD's specifications. In some cases, site visit is allowed only after a contractor wins the bid and signs the contract with the Employer. Therefore, contractors in such cases can only develop site-specific construction management plan after the contract award. Despite various scenarios, their construction management plan all needs to be submitted to the PMU/PIUs and their Engineer for approval. Once the Engineer on behalf of the Employer review and clear such construction plan, they will issue the Order to Commence the construction.

165. Such Construction Management Plan normally encompasses EHS aspects as mandated in many countries and FIDIC standard BDs. In ADB projects, all BDs now include EHS requirements directly and indirectly in the engineering specifications. This is because abundant information and evidence point to the need for engineering solution to EHS issues first and foremost. The EMP is only small part of the construction management plan and can't replace the latter. While preparing the construction management plan, the bidders/contractors need to include site specifics to the EMP and submit together to the PMU/PIUs for approval.

166. Most of the EMP measures for construction are at the same time also good construction practice especially those related to environment and safety, thus inseparable from construction measures. For this reason, FIDIC guidelines and many DMCs also require that the duties of supervision engineers (SE) especially resident SEs include not only supervising civil work quality and timeliness but also EHS aspects which can affect the former two. Therefore:

167. **During** construction, supervision, monitoring and reporting of EMP implementation should have the following layers, in order to be efficient and cost-effective:

(i) **First layer:** Routinely checking on-site by supervision (resident) Engineer who are supposed to be on site **daily** and submit to PMU/IA at least a monthly report anyway about civil work progress and quality -need include performance on the EMP implementation in their reports;

(ii) **Second layer:** The PMU/IAs assisted by environmental staff and consultants will carry out on-site supervision and inspection on random or regular basis, and record the findings and remedies or correction plan etc in writing;

(iii) **Quantitative monitoring**: can be undertaken by external monitoring entity engaged by the PMO. The contract with monitor needs to request them to submit the testing results with explanation if the result comply with applicable standards or not, and analysis of the reasons for non-compliance;

(iv) **Reporting:** Based on work of a-c, the PMO can easily compile semi-annual report to the gov and ADB on environ performance and the EMP implementation.

168. **During** operation**,** supervision and reporting will be undertaken mainly by the PMO:

(i) The PMU/PIUs (supported by their environmental staff or consultants) need to carry out on-site supervision and inspection on random or regular basis, and record the findings and corrections etc in writing;

(ii) **Quantitative monitoring**: be undertaken by external monitoring entity engaged by the PMO. The contract with monitors needs to request them to submit the testing results with explanation if the result comply with applicable standards or not, and analysis of the reasons for non-compliance;

(iii) **Reporting**: Based on work of a-b, the PMU/IA can easily compile semi-annual report to the ADB on environ performance and the EMP implementation.

169. To achieve this end, more direct and effective means is field supervision, inspection and training. Their findings and recommendations and trainings etc., should be documented in a semi-annual report of the NPMO as a management tool and submitted to the goverment and ADB. The main content and indicative outline of the environmental report is in Box 1.

Box 1: Outline of the Environmental Report

Introduction: concise project description but indicates changes; and project progress in this reporting period, use tables to show clearly.

Mitigation measures: their implementation status (fully followed or not; if not, which parts are not and why; actual performance and findings; any issues and gaps; reasons for them; corrective actions proposed and/or remedy already taken). Note: no need to repeat the EMP measures.

Quantitative monitoring: summary of results and conclusion, explain if comply with standards or not, and analyze the reasons of non-compliance. (Note: full data and original reports submitted in annex);

Training: carried out during this period, how, to whom, results and effects; If no training carried out during the period, say so in Intro or Conclusion without this chapter;

Any complaints through GRM: what, when and where, how they are resolved etc. If no grievances during the period, say so in Intro or Conclusion without this chapter;

Requirements for the changes in the project: explain domestic EIA requirements, progress made, and how to also meet ADB requirements.

Conclusion on this reporting period and recommendations/work plan for the next.

Table VI-1: Environmental Management Responsibilities

Phase	Parties	General Responsibilities	Environmental Responsibilities
Design and Pre-construciton	EA: MoWRAM PMU	Provides overall project design and preparation support	Ensures environmental safeguard requirements of Cambodia and ADB are adhered to
	IAs: PIU at Battambang and Pursat	Coordinates design for each subproject	Coordinates preparation of environmental assessments
Construction phase	EA: MoWRAM PMU	Overall project management support	Has overall responsibility for environmental management to meet requirements of Cambodia and ADB
	IAs PIU at Battambang and Pursat	Coordinates construction of subprojects within its province	Has direct responsibility to supervise environmental management of subproject construction within its province and adherence to EMP requirements
	Supervising Engineer(s) (SEs) of IAs	Supervises and oversees construction at each site on a daily basis as per Supervision Engineers' contractual obligations	1.Ensures and supervise contractors and their workers to follow the EMP measures at each construction site, as most EMP measures are inseparable from good construction practice. 2. Submits monthly reports to the IAs including EMP implementation performance. 3. Immediately reports to the IAs and EA any spills, accidents, fires and grievances received, and takes appropriate action
	Contractor(s)	Implements all aspects of construction.	Implements all aspects of EMP construction mitigation measures
	Project Implementation Consultant - Environment (PIC-E)	Provide support to the EAs and IAs in project management. Responsible for supervising and guiding construction contractors	1.Support the EA and IAs to supervise on-site EMP implementation on top of daily supervision by Supervising Engineer(s). 2. Provides construction and operation phase EMP training. 3. Assists in quantitative monitoring of EMP. 4. Assists in semi-annual monitoring reports. 5. Other tasks according to their ToR
Operation phase	PMU at MOWRAM	Provides overall project operation support.	Has direct responsibility for environmental management of subproject operation within its province to meet Cambodia and EMP requirements on EHS
	PDAWRAM	Responsible for day-to-day O&M of SPs in its province	Undertaking inspections and monitoring at their discretion

B. Mitigation Measures

163. Based on the impact assessment and risk analysis, past experience of similar projects, applicable national requirements and international good practice as reflected in the IFC's EHS guidelines, measures to mitigate adverse impacts and risks during preparation, construction and operation phase are presented in the following tables:

Table VI-2: Pre-construction Phase Mitigation Measures

Sub-Project Activity	Environmental Risk or Impact	Mitigation Measures	Implement by	Supervised by
National Environmental Approval Disclosure and consultation	All	1. The ESIA/IESIA/EMP need to be prepared based on MoE's Prakas No. 21 or consultation with MoE and obtain approval before Construction. 2. Inform and consult with local communities about the final design, mitigation measures and the Grievance Redress Mechanism	PMU-PMC Local Firm	MoE
Bidding, and contracting	All	1. Include the relevant parts of the EMP in bidding documents to ensure bidders know their environmental obligation and related cost when bidding; 2. Include the relevant parts of the EMP in contracts to ensure that EMP measures are an obligation for contractors and supervision engineers. 3. After signing the contract, a Construction Environmental Management Plan (CEMP) will be prepared by contractors, including an Emergency Response Plan. The CEMP shall be approved prior to starting the civil work.	PMU/ PIU/PMC	EA
Identify and select sites for disposal and borrow pits	Risk/impacts on flora and fauna Soil and land resources	**Selection criteria for disposal sites and borrow pits:** 1. Where possible existing borrow pits or spoil disposal sites shall be used. 2. If new sites are needed, the contractor shall obtain approval from the relevant authorities and from PMU/PMC to ensure that sensitive habitats are avoided: 3. Not in ecological sensitive area, Protected Area or Key Biodiversity Area 4. Not in wetlands or riparian zones, i.e. at least 500 meters from river, lake 5. Ensure that the site shall be above the flood level. 6. Not on slope-land of more than 10%, to avoid erosion or landslide 7. Not in land with agricultural, spiritual, cultural, historical etc value; 8. Not where groundwater emerges, or a thick organic layer is present 9. Obtain and document agreement with the landowner;	Contractor	PMU/PMC
Unexploded Ordnance (UXO) survey, & removal	Risk of injuries or fatalities among workers or members of the public	1. Consult national military to confirm all relevant areas are clear from UXO. 2. Cambodian Mine Action Centre to clear areas where necessary and provide evidence of clearance to PMU in advance of construction. 3. As evidence, submit a certificate of UXO clearance and attach it as an annex to the subsequent monitoring report once the certificate of clearance has been awarded.	Cambodian Mine Action Centre PIU	PMU/PMC
GRM	Any risk or impact as perceived by	1. PMU to provide contractor with GRM contact details which the contractor will use to print 'GRM Contact Cards' for its staff to hand to complainants and will keep cards with all vehicles, machinery and site managers/foremen.	Contractor and PIUs	PMU/ PIU/ PMC

Sub-Project Activity	Environmental Risk or Impact	Mitigation Measures	Implement by	Supervised by
	affected persons	2. Contractor to raise awareness of all workers on how to respond when affected person or member of the public has a complaint i.e. direct the person to the most senior site manager present at the time and provide a 'GRM Contact Card'. 3. Erect sign boards with project details and GRM procedures/contact details at the entrance to each construction site/camp or at strategic locations.		

Table VI-3: Construction Phase Mitigation Measures

(Contractors are responsible for implementing measures, supervised by supervision engineers, PMU/PIUs and their consultants)

Project Activity	Environmental Risk or Impact	Construction Phase Mitigation Measures
Civil works	Air quality	1. Select Borrow sites located as close as possible to the construction to reduce distances. 2. If Concrete batching facilities are in need, it will be located at least 500 m (0.5 km) downwind from the nearest dwellings in order to reduce the impact of dust and fumes on humans and to be fitted with necessary equipment such as bag house filters to reduce fugitive dust emissions. 3. Water will be regularly sprayed to suppress fugitive dust at construction sites, material handling areas, access road and borrow pits. 4. Trucks carrying dry construction materials such as earth or waste will be covered with tarpaulins or other suitable cover. 5. Construction vehicles and machinery will be maintained to a high standard to minimize emissions and ensure compliance with the National exhaust emission standards. All mobile equipment should be fitted with catalytic converters. 6. A speed limit of 30 km/h for construction related traffic through inhabited areas and on the access road will be enforced. 7. All open burning of construction and demolition waste material and refuse will be prohibited.
Civil Works	Noise	1. Maintain all exhaust systems in good working order and undertake regular equipment maintenance to ensure compliance with applicable regulations and manufacturers' instructions. 2. Implementation of operating and maintenance practices of equipment and machinery to ensure that they are well-maintained. 3. Ensure that noise control options such as silencers and mufflers are fitted to exhausts, compressors and fans for construction equipment (such as hydraulic excavator, bulldozer, front loader, backhoe and trucks). 4. Provide advance warning to the community on timing of noisy activities. Seek suggestions from community members to reduce noise annoyance and notify the communities about how to raise their concerns (if any) through the Grievance Redress Mechanism.

Project Activity	Environmental Risk or Impact	Construction Phase Mitigation Measures
		5. Undertake noise monitoring at the closest residential area and other noise sensitive receptor during times with ongoing construction work to ensure compliance with the relevant noise standards. 6. The contractor shall provide all construction personnel working in the vicinity of noisy construction activities (defined as those activities generating noise levels greater than 80 dB(A)), or any construction personnel who requests hearing protection, with hearing protection equipment. 7. A speed limit of 30 km/h for construction related traffic through inhabited areas.
Civil Works	Loss of economic value trees	1. In accordance with the permit to cut or remove trees (to be obtained prior to start construction), all trees over 3 m in construction sites shall be preserved, if they are not required and permitted to be removed. The cutting and removal of trees shall be informed to DWRAM and the local authorities. 2. An inventory shall be held of trees to be cut to update Table 4-3 after detailed design, and addition replantation shall be sought upon completion of the work. 3. Hunting any wild animal, birds and fish are prohibited
Civil Works	Surface Water and Groundwater	1. Installation of temporary non-erodible ditches or bunds at the construction site to divert clean runoff away from exposed areas, and convey potentially dirty runoff to sediment control devises. 2. Stockpiles and materials will be stored at least 50 m from surface waters with drainage directed away from the canals and streams or water sources. 3. The sediment quality of the dredge spoil will need to be tested and assessed against an appropriate standard before re-use in the structure of embankments. The sediment testing results will confirm safe re-use of the material 4. No washing or repair of machinery within 50 m of surface waters. 5. Construction working areas will be clearly demarcated and encroachment onto adjacent areas avoided. 6. Portable toilets and small wastewater treatment units will be provided at the construction site and labour camps. All sanitary facilities will be located at least 50 m from surface water bodies. All workers must be instructed to use these facilities, which shall be kept clean at all times. 7. Pit latrines and septic tanks should be placed at least 2 m above the groundwater table must be located at least 50 m from surface water bodies and water wells and in areas of suitable soil profiles. 8. All hazardous materials including hazardous waste will be stored on an impervious surface, under cover, in adequate tanks or containers and within secondary containment. A bund will be provided around any above ground fuel storage tank with capacity of 110% of the largest single tank. Storage of hazardous materials shall be at least 50 m from surface water bodies with no direct drainage to surface water. 9. Areas where spills of fuel or oil may occur will be equipped with easily accessible spill control kits to assist in prompt and effective spill control. 10. Refueling of machineries by service vehicles will be conducted with measures preventing oil spillage during refueling including placement of buckets under refueling nozzles.

Project Activity	Environmental Risk or Impact	Construction Phase Mitigation Measures
		11. Runoff accumulating at the bottom of excavation pits during construction will be pumped out, reused where practicable or otherwise conveyed to appropriate sediment retention devises before being discharged to the environment. 12. Hazardous waste (oil waste) shall be properly collected and stored in closed containers under shelter for recycling or disposal by a duly authorizes enterprise.
Spoil handling and disposal	Flora and Fauna Soil and land resources	1. Disposal of unsuitable spoil (too sandy for compaction). This spoil will be made available to nearby communities for use as building pads and bunds. 2. Set out the site boundaries and ensure that the surrounding land is not disturbed; 3. Ensure that spoil is disposed of only at the designated disposal sites and that no material is side tipped along roads or down slopes, dumped on private or public land, or dumped in water bodies; 4. The contractor shall install erosion and sediment controls such as sedimentation ponds, non-erodible channels or bunds at each site and progressively adjust the measures as the landform changes, to minimize on-site erosion and prevent off-site sedimentation; 5. Undertake inspections within 24 hours of a heavy rainfall event; 6. Use appropriate native and non-invasive plant species for re-vegetation and rehabilitation work. 7. To mitigate impacts on water and soil quality and hygiene risks, implement Excavation Management and Disposal Plan
Solid and Liquid Waste Management	Resource use and natural resource contamination	1. Recyclables will be separated at source and given/sold to recycler (plastic, metal, card, paper as a minimum). 2. Safe temporary storage of hazardous waste as required 3. To the extent possible, a duly authorized waste company will be contracted to recycle hazardous waste. 4. Non-hazardous, non-recyclable solid waste will be temporarily deposited and managed together at existing landfill/dumpsite. 5. There will be no burning of waste at the site. 6. All vehicles/drivers will be provided with plastic bags for waste collection and prevent any unauthorized waste disposal with particular attention paid to prevention of littering. 7. The Contractor will be required to train the workers in proper waste management.
Hazardous and polluting materials	Pollution to soil, surface water, groundwater, fauna and flora	1. Storage facilities for fuels, oil, cement, and chemicals shall be within secured areas on impermeable surfaces, provided with bunds and cleanup installations; 2. Vehicles and equipment shall be properly staged in designated areas to prevent contamination of soil and surface water; 3. Vehicles, machinery, and equipment maintenance and re-fueling will be carried out in such a way that spilled materials do not seep into the soil; 4. Oil traps will be provided for service areas and parking areas; and

Project Activity	Environmental Risk or Impact	Construction Phase Mitigation Measures
		5. Fuel storage and refilling areas will be located at least 50m from canals and channels and will be protected by temporary drainage bunds to contain spills.
Community Health and Safety	Human health and safety	1. Prior to start of construction work, the contractor in cooperation with the PIU will consult with the local authorities and potentially affected residents/private landowner. Inform them about the upcoming construction work, safety precautions and how to raise concerns or file complaints (GRM); 2. The contractor shall fence off the construction area and control access to the site. 3. A speed limit of 30 km/h for construction related traffic through inhabited areas. 4. The contractor shall install traffic signage and fluorescent bollards and warning lights to direct traffic and prevent vehicles driving into the lanes with construction activities. 5. The contractor in cooperation with the local authorities shall implement traffic management to ensure a smooth traffic and prevent congestion.
Occupational Health and Safety and Emergency Response	Human health and safety	1. Prepare a health and safety plan containing site-specific precautions in accordance with relevant occupational health and safety guidelines; 2. Inspect and check the relevant construction equipment to ensure that it meets the applicable mechanical and safety requirements; 3. Inspect the worksite to ensure that the equipment can be safely mobilized and operated, and that there are no unmitigated risks; 4. Install appropriate fencing and control access to the site; 5. Install appropriate safety signage and markings; 6. Provide fall protection when workers are exposed to unguarded platforms or walkways higher than 2 m; 7. Ensure there are safe ways to enter and exit the excavation; 8. Keep excavations dry; 9. Provide safety precautions when using high voltage electric power tools; 10. Carry out daily toolbox meetings (safety briefings); 11. Maintain an accident record book where all major or minor accidents and incidents are recorded with actions taken; 12. Educate the workers on construction hazards; 13. Train drivers on safe driving skills and traffic regulations; 14. Appoint an Environment, Health and Safety Officer who is a qualified engineer; 15. Make adequate first aid equipment available on site; 16. Carry out training and awareness of the workers on HIV-AIDS prevention; 17. implement emergency preparedness and response procedures Response Plan as planned in the CEMP. 18. Ensure that all workers are equipped with and use Personal Protective Equipment (PPE). 19. The Contractor will set out an Emergency Response Plan

Project Activity	Environmental Risk or Impact	Construction Phase Mitigation Measures
Labour Camp Management	Contamination of water, soil, waste production and social issues	1. If a camp for construction workers is required, the contractor will set out a camp management plan in the CEMP together with a location map and a site layout map indicating the site facilities and infrastructure. 2. The camp will have adequate and separate accommodation and sanitation facilities for male and female workers, and the facilities will meet good standards of health, hygiene and comfort. 3. There will be adequate supply of clean and safe water, adequate waste and wastewater disposal systems, appropriate protection against heat, cold, noise, damp, fire and disease-carrying or poisonous animals (e.g. insects) 4. Relevant training on camp management will be provided to all staff. 5. At the end of the construction phase, all camp facilities, structures, installations and pavements (above ground and below ground, fixed and moveable) will be dismantled or demolished and removed (reused, sold/recycled, disposed of as waste) from the site. 6. All chemicals, waste and pollution will be removed and safely disposed of. 7. Septic tanks and other sanitary/waste disposal systems will be emptied, and the content disposed of in accordance with local regulations. The installations will be excavated and removed. 8. The site will be recontoured, depressions backfilled. Topsoil will be applied, and the site will be revegetated
Excavation	Unanticipated finding of artifacts Cultural heritage	1. Upon a chance find of an artifact, all work will be stopped immediately, find left untouched, and the PIU will be notified to determine the next step and contact the responsible authority, if necessary. 2. During construction, contractors will ensure that any local cultural sites (including shrines and graves) will be kept clear of construction material and protected from dust and other disturbance. Access to these sites will not be impeded, and after construction is finished any disturbed surroundings will be restored to pre-construction standards

Table VI-4: Subplan on Excavation, Spoil and Disposal

Stepwise Mitigation Measures
Determine dredging process and methods. • Select most suitable method for site conditions and to minimize risks. • Dredgate will be sun-dried at temporary storage areas to reduce transport cost and leakage along the route. • Temporary storage and sun-dry areas will be at least 20 m from water bodies or settlements or other sensitive receptors, with compacted floors and surrounding bund to prevent leakage to water or soil /farmland, and covered as necessary to control dust.
For all dredgate or spoil that can be reused as fill or in farmland**:** • Need to sign written agreement with farmers or disposal site owners to prevent any dispute and grievances in future before commencing the disposal. • Dredgate will be disposed of at a place to be determined during early stages of project implementation. The site will be mechanically compacted, contoured to minimize length and steepness of slopes, and revegetated as soon as possible to avoid erosion. • However, local farmers will have the option of using dredgate as fill if they choose. If this option is selected, farmers will be advised to first digest or compost the materials to kill pathogens and prevent disease spread.
For dredgate and spoil that need to be disposed of: • Will be transported in covered trucks to secure locations approved by the relevant authorities specifically the provincial Governments of Pursat and Battambang. • Pre-treated as required before disposal, and permanently covered by an impervious soil cap. • The disposal site will be mechanically compacted, contoured to minimize length and steepness of slopes, and revegetated. Site drainage will be provided.

Table VI-5: Emergency Response Plan for Construction

– Contact numbers for local emergency response providers (fire, ambulance, police) and provincially accredited medical centers will be prominently displayed at each site, and updated as required (e.g. to account for changing work locations along a pipeline or canal). Communications with local emergency response providers will be tested on a monthly basis. – Contractors will have at least one worker trained in first-aid and one worker trained in fire response will be available at the construction sites at all times when work is undertaken. – In the event of an emergency the siren will be sounded, work will be halted, and if necessary the site will be evacuated. Initial emergency response will be provided by trained contractor staff on site (medical, firefighting), unless unsafe to do so, supported by local emergency response providers as required. Injured workers will be transported to the nearest appropriate medical facility by ambulance. – Fire extinguishers, spills containment equipment, and first aid kits will be provided at each site, maintained and clearly identified. – Records will be maintained for all emergencies, including nature of emergency, extent of injuries or property damage, response, and required follow-up. – Detailed training will be provided to contractors emergency first response staff (medical and fire), and all workers will receive regular briefings on all aspects of the ERP prior to the start of construction and on a regular basis (e.g. monthly). – The contractor shall prepare the detailed emergency response plan to reflect the scope of works and situation on the ground. This plan shall be attached with the CEMP. – Provision of life jackets, rescue rings, especially when work involves proximity to the river.

Table VI-6: Preventive and mitigation measures for operation phase

Potential Environmental Risk or Impact	Operations Phase Mitigation Measures	Implemented by	Supervised by
Fisheries and Aquatic Health	1. Excessive water withdrawal will be addressed through support to River Basin Management Organisations in each catchment where works will be undertaken. The volume of withdrawals will be considered during the preparation of river basin plans and water distribution planning. 2. MOWRAM should develop a formalized system for defining environmental flows. This will be undertaken during Output 1.	River Basin Management Organisations MOWRAM	PMU/PMC PMC
Solid Wastes and Wastewater	1. Good practice hazardous and solid waste management practices implemented. 2. If project facilities, such as pumping stations, employ part-time or full-time workers, they will require access to drinking water. 3. Such facilities will be equipped with treated potable well water, and appropriately sited and designed septic tanks in DED.	PIU	PMU
Occupational and Community Health & Safety	1. An Operation and Maintenance manual will be prepared for each major component of construction works for irrigation under Output 2 and flood under Output 3. This manual will describe the safety measures for workers and adjacent communities under the relevant construction for response on-site. 2. Risks will also be addressed through relevant O&M plans for subprojects under Output 2 and Output 3 in compliance with relevant workplace regulations. These will be developed as part of Output 2 and Output 3, and will contain the following: - Contact numbers for emergency response providers (fire, ambulance, police) and provincially accredited medical centers will be prominently displayed, and updated as required. Communications with local emergency response providers will be tested on a semi-annual basis. - Operator will have at least one worker trained in first-aid and one worker trained in fire response on-site each shift. - In the event of an emergency the siren will be sounded, work will be halted, and if necessary, the site will be evacuated. Initial emergency response will be provided by trained staff on site (medical, firefighting), unless unsafe to do so, supported by local emergency response providers as required - Injured workers will be transported to the nearest appropriate medical facility by ambulance.	PIU PIU PIU	PMU PMU PMU

Potential Environmental Risk or Impact	Operations Phase Mitigation Measures	Implemented by	Supervised by
	- Fire extinguishers, spills containment equipment, and first aid kits will be provided at each site, maintained and clearly identified. - Records will be maintained for all emergencies, including nature of emergency, extent of injuries or property damage, response, and required follow-up - Railings will be installed along canal banks if schools or markets are nearby. For permanent works proper fencing will be installed at markets and schools – to be detailed at detailed design phase. 3. Community-based emergency response plans will be developed as part of Output 1, with particular reference to flooding and natural disasters.		
Induced Impacts	1. Improve canal maintenance and management to prevent stagnant water and reduce mosquito breeding sites. 2. Promote community awareness and education on safe water handling, sanitation practices, and vector control measures. 3. Provide access to clean water sources, sanitation facilities, and healthcare services to reduce reliance on contaminated canal water. 4. Implement vector control strategies such as larviciding, mosquito nets, and insect repellents to reduce mosquito populations and prevent disease transmission. 5. Strengthen surveillance and monitoring systems to detect and respond to disease outbreaks promptly.	PIU	PMU

C. Environmental Monitoring Plan

164. The purpose of quantitative monitoring activities will be used to assess: (i) performance or effectiveness of environmental mitigation measures or compliance with pertinent environmental rules and regulations; (iii) overall effectiveness of EMP implementation; and (v) the need for additional measures corrective actions if non-compliance is observed.

Table VI-7: Environmental Monitoring Plan

Subject	Parameter	Location	Frequency	Implemented by
Construction phase				
Wastewater Discharge	Temperature, pH, TSS, DO, COD, BOD_5, NH_4^+	discharge of selected sites and camp	Daily observations. Sample test as required by local environmental authority or if complaints received	Supervision engineer, also inspected site visit by PMU/PIUs
Air Pollution	Dust, particulate matters (PM_{10}, $PM_{2.5}$)	Construction sites	Daily, by observation. If there is dispute /complaint etc, recruit environmental Monitoring entity/Lab to test	Same as above
Noise	Noise	construction sites	Same as above	Same as above
Operation				
main canal water quality	Temperature, pH, TSS, DO, COD, BOD5, NH4	Kbal Hong Main canal and Kang Hot Main canal	Semi-annually	Provincial Department of Water Resources and Meteorology

D. Environmental Training and Capacity Building

165. **Assessment of environmental capacity:** During the preparation of the IEE, the team checked the capacity and track-record (as it pertains to environmental management) at MoWRAM and found that there are a number of people who have fulfilled the role of 'focal point' for safeguards on other donor funded projects. However, currently there is little experience of implementing environmental mitigation measures and supervision particularly at a provincial level. The engagement of a National Environmental Specialist especially at provincial level throughout implementation will be critical to ensure the capacity of the PIU staff and to ensure monitoring and reporting are managed effectively during implementation. The proposed training is set out in Table VI-8. Specifically, the training requirements for the project include to train the PIU, the contractor, and other relevant stakeholders on the implementation of the EMP.

Table VI-8: Environmental Health and Safety (EHS) training program

Subject / Content	Participants	Trainer / Organisation	When / Frequency	Duration (days / event)	No. of participants
EMP adjustment and implementation: Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting	PMU, PIU, contractors	I/NES of Project Management Consultants	Twice - Once prior to, and once after 6 months of constructio n	2	10

Subject / Content	Participants	Trainer / Organisation	When / Frequency	Duration (days / event)	No. of participants
Grievance Redress Mechanism (GRM) and roles and responsibilities	PMU, PIU, contractors, Commune Councils	I/NES of Project Management Consultants	Twice - Once prior to, and once after 6 months of constructio n	1	10
Development of the CEMP (content, function, roles and responsibilities, safeguard standards)	PMU, PIU, contractors	I/NES of PMC	Twice: Upon contract award and after submission of the first draft	1	5
On-the-job training on the implementation of the CEMP including monitoring and reporting requirements	PMU, PIU, contractors	I/NES of PMC	Twice: at the start of constructio n and 6 months into constructio n	2	5-10
Pollution control on construction sites (air, noise, effluents, solid waste)	PMU, PIU, contractors	I/NES of Project Management Consultants	Once (during project implementa tion)	2	10
Environmental monitoring -Monitoring methods, data collection and processing, reporting systems	PMU, PIU, contractors	I/NES of Project Management Consultants & MoE (environmental analyst)	Once (at beginning of project constructio n)	2	10
CEMP implementation: Health and safety; Pollution control and minimisation of disturbances; and Monitoring and reporting	Contractor's staff	Contractor's Environment, and Health and Safety Officers	To be specified in the CEMP	To be specified in the CEMP	To be specified in the CEMP

E. Grievance Redress Mechanism (GRM)

166. A grievance redress mechanism (GRM) will be established in each subproject province in compliance with ADB's SPS 2009 requirement, to prevent and address community concerns and assist the project to maximize environmental and social benefits.

167. The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, and e-mail, will be available.

Opportunities for confidentiality and privacy for complainants will be honored where this is seen as important.

168. The PMU will establish a Project Public Complaints Unit (PPCU), which will act as a central recording and coordinating unit for all subprojects under the Project. Each subproject PIU will ensure that the GRM is publicized locally so that the community is fully aware of the mechanism and the local points of entry to it. The setting up of the GRM in the PMU and its initial implementation through the PMU will be supported by the environmental consultant of the PMC.

169. When construction starts, a sign will be erected at each construction site providing the public with updated project information and summarizing the grievance redress mechanism process including details of the GRM entry points. The contact persons for different GRM entry points: PMU, FWUC leaders, contractors, and operators of project facilities, will be identified prior to construction. The contact details for the entry points (e.g. phone numbers, addresses, e- mail addresses, etc.) will be publicly disseminated on information boards at construction sites and on the website of the local government.

170. The preferred action sequence for complaints handling is that the complaint should be investigated and resolved by the unit receiving the complaint. If this is not possible, the complaint should be referred to the PMU (whose wider membership will enable coordinated action in response).

171. The PIUs will maintain records of complaints and actions taken to correct them. This data will be included in the PMU's reports to the ADB. The PIUs will establish a GRM tracking and documentation system. The system will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

172. The procedure and timeframe for the grievance redress mechanism are described as follows. The stages are represented by different colors in the flow diagram:

(i) **Stage 1:** Contractor/villager chief at village level (5 working days). Affected People (APs) will present their complaints and grievances verbally or in writing to the contractor or village chief. The receiving agent will be obliged to provide immediate written confirmation of receiving the complaint. If after 5 days the aggrieved AP does not receive a response, the complaint may be brought to the PIU at provincial level.

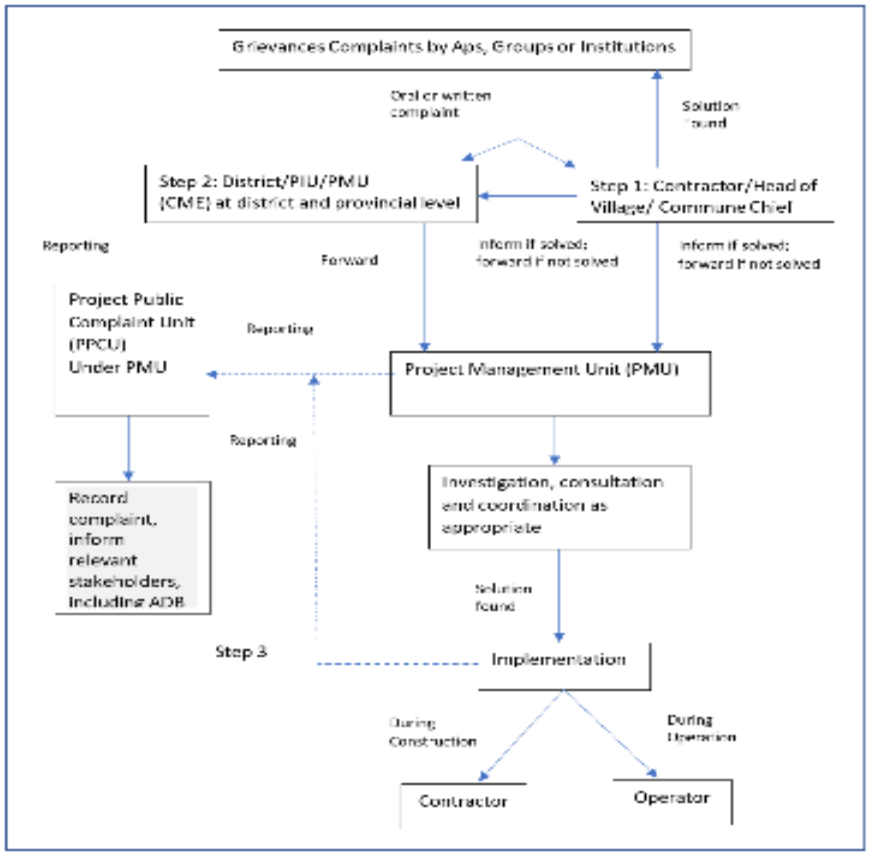
(ii) **Stage 2:** PIU at provincial level (5 working days). This level has 5 working days within which to resolve the complaint to the satisfaction of all concerned. If the complaint is not resolved at this stage, the PI at provincial level will bring the case to the PMU at national level.

(iii) **Stage 3:** PMU at national Level (10 working days). This level has 10 working days within which there must be a meeting with the aggrieved party and in a further attempt to resolve the situation. Within 10 working days of submission of the grievance, the PPCU must make a written decision and submit copies to the MOWRAM/PDOWRAM and the APs. If the complaint still not be solved at this

stage, the complaint may be brought to ADB.

173. During construction, the PPCU will be informed by contractors and construction supervisors, FWUC staff, or PMU if complaints about the project are issued. During operation, the PPCU will be advised of complaints by the PDOWRAM and FWUC. The PPCU will also inform the ADB project team and submit all relevant documents.

Figure VI-1: GRM Procedure



Note: AP = Affected Person; PMU = Project Management Unit; FWUC = Farmer Water User Community