Initial Environmental Examination

May 2013

India: Karnataka Integrated and Sustainable Water Resources Management Investment Program

Prepared by Karnataka Neeravari Nigam Limited for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 1 May 2013)

Currency unit	–	Indian rupee/s (Re/Rs)
Re1.00	=	$0.01864
$1.00	=	Rs53.65

ABBREVIATIONS

AC-IWRM	Advanced Centre - Integrated Water Resource Management
ADB	Asian Development Bank
AEE	Assistant Executive Engineer
BGL	Below ground level
CADA	Command Area Development Authority
CE	Chief Engineer
CPCB	Central Pollution Control Board
DoEF	Department of Environment and Forests, Government of Karnataka
EARF	Environmental Assessment and Review Framework
EE	Executive Engineer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA, 1986	Environmental Protection Act, 1986
GoI	Government of India
GoK	Government of Karnataka
Ha	Hectares
HWHAMA	Hampi World Heritage Area Management Authority
IEE	Initial Environmental Evaluation
IWRM	Integrated Water Resources Management
KISWRMIP	Karnataka Integrated and Sustainable Water Resources Management Investment Program
KSPCB	Karnataka State Pollution Control Board
MAB	Man and Biosphere
MFF	Multitranche Financing Facility
MoEF	Ministry of Environment and Forests, India
MW	Megawatts
NABET	National Accreditation Board of Education and Training
O&M	Operation and Management
PMU	Project Management Unit
RSPM	Respiratable Suspended Particulate Matter
SE	Superintending Engineer
TA	Technical Assistance
QCI	Quality Council of India
UNESCO	United Nations Educational, Scientific and Cultural Organisation

NOTE

(i) In this report, "$" refers to US dollars.

EXECUTIVE SUMMARY

1. The State Government of Karnataka (SGOK) has requested financing from the Asian Development Bank (ADB) to enhance water security in selected basins where there is increasing water stress due to rapid economic growth and future competing needs for water supply and industry. Based upon an agreement between Government of India, SGOK and ADB agreed to prepare the Karnataka Integrated and Sustainable Water Resources Management Investment Program (KISWRMIP). This is to be financed through a Multi-tranche Financing Facility (MFF) to enable flexibility in investment decisions and timing based on the needs and constraints of the project, instead of a precise definition of investments up front as conventionally required.

2. There are three outputs for the project. These are, Output 1: State and basin institutions strengthened for integrated water resources management (IWRM), including river basin planning, strengthening policies for holistic water resources management and decision based support systems (geographic information systems, use of telemetric data for resources planning etc), Output 2: Irrigation system infrastructure and management modernized, Output 3: Program Management Systems Operational. Output 2 of the project involves modernization the irrigation schemes for the canal systems of Tunghabhadra Left Bank Canal, Vijayanagara Channels, Gondi and the Bhadra Canal system. These are all exiting irrigation systems which require upgrading to improve system efficiency in supply of irrigation water. Of these only Gondi and Bhadra are to be implemented under Project-1 of the MFF and are the focus of this Initial Environmental Examination (IEE).

3. Modernization activities (which are the only physical interventions to be undertaken under the program) include: (i) irrigation canal lining (pre-case concrete and in-situ lining);(ii) provision of additional control and regulation structures (like cross regulators and proportional offtakes); (iii) selective on and off-line storages; (iv) village road bridges; command area development works comprising minor and field channel improvements, offtake structures and improved field management of water using high efficiency irrigation systems (like drip irrigation); (v) buried conveyance pipes for improved field distribution of irrigation water and (vi) installation of discharge measuring and other telemetry instruments within the irrigation subproject and throughout the sub-basin.

4. The project is located in the Bhadrawati taluk[1] of Shimoga district of Karnataka state. Part of this district comes under the Western Ghats. From the available information and plans it unlikely that there will be any major adverse environmental impacts from the proposed investment project. Considering the limited impact of the project is categorized as B for environmental safeguards and therefore an IEE prepared. An environmental assessment and review framework has also been prepared for the overall program to guide preparation and safeguard assessment of future projects and investments to be made under Project-2..

5. There are also likely to be a number of positive impacts from project activities such as reduction in overall irrigation and sub-basin system losses, improved drainage resulting in better soil health, increased agricultural productivity and reduced habitat for certain disease vectors. These are discussed in greater detail in the impact assessment section.

6. Negative impacts are expected mainly in the construction phase – when irrigation canal lining and other structures (eg. outlet structures, bridge replacements, command area works,

[1] Administrative unit and local term for sub-district

etc) are to be implemented. The construction related activities of concern are the stockpiling of materials, transport routes, and localized impacts at the various sites. These sites include quarries and borrow pits, material storage, labour camps and construction areas. The major concerns related to construction activities are (i) safety of the workers and local population, (ii) waste disposal, (iii) impact to local ecosystems due to degradation or destruction, (iv) reduced access to the local population dependent upon the sites, (v) long term degradation of sites such as erosion or waterlogging due to inadequate rehabilitation, (vi) damage to local infrastructure, and (vii) health risks from poor site management or safety and labour management such as waterborne diseases due to inadequate provision of sanitation facilities.

7. On-line and off-line storages which collect catchment runoff, overland flow from an upstream irrigation area and water from the canal system may be separated and then regulated to improve functioning and water management of the canal system. This may affect, to some extent the water levels in some ephemeral wetlands. However this would need to be further assessed following topographic survey and design of the intended storage.

8. Increased irrigation efficiency is another possible concern for the environment. While increased irrigation efficiency in the irrigation conveyance system and improvements in field application and irrigation management practices would result in reduced waterlogging, it may also result in reduced return flows to the river. However, the introduction of telemetry and other discharge measurement equipment is expected to improve the data on inflow and outflow to the system. This will provide more science based and real time data to improve management of the sub-basin water resources, ensuring sufficient environmental return flows.

9. Output 1 of the project will address river basin water resource planning including environmental flow requirements. Much of this can be more appropriately addressed in the overall IWRM framework of the KISWRMIP and the river basin management activities. Guidelines for the operation of tanks that are integrated into the water distribution system would ensure increased multiple benefits (environment and socio-economic).

10. In the case of construction related activities, good site management, consultative processes to ensure local populations are not adversely impacted, rehabilitation of sites, and safety measures at all sites are the major management actions required. Safety needs should not only include appropriate signage and warnings, but also safety equipment for workers and first aid in case of any accident until the injured are taken to appropriate medical centres.

11. Most of the negative impacts are likely to be managed with appropriate interventions which are to be included in the project design, or in the case of construction related activities through appropriate contract clauses. The implementation of the environmental management plan (EMP) will be monitored.

I. PROJECT DESCRIPTION

1. The impact of the proposed Karnataka Integrated and Sustainable Water Resources Management Investment Program (KISWRMIP) is enhanced availability of water resources in selected river basins in Karnataka and the outcome is improved integrated water resources management in the selected river basins in Karnataka. The program supports three outputs over two tranches. The outputs are: (i) State and basin institutions strengthened for integrated water resources management (IWRM), (ii) irrigation system infrastructure and management modernized, and (iii) Program management systems operational.

2. Output (ii) will help improve water use efficiency in selected irrigation systems to improve water resources management within the basin/sub-basin. It will include (i) modernization of existing irrigation infrastructure in three subprojects within the selected sub-basin; (ii) upgrading system management through installation of telemetry and decision support systems; and (iii) strengthening water user cooperative societies (WUCS) for effective operation and maintenance of the irrigation distribution system. The sub-projects to be financed under the three tranches are: (i) Gondi irrigation system with a command area of 4,600 ha will be modernized under Project-1, (ii) Vijayanagara channels with a command area of about 11,000 ha to be modernized under Project-2, and (iii) Tungabhadra Left Bank Canal system with a command area of about 244, 000 ha of which about 40,000 ha will be modernized under Project- 2.

3. This IEE describes impacts and mitigation measures associated with investments in the Gondi irrigation scheme, under Project-1 of the program.

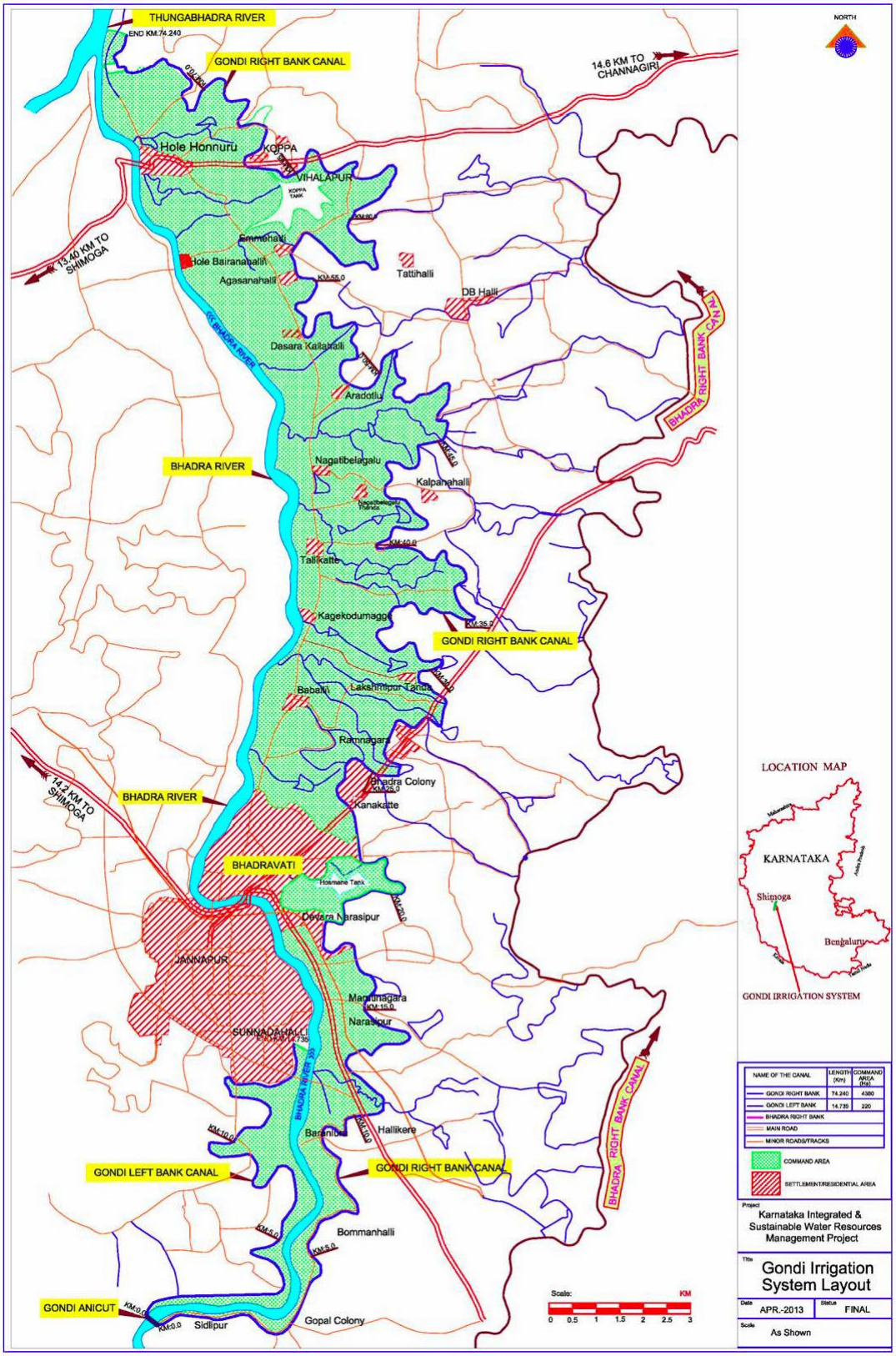
4. The Gondi anicut (weir) which is the offtaking point for Gondi irrigation system, is built across the Bhadra river, near Gondi village which is 11.6 Km from Bhadravathy town, Bhadravathy taluk, Shimoga district. It is situated at a latitude 13°46' N & longitude 75° 41' E. Gondi anicut is located at 14.50 km downstream of the Bhadra reservoir. The construction of the anicut commenced in 1916 and was completed in 1926. The right bank canal for Gondi irrigation system was commissioned during 1926-27. The work of the left bank canal started during 1951 and was completed during 1953-54.

5. There are two main unlined canals originating from Gondi anicut these are the left and right bank canals. Main details are presented in Table 1 and layout plan in Figure 1.

Table 1. Design Details for the Gondi Irrigation System

Canal	Length (Km)	Design discharge (cumecs)	No of Offtakes	Command Area (hectares)
Left bank	14.5	0.56 or 20 cusecs	20	212
Right bank	74.4 with 16 distributary canals	7.50 or 265 cusecs	130	4388

Figure 1: Layout of Gondi Irrigation System



6. The gross command area (GCA) is 5060 Ha, the cultivable command area (CCA) is 4600 Ha and the sanctioned ayacut (area under irrigation) is 4465 Ha.

A. Assessment of the Irrigation System

7. The main canals are contour canals and the height above the river increases with distance downstream. The system is in poor condition, most notably the right main canal where water appears to be unable to pass from head to tail as a result of sediment blockage from about km 45. Below this water comes from the Bhadra system as overland flow and intercepted drainage (most likely the source of the sediment). The downstream 40% of the Gondhi system is therefore vulnerable to water shortage when the Bhadra system is not operating. The water balance, agricultural water requirements and canal flow requirements were calculated to assess the engineering design of the project's Detailed Project Design (DPR).

8. There are 20 tanks within the right bank command area many of which are enlargements of the main canal. One of these tanks commands about 260 ha and has gated outlets to enable active management of supply. There are about 150 pipe outlets, typically serving 20-320 ha directly from the main canals. Some of these have gates but they are never operated and others have no gates at all. The result is uncontrolled release of water. There is no engineered drainage system although there are many reports of waterlogging.

9. The primary objectives of the modernization include supply of canal water to the lower Gondhi canal section and to save water that is to be transferred to a newly constructed irrigation area in the Upper Bhadra irrigation system.

1. Canal Modernization Activities

10. The following interventions are envisaged to upgrade the system:

(i) Repairs to the Gondi anicut and canal head works e.g. repointing of existing structures, replacement of gates, reconstruction of any minor damaged sections etc.

(ii) Improvement of main canals and distributaries including provision of concrete canal lining to improve conveyance and upgrading of canal access roads. Lining may be a combination of slip formed channel and large precast units in order to minimize the duration of canal closures.

(iii) Repair / replacement of all canal structures including bridges and crossings, drainage inlets and relieving weirs, pipe outlets and provision of new structures such as cross regulators where necessary to support the future operational objectives. Ramps into canals for laundry and animal drinking will be provided.

(iv) Possible modification of current on-line storage (tanks) where feasible to become actively managed off-line storage and enhancement of existing off-line tanks for more pro-active management. Modification options and impacts will be assessed during detailed planning and design.

(v) Command area development works comprising lined channels, low pressure gravity-supplied pipe distribution where technically feasible and drainage where required.

(vi) Provision of electronic flow measurement with telemetry at about 20 locations on the main canal and drainage system and flow measurement with recorders at all outlets.

(vii) Capacity development of system operations staff and water users to enable them to effectively use the flow measurement system and provide a more efficient and equitable water distribution service more closely aligned with farmers' needs.

(viii) Agricultural extension and on-farm water management training to equip the farmers with the skills to use water more efficiently.

(ix) It is also envisaged to develop managed conjunctive use of canal water, water stored in tanks and pumped groundwater and undertake small pilots of pressurised irrigation using gravity supply from the main canal with possible interlinking to existing drip irrigation that uses groundwater.

a. Responsible Government Institutions

11. The responsibility of operation and maintenance of the Gondhi irrigation system is with the Karnataka Neeravari Nigam Limited (KNNL) through its field office of Chief Engineer, Upper Tunga Project (UTP) Zone, Shimoga. The project is under the jurisdiction of the Superintending Engineer, Bhadra Reservoir Project Circle, B R Project.

12. Responsibility for the command area aspects of the project, including construction of field irrigation channels and drains, command roads, reclamation waterlogged soils and formation and support to water user cooperative societies (WUCS) lies within the jurisdiction of the Bhadra Command Area Development Authority (CADA), Malavagoppa, Shimoga. Agricultural support services for government schemes and subsidies are provided through the Shimoga District Agriculture Department Office. There are 3 Community Service Organizations active with canal irrigation in the project area.

b. Water User Cooperative Societies (WUCS)

13. There are 9 WUCS in Gondhi Right Bank Channel 3 of these have entered into Memorandum of Understanding (MOU) with KNNL on water management and have benefited from a one-time functional grant which is kept in the Bank as fixed deposit. On the left bank there is potential to form one WUCS. Overall the effectiveness and activities of WUCS in the project area is very limited.

2. Construction Activities:

14. In relation to environmental implications, the main construction activities are expected to involve:

(i) Clearance of vegetation along the canal rights of way to provide access and working space for the construction activities.

(ii) Excavation where necessary within the existing canals. Suitable excavated material may be re-used within the construction works and unsuitable material (too silty) may be placed on fields to improve soil quality. The total excavation volume is estimated to be about 250,000m^3.

(iii) Filling of about 350,000m^3 to restore the canal cross section and access track. Fill material will either be suitable material from the excavation or from borrow areas.

(iv) Gravel surfacing of canal roads using material from suitable quarries or borrow areas.

(v) Concrete lining either using mechanised paving equipment, precast concrete units or hand-placed concrete. Concrete for paving equipment would be supplied by ready-mixed concrete but concrete for hand-placed lining will probably be

mixed on site. Precast units would be stockpiled on site for a brief period before installation.

(vi) Reconstruction of canal structures using reinforced concrete. Most structures will be cast in place although some works may use precast concrete. Rebuilding of larger structures may take a month or more and will probably follow after the lining works.

(vii) Provision of either concrete field channels or pipes within the command area which will require temporary access over fields.

The logistics associated with the construction work include:

(i) Extensive movement of trucks carrying soil, gravel for roads and either ready-mixed concrete or materials for concrete.

(ii) It is not currently envisaged that there will be work camps in the field as the construction sites are close to Bhadravati town. Given the scale of the works, it is unlikely that there will be a requirement for major on site construction camps/or large batching plants etc.

(iii) The canals under modernization do not pass through or immediately adjoin forest. The Gondi Anicut and Gondi left bank canal at the anicut is within 1 km of a minor forest (sandalwood plantation) and 6 km of a reserved forest (and wildlife reserve) on the left side of the Bhadra reservoir, with the Bhadra Left Bank canal and settlements in-between. The Gondi Anicut and Right Bank Canal near the anicut are 2 km from a minor/State forest with settlements in between. It is 11 to 12 km from the Wildlife and Tiger Reserve with the Bhadra Right Bank canal and settlements in-between. Elsewhere the canal is more than 2.5 km from reserved forest with the Bhadra Right Bank canal and settlements in-between

(iv) Modernization works for each site will occur just the once and activity at any one location will only be for a few days in total. Passing traffic will increase for most of that closure period. Overall modernization is expected to take place in 1 or 2 canal closure periods each year (mid May – mid July or December) when the canals are normally empty. Overall construction is expected to be completed in 3 years (the duration of Project-1).

(v) It is expected that about 213,000 m^3 of material will be excavated from the canal. Where possible it will be used for construction purposes. However, discussions with farmers have also identified that farmers consider the material to be nutritive and therefore may also be interested in using it on their fields. According to existing estimates about 357,000 m^3 will be need for filling. Some of this, as found suitable will be from the excavated material. The material unsuitable for filling can be disposed in farmer fields, after discussions with them.

a. Improved In-scheme Storage

15. Gondi irrigation system contains at least 20 small tanks (off-;line and on-line storages). Some of these are along the main canal and were formed where the canal cuts across small side valleys. Others are within the command area. One of these tanks, Koppa Dodakere, commands about 60ha and has gated outlets to enable active management of supply to its command area. The tanks along the main canal are on-line, which mean that their water levels fluctuate with the main canal. As such, they reduce the responsiveness of the system to flow changes. These tanks will therefore be modified to enable active and most efficient management of the stored water – providing supplies during low flow season and providing storage for regulation of canal flows during excess periods.

b. Command Area Development

16. To realise the overall objective of improved water use efficiency it is necessary to improve the entire distribution system between head works and the crops. This involves improving the distribution system in the command area and, if necessary, supporting measures such as land levelling and drainage. There is considerable potential to upgrade the command area distribution system in Gondi. It is recommended that this distribution system includes piped distribution where feasible using uPVC or high density polyethylene pipes. Final distribution of water from the fixed pipe outlets could be undertaken using a flexible hose. A piped system will provide several benefits including: (i) negligible land take; (ii) reduced conveyance losses; (iii) reduced opportunity for water to be drawn from points between the agreed outlets; (iv) a clearly defined rotation system for sharing the use of the pipe outlets.

c. Gravity-Fed Pressure Irrigation

17. Part of the command area has slopes greater than 1% with land more than 10m below main canal level. This provides opportunity to mobilize sufficient pressure for micro sprinklers or drip irrigation with associated increase in water use efficiency. There may be potential for interlinking of the pressure supply from the canal system with the drip irrigation systems provided for some arecanut plantations to enable conservation of groundwater supplies for periods when insufficient surface water is available. Drip irrigation is an innovative technology for making significant improvements in water use efficiency at the field level.

d. Reuse of Drainage Flows

18. At present the Gondi main canals intercept drainage flows (both runoff from rainfall and excess flow from irrigation) from the Bhadra canal command areas. However, with better water management within the Bhadra system this source of water is expected to diminish. Within the Gondi command area there is also potential to intercept runoff for re-use further downslope (the tanks within the command area probably do this) which raises the water use efficiency within the system. The existing situation needs to be mapped and further potential for water reuse identified.

e. Conjunctive Use

19. Opportunities will be identified for conjunctive use of surface water (canal supplies, water stored in tanks and pumping of surface water during canal closures) rainwater and groundwater, particularly to sustain perennial crops during canal closures. The potential groundwater storage and the likely abstraction should be estimated and compared with expected recharge from rainfall and irrigation percolation losses, while taking account of the tendency for groundwater to migrate downslope.

f. Flow Measurement

20. Improved flow measurement will provide information to support better operation of the irrigation system both in terms of day-to-day flow management and quantification of flow volumes supplied. Main canal flow measurement will use electronic flow measurement devices with telemetry to enable real time data acquisition to guide system operation. Likely measurement points are at boundaries of WUCSs, at major inflows and possibly at selected command area outflow points. In addition, flow measurement using flumes with water level and

flow volume recorders is proposed for all outlets so that water provided to each WUCS can be quantified.

21. The construction work will take place over a period of 3 years and will correspond to the closure period of the canal. This will be from May to June, a one month period and again November to December, a two month period. The scope of activities for all major construction work is given in the table below.

	Left Bank Area	Right Bank Area	Total	Scope
CCA (ha)	220	4380	4600	
Main canal length (km)	14.7	74.4	89.1	Lining
Distributaries	0	16 No. / 34km	16	Lining
Cart bridges	20	86	106	Replace
DPOs on main canal	20	130	150	Replace
DPOs on distributaries		52	52	Replace
Drainage inlets	2	51	53	Improve
Relieving weirs	3	22	25	Improve
Escape sluices	0	6	6	Improve
Aqueducts	0	3	3	Repair
Tanks	0	20	20	Improve

g. Support to System Operation

22. Capacity building of the WUCSs is required to enable them to be sustainable and undertake operation and maintenance of the irrigation distribution system. Specific training of system operations staff will be provided to enable them to benefit from the flow measurement system to provide efficient operation with minimal wastage.

3. Agriculture Related Activities

23. The major agriculture related activities planned under the project are,

(i) Crop diversification by introducing short duration and market value added crops such as vegetables, flower cultivation.

(ii) Introduction and increase in the area under System of Rice Intensification (SRI) Paddy cultivation which will increase yields and significantly reduce water use.

(iii) 100% coverage of the area in capacity building of Water User Cooperative Societies in sustainable agriculture including soil testing, balanced fertilizers and use of micro nutrients, Integrated Pest Management, management of agri-chemicals and waste management including container disposal (including health and safety aspects). This will reduce the current applications of fertilisers which are said to exceed recommended levels.

(iv) Adoption of rice (Kharif) following pulses (Rabi) cultivation

(v) Increase in area of crops under micro irrigation which will reduce water runoff and recharge of groundwater in the Rabi season

(vi) Increase of area under horticultural crops with special focus on Arecanut, tissue cultured Banana

(vii) Improved extension and training through WUCS to farmers to increase water saving, agricultural production, farmer profitability and environmental sustainability

4. Land and Water Use and the Environment Conditions

24. At the peak of the irrigation season (Rabi), it is believed that, other than for urban water supply, little water is released into the rivers and all the inflows are diverted through the main canal off-takes for irrigation. As a result flows in rivers are extremely low for a considerable part of the year[2].

25. Currently water is supplied to the Gondi irrigation system from the Gondi anicut. For the lower Gondi canal beyond about chainage 45 km, irrigation water is received as tail water from the Bhadra system. Tailwater from the Gondi system, as well as rainfall runoff from both, flows through to the Bhadra river. Return flows during the rabi season are thought to be used further downstream by irrigation systems. Return flows are also considered to be a source of non point source pollution with elevated nutrients in particular for the river.

26. Once the project is implemented, the Gondi DPR indicates that the current irrigation water usage in the Gondi system will be reduced by 0.5 TMC (14.12 Mm^3)[3]. The saved water will be transferred to new irrigation developments in the Upper Bhadra catchment As a result of this and a major reduction of flows entering the Gondi system once the Bhadra system is being operated optimally, Tailwater, as well as non point source pollution leaving the Gondi system and entering the Bhadra river is expected to be much reduced. Within the Gondi area, the recharge of groundwater during the Rabi season should also be much reduced as the area of paddy is replaced with SRI rice and other annual and perennial crops.

27. The land in the command area is currently fully cropped based on satellite interpretation and so there is little likelihood that the area of irrigated land will expand especially given the planned reduction in the supply of water. A greater intensity of use is likely however and this is likely to involve greater use of agrichemicals although to the use of nitrogen , phosphorus and potassium already exceed recommended levels. An agricultural extension effort is to be implemented to reduce these inputs and to introduce integrated pest management and integrated nutrient management.

2 CDTA Report (2010) Component 2: Sub-Basin Framework Plans for Efficient and Sustainable Water Resources Management. Integrated Water Resource Management and Sustainable Water Service Delivery in Karnataka (ADB TA No. 7418-IND)

3 Modernization of Left Bank Canal and Right Bank Canal of Gondi Anicut in Bhadravati Taluk, Shimoga District. Detailed Project Report September 2012, 3G Consultants. p30.

II. POLICY, LEGISLATIVE AND INSTITUTIONAL ARRANGEMENTS

A. Policy

28. There are a number of acts and rules of the State and National Government that may be of important to the project. While some of these could define activities to be done and location of the project, there are others that may be supported by project activities. This section discusses these regulations and their implications.

1. National and State Legislation

a. Environmental (Protection) Act, 1986, Environmental Impact Assessment Notification, 1994 and recent amendment of 2006, and rules

29. This act vests power in the Central Government to take necessary action to protect the environment and in the prevention of environmental pollution. Under this act, standards for pollution and the discharge of effluents, as specified under the various pollution control acts are made. Under this act procedures and safeguards for handling hazardous substances are also laid down. All projects and activities are broadly categorized into two - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and man made resources.

30. According to notification of 2006 under sub-rule (3) of rule 5 of the EPA, 1986, powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986, read with clause (d) of sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 construction of new projects or activities or the expansion or modernization of existing projects or activities listed in the Schedule to the notification entailing capacity addition with change in process and or technology will only be undertaken after the prior environmental clearance from the Central Government or as the case may be, by the State Level Environment Impact Assessment Authority.

31. The Schedule includes in 1(c) river valley projects, including irrigation projects. The table below gives details of what is mentioned under 1(c) of the Schedule.

		Category with threshold limit		Conditions if any
Project or Activity		A	B	
1(c)	River Valley projects	(i) ³ 50 MW hydroelectric power generation; (ii) ³ 10,000 ha. of culturable command area	(i) < 50 MW ³ 25 MW hydroelectric power generation; (ii) < 10,000 ha. of culturable command area	General Condition shall apply

32. Any project or activity specified in Category 'B' will be treated as category 'A', if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as identified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, and (iv) inter-State boundaries.

33. Based upon the above criteria and available information it has been identified that the project is within 10 km of the Bhadra Wildlife Sanctuary (Figure 1). The Gondi Anicut is the closest project point to the reserve and is approximately 4.7 km and 9.2 km by the marked lines.
34. Also, the project is within the 10 km zone of a critically polluted area, Bhadrawati. Therefore, this project could be considered a category A/B project requiring a clearance from the central government. The specific categorization is awaited following review of the detailed project report for the Gondi irrigation system by the Central Water Commission of the Ministry of Water Resources. The CWC will provide definitive confirmation of the categorization and which level of clearances are required.

Figure 1: Distance from Project to Bhadra Wildlife Sanctuary (Source Google Earth)

35. For any project that requires an environmental clearance under Government of India's EPA, 1986 there will be a need for an accredited consultant registered with the Ministry of Environment and Forests to undertake the environmental impact assessment (EIA) and obtain a clearance from it, as has been stated in the Office Memorandum: Accreditation of the EIA Consultants with Quality Council of India (QCI)/ National Accreditation Board of Education and Training (NABET) Dated 9th December, 2009 and available at the ministry's website.

b. The Biological Diversity Act, 2002

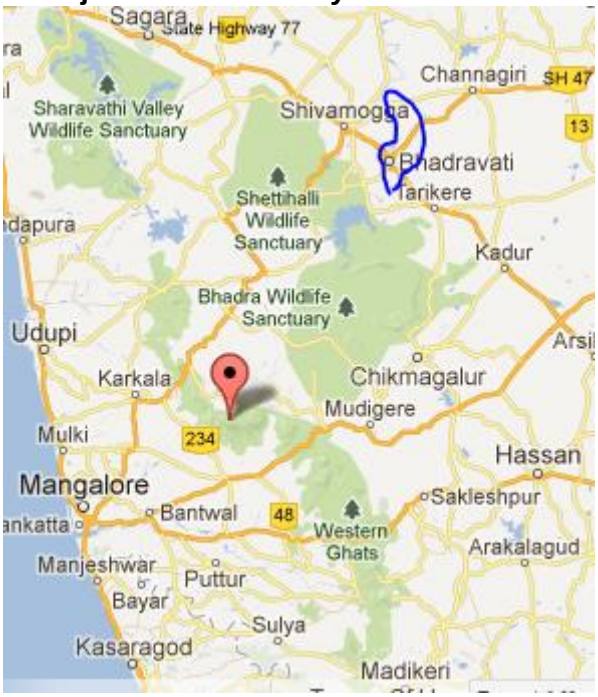
36. According to this act, where the Central Government has reasons to believe that an area rich in biological diversity, biological resources and their habitats is threatened by overuse, abuse or neglect, it could issue directives to the concerned State Government to take immediate ameliorative measures. The Central Government, as seen appropriate, integrates the conservation, promotion and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies. The State Government, under this act, can also declare areas of biological importance as heritage sites.

37. Based on this act's recommendations, the state has started to create biodiversity management committees in Karnataka. The purpose of these committees is promoting conservation, sustainable use and documentation of biological diversity including preservation

of habitats, conservation of landraces, folk varieties and cultivars, domesticated stocks and breeds of animals and micro-organism.

38. The UNESCO MAB site – the Nilgiri Biosphere reserve which includes Kudremukh Wildlife Sanctuary and National Park (red pointer Figure 2), the source of Rivers Bhadra and Tunga, and Western Ghats reserve (indicated in Figure 2) are within approximately 80 km of the project area (blue outline shape in Figure 2. Also as indicated above, the Bhadra Wildlife Sanctuary and other wildlife areas are near the project site and shown in Figure 1.

Figure 2: Project Area Proximity to Wildlife Reserve Areas



c. Karnataka Forest Act, 1963, Karnataka Forest Rules, 1969, Karnataka Preservation of Tree Act, 1976

39. The Karnataka Forest Act defines the use and management of Reserved Forests, District Forests, Village Forests and Private Forests, the control of forest products – both timber and other forest products. It also defines 'reserved trees' or trees that cannot be cut without permission from the Forest Department and the cutting of 'Government Trees' from private lands. According to the Tree Act the felling of any tree; even on private lands, requires permission from the appropriate authority for the area, as specified in the legislation. This authority is designated as the Tree Officer. A few exceptions to the legislation have been given in chapter 5 of the document. The legislation also mentions that there is a need to plant trees of the same or different species in lieu of the felled trees, as directed by the Tree Officer.

40. Construction activities likely to result in the removal of some trees, whether to access identified intervention areas, create infrastructure or even use of wood as fuel wood by the construction labour or other uses are, based upon the provisions of this legislation required to obtain required permissions etc.

d. Karnataka Groundwater (Regulation for Protection of Sources of Drinking Water) Act, 1999

41. This bill defines the procedures for sinking of wells near public drinking water sources, declarations of watersheds as over exploited and the prohibition of sinking wells in such watersheds and the abstraction of water from wells in the watersheds.

42. Considering existing climate change predictions for the basin and the district there may be changes in the rainfall pattern. Also, there have been droughts in the area in the past. In such a scenario, there is may be additional temporary restrictions on the use of groundwater for all purposes other than drinking.

e. Karnataka Act No. 25 of 2011. The Karnataka Groundwater (Regulation and Control of Development and Management) Act 2011

43. This act further strengthens the Karnataka Groundwater (Regulation for Protection of Sources of Drinking Water) Act, 1999 as it brings a general legislation to control in-discriminatory exploitation of ground water especially in the notified areas in the State. This act also provides for declaration of areas as drought hit, restriction and regulation of use of groundwater in notified areas and specifying minimum distance between irrigation bore wells.

44. Conjunctive water use plans would need to consider the provisions of this legislation and obtain required permissions while developing the plan.

f. Insecticide Act, 1968

45. This act provides a list of pesticides which are restricted or banned for use in India. There is a list of 34 pesticides and formulations banned for use in India. There are another seven withdrawn pesticide, eighteen refused registration and thirteen for restricted use in India.

46. Discussions in the field identified the use of pesticides restricted in India like endosulphan and monocrotophos. The major reason for this use is that they are considered extremely effective in comparison to other known formulations by the farmers. The project would therefore need to undertake concentrated efforts to ensure that such formulations are not used and appropriate alternate pest management techniques are known, understood and implemented by the farmers.

g. Noise Pollution (Regulation and Control) Rules, 2000

47. This legislation defines the levels of noise permitted in each area, including from vehicular traffic, generators, construction activities and mechanical devices. This rule would be important especially during the construction period of the project. The ambient noise quality standards under this rule are given in the table below. These levels need to be adhered to for all project activities.

Area Code	Category of Area/Zone	Limits in dB(A) Leq *	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55

(C)	Residential area	55	45
(D)	Silence Zone	50	40

h. Air (Prevention and Control of Pollution) Act, 1981, its Rules and amendments

48. Under this Act, Boards (Central and State) for the prevention and control of air pollution have been set up to monitor and manage activities that would lead to air pollution in India, and to declare air pollution control areas. The act also sets ambient air quality standards for industrial, residential and ecologically sensitive areas.

49. This will be important during the construction phase, where there is likely to be use of diesel generators for provision of energy and other activities that may result in air pollution. Also, based upon the area where the project activities are underway, the standards, as defined by the Act are to be adhered to. These standards are given in the Act.

i. Water (Prevention and Control of Pollution) Act, 1974, its Rules and amendments

50. This law is to control and prevent water pollution. This legislation also defines discharge standards and permit needs for any effluent/wastewater discharged. It includes surface and ground water and marine discharges. The Act also discusses possible water pollution, prevention and control areas for the application of this act.

51. Presently the project does not envisage undertaking any activity that would result in effluent discharges and therefore permission under this act is not required. Nonetheless, at the construction phase of the project, there may be a need to look at possible discharge from various activities to ensure that discharges do not result in the change in the quality of water bodies, whether temporarily or permanently. Water quality standards for different uses have been defined by the Central Pollution Control Board, Government of India.

j. Manufacturing, Storage and Transportation of Hazardous Chemicals Rules, 1989 and Amendments

52. This Rule is for the management and transportation of hazardous chemicals and substances – that include toxic and flammable substances, their use, processing and storage. Schedule 1 to 4 of this rule describes what is categorized as hazardous, their quantities and levels of toxicity. These include a number of pesticides, and liquid and gaseous fuels. According to the rule, the agency needs to identify possible accidents and risk from the chemical during transport, storage or usage, ensure ways to avoid any hazard from taking place and in case of an accident, ensuring clean up and reporting of the accident to the appropriate authority. The rule also states that no industrial activity is to start until a safety report is filed to the concerned authority according to Schedule 8 of the rule. These must be followed and no changes in activities undertaken without updating of the report within another 90 days. Equally, any hazardous chemicals stored or transported need to be labelled as specified in the rules and an updated safety data sheet to be kept.

53. This could be relevant to the project as there could be certain chemicals and fuels likely to be stored for project needs. Some of these could be flammable or toxic. Prior to starting any activity the project would need to identify if there are any chemicals as identified in Schedule 3

of the project. If so, appropriate handling procedures and safety permits etc would need to be developed and submitted to the concerned authority.

k. Wetlands (Management and Conservation) Rules, 2010

54. Activities not permitted in wetlands include reclamation, setting up of new or expansion of existing industries, dumping of waste or discharge of effluents, any activity that adversely impacts the wetland ecosystem.

55. Any activity that could have an adverse impact on wetlands in the project area must be carefully designed to ensure that they are according to this legislation. By the definition of the Act the existing 20 tanks in the project can be classified as wetlands. However, there are no protected wetlands in the area[4].

l. Draft Guidelines for Integrated Water Resource Development and Management, 2010, Central Water Commission

56. The Guidelines mention the need to consider ecological needs of water and therefore the maintenance of appropriate minimum flows of rivers for ecological needs, aesthetics and other requirements. The guidelines go further and mention the need for catchment treatment, integrated watershed projects, restoration of ecological balance. No rules of thumb or calculations for assessing minimum flows are given in the guidelines.

57. The activities identified also include increased water use efficiencies. It is therefore suggested that the project consider the implications of the plan on environmental flows and if there is a need to suggest any changes. Any identified concerns would need to be addressed through the project's IWRM activities. There are international guidelines[5] that could be used for guidance on environmental flows for the river.

m. The Ancient Monuments and Archaeological Sites and Remains Act, 1958, The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 and their rules and amendments, and The Karnataka Ancient and Historical Monuments and Archaeological Sites and Remains Act, 1961

58. This act identifies limits of prohibited and regulated areas and the activities that can be carried out in them and the required permissions. According to this Act, areas within a 100 meters radius of notified monuments are prohibited and another 200 meters regulated.

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[4] This rule defines a wetland – which according to the rule is 'an area of marsh, fen, peat land or water; natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters and includes all inland waters such as lakes, reservoirs, tanks, backwaters, lagoons, creeks, estuaries and manmade wetlands and zones of direct influence of wetlands that is to say drainage areas or catchment areas of the wetlands as determined by the authority, but does not include main river channels, paddy fields and the coastal wetlands covered under the notification of the Government of India in the Ministry of Environment and Forests, S.O. 114 (E) dated 19 February, 1991 published in the Gazette of India Extraordinary, Section 3, Sub-Section (ii) of dated the 20th of February, 1991. The rules also identify various types of wetlands including those in UNESCO World Heritage sites, ecologically sensitive areas, below 2500 metres with an area of at least 500 ha, other notified wetlands or those identified by the Wetland Authority.

[5] Dyson, M., Bergkamp, G., Scanlon, J. (eds). Flow. The Essentials of Environmental Flows. IUCN, Gland, Switzerland and Cambridge, UK. xiv + 118 pp.

However, if required this area can be extended to protect the monuments and archaeological site. Any work in the prohibited area needs to be carried out by the archaeological officer and if work is carried out in a regulated area by persons other than the archaeological officer then there is a need for permission to undertake the work as defined in the regulation. Also, for any work in either the prohibited or regulated area permission is required to carry out any work. However, this Act also defines the sort of work that can be carried out within areas notified under this act. Furthermore, any construction, mining or other activity in the vicinity of a protected or regulated area would also need permission from the competent authority. These regulations prohibit cultivation within protected areas if it involves digging of more than 1 foot of soil.

59. While no protected monument has been identified in the project area, there could be chance findings. In the event of chance findings, as required under this Act the competent authority must be consulted and, as required, actions taken up.

60. Given below (Table 2) are the major Indian legislations that are applicable to this project along with the actions that would need to be undertaken for each of these regulations. These must be followed as a part of the environmental compliance activities for the Gondi Anicut subproject at the time of construction or implementation, as required.

Table 2: GOI Legislative Environmental Compliance Requirements

Component	Applicable Legislation	Action Required
All irrigation project modernization activities	Environmental (Protection) Act, 1986	Requires environmental clearance – as discussed in the Schedule of the act
Any component where there is a need to acquire forest land or access any produce from forest produce Any trees cut by project activities	Karnataka Forest Act 1969, Wildlife Act, 1972 and Karnataka Preservation of Tree Act, 1976	Apply for permission and undertake any action as directed by the Forest Department Apply for permission and undertake any action as directed under this act – e.g. undertake compensatory plantation activities.
Any impact on biodiversity hotspots or sensitive areas due to project activities	Biodiversity Act, 2002	Consult with the Biodiversity Board to identify any sensitive areas and appropriate actions to minimize impact from project activities
For conjunctive water plans where groundwater is to be used	Karnataka Groundwater (Regulation for Protection of Source of Drinking Water) Act, 1999 and Karnataka Groundwater (regulation and Control of Development and Management) Act 2011	Taking permission for sinking of bore wells, ensuring minimum distance between irrigation wells and follow directions of legislation if area declared drought hit.
Especially during construction period	Noise Pollution (Regulation and Control) Rules, 2000	Ensure all activities adhere to the existing noise limits
Pollution due to vehicle and construction activities	Water (Prevention and Control of Pollution) Act, 1974	Ensure any activity undertaken is within the existing discharge standards, based upon the designated use of a water body.

At time of construction especially when there is likely to be use of diesel generators for energy and the various vehicles and machinery at the site and for transportation. Also at various quarry and other sites resulting in atmospheric dust	Air (Prevention and Control of Pollution) Act, 1981	Ensure that all activities comply with the existing air quality levels. Vehicles have required pollution under control certification from appropriate authorities
Waste dumping at construction or in the O&M phase	Wetland (Management and Conservation) Rules, 2010	Ensure compliance to the rules by ensuring identified waste disposal is in waterbodies and wetlands.

2. Asian Development Bank

61. From ADB's perspective the Safeguard Policy Statement (SPS) 2009 describes operational policies that seek to avoid, minimize, or mitigate adverse environmental impacts of development activities where ADB is involved. Impacts of project activities on the environment are to be identified early in the project cycle so that appropriate mitigation and management actions are undertaken. The SPS also states that the implementation of the identified safeguards is the responsibility of the client/borrower, while the ADB is to monitor compliance.

62. In the case of MFF lending modality, an Environmental Assessment and Review Framework (EARF) is also to be developed. The EARF will provide guidance to the assessments of the subprojects of subsequent Tranches.

63. The ADB has also developed categorisation of all projects according to the level and type of impacts and type of investments. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. Projects can be categorised into four depending upon their impacts. Based upon this categorisation the Gondi irrigation subproject has been categorised as Category B. This is defined as: *'A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required'*.

3. International Conventions

64. India is a signatory to a number of international conventions and treaties. However, none have been identified to apply to the project. The list below gives a list of these conventions.

(i) Ramsar Convention on Wetlands
(ii) CITES (Convention on International Trade in Endangered Species of Fauna and Flora)
(iii) TRAFFIC (The Wildlife Trade Monitoring Network)
(iv) CMS (Convention on the Conservation of Migratory Species)
(v) CAWT (Coalition Against Wildlife Trafficking)
(vi) CBD (Convention on Biological Diversity)
(vii) ITTC (International Tropical Timber Organisation)
(viii) UNFF (United Nations Forum on Forests)
(ix) IUCN (International Union for Conservation of Nature and Natural Resources)

(x) GTF (Global Tiger Forum)
(xi) Cartagena Protocol on Biosafety
(xii) SAICM (Strategic Approach to International Chemicals Management)
(xiii) Stockholm Convention on Persistent Organic Pollutants (POPs)
(xiv) Basel Convention on the Control of Trans-boundary Movement of
(xv) Rotterdam Convention on Prior Informed Consent (PIC) for certain
(xvi) Hazardous Chemicals and Pesticides in International Trade
(xvii) UNFCCC (United Nations Framework Convention on Climate Change)
(xviii) Kyoto Protocol
(xix) UNCCD (United Nations Convention to Combat Desertification)
(xx) Montreal Protocol (on Ozone Depleting Substances)
(xxi) IWC (International Whaling Commission)

B. Institutional Arrangements and Systems

65. The national and state level government agencies focusing on environmental management and regulation are given below. State level agencies function directly below their line national level agencies.

1. National Level

a. Ministry of Environment and Forests

66. The Ministry of Environment & Forests (MoEF) is the nodal agency in India for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programme. The principal activities undertaken by Ministry of Environment & Forests consist of conservation & survey of flora, fauna, forests and wildlife, prevention & control of pollution, afforestation & regeneration of degraded areas and protection of environment, in the framework of legislations.

67. It is located at the national level and has regional offices for various regions and works in coordination with the national office in order to undertake any work, clearances and other consultation related activities. This includes one for the South region for which the office is located in Bangalore. This ministry is also in charge of any forest related clearances as identified under the forest acts and to be undertaken by the central ministry.

b. Central Pollution Control Board

68. Central Pollution Control Board (CPCB) is the statutory organisation constituted in 1974. The board provides field information and technical services to MoEF. The Board also monitors and oversees the implementation of the Environmental Protection, Air and Water acts. The functions of the board are,

(i) Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air
(ii) Plan and cause to be executed a nation-wide program for the prevention, control or abatement of water and air pollution
(iii) Co-ordinate the activities of the State Board and resolve disputes among them
(iv) Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement

(v) Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts
(vi) Perform such other function as may be prescribed by the Government of India

2. State Level

a. Department of Ecology, Environment and Forests, SGOK

69. Department of Ecology, Environment and Forests (DoEF) is the apex body in the state of Karnataka with administrative control of environmental management in the state. The department through KSPCB administers the enforcement of various laws and regulations of Government of India. The department formulates environmental management and policy guide lines for Karnataka and grants clearances for projects under its purview.

70. The department is headed by a Principle Secretary to Government and Supported by Secretary (Ecology and Environment). The Secretary (Ecology and Environment) is supported by two Under Secretaries and a Director (Technical).

b. Karnataka State Pollution Control Board

71. KSPCB is the regulatory body in the state of Karnataka for enforcing various environmental legislations of the Government of India. While the regulatory powers are delegated to KSPCB from CPCB, the administrative control of the board rests with DoEF. More specifically, the functions of the board are listed below.

(i) Implementing the provisions of EPA 1986, Water and Air Acts
(ii) Advise the State Government in respect of suitability of particular areas for industrial development
(iii) Assess the quality of environment in terms of ambient air and water quality through monitoring
(iv) Issue and enforce the consent orders issued for industrial pollution control
(v) Oversee, supervise and regulate water, air, solid, bio-medical and hazardous waste management in urban areas

72. The board is headed by a Chairperson who is supported by a Member Secretary and a Chief Environmental Officer. The Chief Environmental Officer is supported by Regional Environmental Officers and the District Environmental Officers in each of the district of the state. The Board has its Central Office in Bangalore. The enforcement of the Acts and Rules are being implemented through thirty three Regional Offices spread throughout the state. The Central laboratory of the Board is located in Bangalore. Regional laboratories have been set up along with Regional Offices.

73. Depending upon the needs of the project, for any clearances these agencies will need to be contacted as directed under the relevant acts discussed in the legislation section.

III. DESCRIPTION OF THE ENVIRONMENT

74. The entire Gondi irrigation subproject is located in the Bhadravati taluk of Shimoga district. The taluk headquarter is Bhadravathi town located on the banks of the Bhadra river. It is located at 130˚ 52' North latitude and 75˚ 40' East longitudes. The town is located at a distance of 270 km from Bengaluru and 20 km from Shimoga. The altitude of Bhadravathi town is 548.70 m above msl.

A. Physical Parameters

1. Weather Patterns

75. The climate is characterised by moderate summers and winters. The year can be divided into three distinct seasons. These are winter from October to February, summer from March to mid-May and the monsoons from mid-May to October. Humidity is at peak during months of July and minimum during month of April. The average wind velocity is 8 kmph, from the south – west direction. Temperature rises after March, April is the hottest month of the year with mean daily maximum temperature going up to 35.8 ºC. With the withdrawal of the monsoons, by the end of October, there is a sharp decrease in temperature. January is the coolest month of the year, with mean daily minimum temperature of 14.3 °C.

76. The mean summer temperature is 25°C - 37°C and the mean winter temperature is 20ºC - 30ºC. Total annual rainfall is about 993.1 mm. Maximum rainfall is received in months from May to October. More than 80% of rainfall is received during the winter season. The average number of rainy days from 1941 to 1999 was 68 rainy days annually, though in 2009 it was about 10 days more. As is seen from Table 3, Bhadrawati taluk's rainfall is lower than the total of Shimoga and rainfall has varied from around 580 mm in 2006 to 1400 in 2009 – nearly a three times difference.

Table 3: Rainfall

	Rainfall (mm)						Rainy Days	
Taluk/District	Normal Rainfall (1941-99)	2005	2006	2007	2008	2009	Normal (1941-99)	Actual 2009
Bhadravathi T.	887	774.2	580.2	1293	952.4	1427.4	68	79
Shimoga D.	1,818.9	1,966.6	1,847	2,472.4	1,827.6	2,252.7	86	87

Source: - Shimoga District Statistical Handbook 2009-10

2. Water Resources

a. Drainage and Surface Water

77. A number of rivers originate from Shimoga District. These include Rivers Kali, Gangavathi, Sharavathi and Tadadi. The other major rivers which flow through the district are Tunga, Bhadra and Varada. The rivers Tunga and Bhadra meet at Koodli in Shimoga District to form the Tungabhadra.

78. There are a number of water bodies both natural and manmade in Shimoga district. This includes the famous Jog Falls and the Gopashetty Koppa, Sharavati and Gudavi Bird

Sanctuary. However, within the project area there are no Ramsar sites and no water body of any major ecological significance has been identified.

79. Surface water is supplied to the project area from the Gondi anicut by two main canals one for the Left Bank and another for the Right Bank. There are also many pumps that pump water directly into the project area from the Bhadra River.

80. The project area has a high slope and so surface drainage and rainfall runoff flows directly to the Bhadra River. Due to waterlogging, which was said to be significant (20-30% in some areas), there are small areas of sub-surface drainage.

b. Groundwater

81. Table 4 shows the groundwater levels for Bhardavati and Shimoga districts which are much larger areas than the irrigation areas and so include areas where there is much groundwater pumping to supplement rainfall. The data shows a general deepening trend for Bhadravathi taluk with a sudden reduction in depth in 2009. There is no specific groundwater data (depth or usage) for the project area and the household survey and field visits indicated that there was little use for irrigation due to the low yielding sediments. Groundwater is a significant source for household use. Due to high hydraulic loadings from rice cultivation in particular but also other irrigated crops water table levels are likely to be shallow and this is confirmed from the social survey where water tables were said to be affecting foundations and causing rising damp in buildings.

82. Future activity should look to create a register of groundwater pumps and usages (domestic and agriculture etc) in the project area (depth, volume, quality, seasonality, use of water, area irrigated, etc). This may be considered under Output-1 for river basin planning and as contribution to the project geographic and management information systems databases.

Table 4: Ground Water Level (in meters) 2008-09

Taluk/ District	2005	2006	2007	2008	2009
Bhadravathi T.	7.28	8.71	11.67	12.94	4.24
Shimoga D.	7.35	7.09	7.20	7.46	5.90

Source: - Shimoga District Statistical Handbook 2009-10

c. Water Utilisation

83. About 50% of irrigation supply at the district and taluk levels (and therefore including taluks outside of the irrigation area boundaries) is from canals with local tanks providing another 33% of irrigation water. This is much higher than the district total, where canals only provide a quarter of the total irrigation needs and tanks 45%. Groundwater is the third highest source of irrigation in both the state and district providing 22% and 15% respectively. As can be seen, both surface and groundwater are being used for irrigation already. Furthermore, the tanks and water bodies seem to be an important source of irrigation water for both the district and Bhadrawati taluk.

Table 5: Net Area Irrigated (hectare) 2008-09

Taluk/ District	**Canals**	**Tanks**	**Wells**	**Bore wells**	**Lift Irrigation**	**Other sources**	**Total**
Bhadravathi	12,745	8,354	399	2,517	1,323	0	25,338

Shimoga D.	33,733	59,955	4,452	22,836	5,607	5,454	132,037

Source: - Shimoga District Statistical Handbook 2009-10

84. Water supply in rural zones of Shimoga indicates that out of 4,566 settlements 3,498 receive more than 55 lpcd (litres/capita/day) supply of water. Based upon the national criteria – of minimum 40 for rural areas, the table reflects that 84% of rural habitations have adequate water supply coverage. However, this data does not provide any information on quality and seasonality to accurately understand the quality of the service. Furthermore, discussions in the field show that people are also dependent upon the canal for provision of water for domestic needs. Canal water is used for washing, cleaning and various domestic purposes, other than drinking. In areas where drinking water is insufficient canal water also supplements the drinking water needs for the rural population. Equally, water from canals is also used by people for bathing of livestock and drinking.

Table 5: Status of Rural Water Supply in Karnataka State - 2003

Water Consumption (Litres per Capita per Day, LPCD)
No. of Settlements

District	0-10	10-20	20-30	30-40	40-55	# <55 LPCD	% <55 LPCD	> 55 LPCD	Total
Shimoga D.	4	301	297	288	178	1068	23.39	3498	4566

Source: - Rural Development and Panchayat Raj Department

85. At a project level, based on the results of the socio-economic survey and field visits irrigation water use is predominantly surface water provided from the canal but also by pumping from the Bhadra river. There is little pumping for groundwater for irrigation to low groundwater yields, however groundwater is an important source of water for domestic use.

d. Water Quality

86. An analysis of groundwater quality by the Department of Rural Development for 14 parameters was undertaken and identifies a number of water quality issues. Of these, some samples of Bhadrawati Taluk tested positive for total hardness, calcium hardness, chloride, sulphate, alkalinity and iron. According to the Karnataka State of the Environment (SOE) report some areas in Bhadrawati are also fluoride affected. The SOE further states that around 25% of household in Shimoga district are affected by iron and fluoride in ground water. Also identified were problems of total coliform. The river at Bhadrawati is also classified as highly polluted according to the State Pollution Control Board, which is likely to be attributed to its industries such as the iron and steel industries.

87. Canals are used for waste disposal. At times people go alongside them using them as sites for defecation and household waste is disposed of directly into the canal.

88. There is highly prolific aquatic weed growth in canals in the project area thought to be contributed to by nutrient rich runoff from the Bhadra irrigation area entering the canal system as well as from local pollution. This is likely to have adverse impacts on the health of the local population which uses the water for various domestic purposes.

89. Groundwater quality is not known however given the risks of high agri-chemical environment and pit latrines it is potentially a significant issue given its apparent importance for domestic use.

3. Land Resources

a. Topography

90. Shimoga is a part of the Western Ghats and therefore the topography consists of planes interspersed with hills of moderate slopes. Bhadra River flows through the taluk which is developed on both sides of the river. Bhadravathi town is at an altitude of 548.70 amsl. The total geographical area of the district is about 8,477 sq kms and is the 9th largest district of the State.

b. Geology and Soil

91. The predominant geological formations of Bhadravthi which is a part of Shimoga district are quaternary alluvium, Dharwar super group - ultra mafic complex, grewake, argoillite, quartz chlorite schist with ortho-quartzite, basal polymictconglomarate. The lower precambrian formations include Metabasalt with thin Ironstone. There also are Archaean formations of granite migmatites and granodioritic to tonolitic gneisses, amphibolites and pelitischists.

92. Soil is usually brown clay loamy soil, red soil, sandy soil, red sandy soil, yellowish loamy soil, lateritic soil, mixed soils & black cotton soils are predominant in the region, which favours growth of cotton, paddy & oil seeds. While loamy and sandy soils are better drained, areas with black cotton soil will require specific attention to ensure appropriate drainage to avoid waterlogging.

c. Land use patterns

93. The total land area in Bhadrawati taluk is 69,101 ha or about 8% of the total district's land area. Of this 61% is under agriculture and 26% under forests. At the district level however the forest cover is higher, accounting for 32% of the total land area while agriculture accounts for 55% of the total. This higher forest cover at the district is because Shimoga district includes part of the Western Ghats forests. Nonetheless, as is discussed later in this section, degradation of forests is resulting in dense and closed forests now turning into open forests. For example, part of Shimoga town has encroached upon the forest area and some of the outskirt areas of the town are presently being cleared of illegal settlers to start an afforestation program and revive part of the forest area. Another 12% of the total land area in Bhadrawati taluk is under pastures and 5% is fallow. Agriculture areas with more than one crop a year account for 18% of the total land area and 29% of the total area under agriculture. The area under trees and groves is a negligible at 66 ha and is less than 1% of the total land area, according to 2008 – 09 statistics. However, it is likely that these groves do not include the arecanut or coconut plantations, which are an important crop in the Taluk and district.

B. Ecological Resources

94. Shimoga district has around 51% of its geographical area under various categories forest. Part of the Western Ghat forests is also in the district. Of the total area under forests only 4% is very dense forest with about a third as open forest, as is seen from Table 6. There is also an increasing area under open forests, with a decrease in dense forests. This is of concern not

only as open forests are often very vulnerable for being taken over and encroached by settlers, but also this area is one of the sources of the water of the district/state's rivers.

Table 6: District- Forest Cover-2011

District	Geographical Area (GA)	Very Dense	Mod. Dense	Open Forest	Total	% of GA	Change	Scrub
Shimoga D.	8,477	205	2,808	1,394	4,407	51.99	-1	23

Source: Forest Report, Forest Survey of India

95. The district's forests also provide many minor non-timber forest products, upon which a number of people are dependent for their livelihood. These include spices and medical herbs like Kairaraka, Soapnut, Alaekai and bay leaf. The forests also provide timber and include timber species like rosewood and teak.

96. Apart from a number of forest areas, the district also has Gudavi Bird Sanctuary, part of the Bhadra Tiger Reserve and the Shettihalli Wildlife Sanctuary. The project area does not fall in any of these sensitive areas. However, towards the tail end of the right bank canal near the confluence of rivers Bhadra and Tunga there is an elephant corridor. Also, it is understood that there are a number of wild animals in the forests surrounding the project areas and these may visit the project area.

C. Human Environment

97. The Gondi irrigation subproject is located in the Bhadrawati Taluk of Shimoga district. This Taluk has a total of 39 gram panchayats and 1 municipality.

1. Demography

98. The total population of Bhadravathi taluk is 338,989 with population density of 491 per km², out of which 52.6% of population resides in the rural areas and 47.4% in urban areas. The sex ratio is 972 females per one thousand males which is higher than the national average.

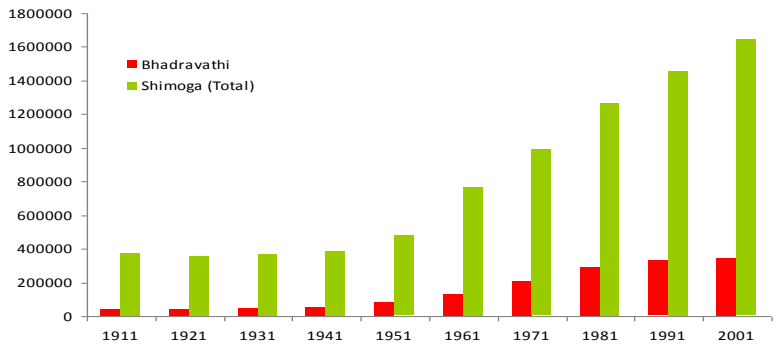
Table 7: Some Demographic Statistics

Taluk/District	Area (km²)	Total	Males	Females	Rural	Urban	Density	Sex Ratio
Bhadravathi T.	690	338,989	171,917	167,072	178,327	160,662	491	972
Shimoga D.	8477	1,642,545	830,559	811,986	1,071,535	571,010	194*	978*

** Average, Source: - Shimoga District Statistical Handbook 2009-10*

99. The population growth in last ten decade shows rapid population growth from 1971-81 (41.6%).**Figure** During 1991-2001 the annual growth rate was around 4.5%. However, the share of the district's population in Bhadrawati taluk in 1911 was only about 10% in 1911 by 1981 it had become 23% of the district's total probably because of the introduction of irrigation. The 2001 census shows that presently Bhadrawati taluk accounts for 20% of the district's total population. With a population growth rate at 4.5%, even if Bhadrawati taluk's share of the district's population becomes stable at 20% or declines, it is still growing at a very high rate.

Figure 1: Population Growth Pattern Bhadrawati and Shimoga



Source: - Shivamogga District Statistical Handbook 2009-10

100. There are a total number of 71,771 households in Bhadravati taluk which is about 20% of the total of the district. Nearly equal numbers reside in rural and urban areas in the taluk, while about 65% reside in rural areas at the district level. The average household size in rural areas is 5 compared to 4.5 in urban areas.

Table 8: Total Number of Households (2001 census)

Taluk / District	Rural Area	Urban Area	Total
Bhadravathi T.	36,253	35,518	71,771
Shimoga D.	218,360	120,026	338,386

Source: - Shimoga District Statistical Handbook 2009-10

2. Education

101. Overall literacy rates in the rural parts of the taluk are about 66% and urban 82%. The female literacy rate is lower in rural area (56%) compared to urban and district rates.

Table 9: Literacy Rate (2001 census)

Taluk/District	Rural			Urban		
	Total	Males	Females	Total	Males	Female
Bhadravathi T.	102,032 (66 %)	58,164 (74 %)	43,868 (57 %)	117,181 (82 %)	63,831 (88 %)	53,350 (75 %)
Shimoga D.	647,632 (70 %)	367,227 (78 %)	280,405 (61 %)	421,302 (84 %)	226,663 (89 %)	194,639 (78 %)

Source: - Shimoga District Statistical Handbook 2009-10

102. In terms of educational infrastructure, Bhadravathi has 356 primary schools with 40,859 students. There are 81 high schools, 21 pre-university colleges, 2 polytechnics and 4 colleges.

3. Health

103. The life expectancy at birth in Karnataka is slightly higher compared to the national average, with 2001 statistics indicating a life expectancy of 65.6 for males and 66.6 for females in Karnataka and 62.4 and 63.4 for females at the national level. Infant mortality rate in

Karnataka compared to national average, is also lower than national averages with 2003 statistics putting the infant mortality rate in Karnataka at 52 and nationally at 60.

104. District level health statistics that monitor 20 identified diseases show that malaria, typhoid, hepatitis, dengue and swine flu incidences have been noted in the state in the first half of 2012 itself. Of the district's total, 21% of dengue, 9% of malaria, 23% of hepatitis and 15% of typhoid cases are from Bhadrawati. All cases reported are of men, which is likely as women may not have equal access to medical services. Therefore, it is likely that the total number of cases in both the district and the taluk may be higher than reported. According to the Compendium of Best Practices in Rural Sanitation of the Water and Sanitation Programme, waterborne diseases in the district include cholera, amoebic dysentery, gastroenteritis, typhoid and jaundice, as is seen in the table below. For all of these there has been a downward trend which has been attributed to the success of the Total Sanitation Campaign in the district which aims at both increasing the use of toilets and improving solid waste management in rural areas.

Table 10: Shimoga District Level Disease Burden for Selected Waterborne Diseases

Diseases	Affected in 2005-06	Affected in 2007-08	Affected in 2008-09	Affected in 2009-10
Cholera	417	165	130	59
Amoebic Dysentery	2,920	1,529	682	324
Gastroenteritis	764	414	196	97
Typhoid	334	209	117	73
Jaundice	208	110	74	42

Source: - Compendium of Best Practices in Rural Sanitation, WSP, 2011

105. In terms of medical facilities there are 12 hospitals and nursing homes totalling 468 beds in Bhadrawati. Another 10 primary centres with 60 beds and a community centre with 30 beds

4. Economic systems

a. Agriculture and Livestock

106. There is a general trend in Shimoga district to convert single cropped areas to horticulture, agri-horticulture and agri-forestry systems. Depending upon monsoon and irrigation facilities, farmers may grow cash crops such as sugarcane and cotton. Kharif paddy lands and upland scrub may coexist. Arecanut (betel nut) plantations are becoming more popular in the district.

107. Major crops in the district include sugar cane, pulses, chillies, cardamom, pepper and betel nuts. Important cereals include paddy, ragi, jowar and maize. Non food crops grown include cotton, oil seed and coffee. The total area under cultivation for the taluk is 39,782 ha and for the district 255,854 ha.

108. Understanding use of agrichemicals, their management and disposal is poor. The result is that organophospates like monochlotophos are not only used randomly, but their storage and disposal is poor. Furthermore, the poor understanding of soil nutrition and the lack of soil testing results in random application of fertilizers based upon what farmers consider is most appropriate. These, and low sanitation coverage has lead to the eutrophication of water bodies with them being covered by weeds like water hyacinths. Discussions in one of the villages

suggested that the weed cover returns in the canal network within 3 months of desilting, reflecting the high levels of nutrition enrichment of the system.

109. Livestock are also kept in the area and there is an increasing preference for hybrid over local breeds, especially for cows. Of the total livestock 45% of the Taluk's livestock consists of cattle, about 25% buffalo and about 10% each for sheep and goat. Some people also rear poultry and ducks. In fact there have been some concerns from the State Biodiversity Board due to the increase in the introduction of hybrid species as most of these species are less drought resistant than native species.

b. Mining

110. Mining is not a major activity in Shimoga district. There are a total of 6 mining leases in the district at present and the total working area of all the mining leases is 158.39 hectares. Limestone mining is carried out in Bandigudda village of Bhadrawati Taluk with the quarry being about 98 ha in size. Building stone quarry leases are situated in Moodalvitthalapur village near Holehonur and Kudligere village and Anthergange villages in Bhadravati Taluk over an extent of 11 hectares. Other mining activities in Shimoga District include mining for building stones like granite and granite gneiss, sand and brick earth.

c. Industries

111. Bhadrawati town is an important industrial centre for the area with two big industries – the Visvesvaraya Iron and Steel Plan, and the Mysore Paper Mills. There are also a number of other factories in Bhadrawati. These include chemical and engineering industries – with a total of 29 factories in the Taluk, employing a little more than 8000 people. There are also a number of small scale industries, such as textile, wood, metal, chemical, electronic and electrical, paper and printing and leather. Many of these industries are highly polluting and contribute to the high pollution loads of River Bhadra.

5. Natural Resource Usage

112. Apart from the forest produce mentioned earlier, there are no other major natural resource products noted in the area. However, most people are dependent on firewood for fuel especially for cooking. Fishing for self consumption and the local market takes place in the many water bodies in the area.

6. Infrastructure

113. Bhadrawati taluk has a total of 1,556 km of sealed roads which is about 15% of the district's total road network. Of these state and national highways account for about 25% of the total roads and another 10% are major districts roads of the district. At the taluk level however state and national highways account for only 8% of the total taluk roads and major district roads for about 15%. The majority of roads are village roads – accounting for about 65% of the total. However, many village roads are not all weather roads resulting in reduced access during the monsoons.

114. Bhadrawati is also connected by the railways with a total of 19 km of broad gauge railway tracks and 1 railway station in the taluk.

7. Cultural heritage, archaeological sites and areas of significant beauty

115. Tourism is an important economic activity for Shimoga District as there are a number of wildlife sanctuaries and other scenic places such as the Jog Falls. Part of the district is included in the hills of the Western Ghats.

116. There are also a number of temples such as the Lakshmi Narasimha Temple built by the Hoysalas in the 13th century is located in Bhadrawati town. Koodli is another important local pilgrimage area, 15 km from Bhadrawati town and is the confluence of Rivers Bhadra and Tunga.

D. Disasters

117. The major natural disasters identified in the state are floods and droughts, with the years 2004, 2007 and 2008 identified as those when the district had been impacted by floods. The years 2002, 2003 and 2007 have been drought affected. That apart, the District Disaster Management Plan identified in 2009 some possible hazards for the district. These are tabulated below. While this table identifies earthquakes as a possible risk, the National Disaster Management Authority, India, Shimoga district, has Bhadrawati in Zone 2, or the low risk area earthquakes. Similarly cyclones are not expected to directly affect the district, though as the table indicates there is a possibility of indirect impact from cyclones.

Table 11: Possible Hazards and their Impact in Shimoga District

Type of Hazard	Period of occurrence	Potential impact	Vulnerable area
Floods	June – August	Loss of crops, damage to infrastructure, life, roads, houses and bridges	Along river courses, entire district
Heavy rainfall	June – August	Loss of crops	Entire district
Drought	January – May	Burning of crops, scarcity of drinking water, fodder, etc	Partly in Shimoga
Earthquake	Anytime	Loss of life and damage to infrastructure	Entire district
Indirect cyclone affect	June – August	Heavy rain, loss of crop	Entire district

Source: - Disaster Management Plan - 2009-10, Shimoga District

E. Climate Change Concerns

118. According to the 2012 Western Ghat Ecological Expert Panel report, the Western Ghats have been identified as landscapes of least resilience, making them very vulnerable to the impacts of climate change. This is of concern as many of the state's rivers including interstate rivers originate there. Part of Shimoga lies in the Western Ghats and therefore would also be impacted by this assessment.

119. An analysis of the Karnataka Climate Change Action Plan, suggests a variability of rainfall in Shimoga of be between 15% and 35% with an expected increase in rainfall between 10% and 20% in the district. However, there is expected to be a decrease in the SW monsoon precipitation and an increase in pre and post monsoon precipitation. The Tungabhadra basin districts of Chikmanglur, Shimoga and Devangare are projected to have an increase in runoff between 0 – 25%, in both kharif and rabi season. There is also expected to be a decrease in the water yields in the Krishna basin overall, which will vary between 30 to 50% in most sub-basins.

120. There is also expected to be an increase in both the maximum and minimum temperature with the projected change for Shimoga being 1.88 ºC on an average, which will be a change of 1.95 ºC in the minimum temperatures and 1.91 ºC in the maximum temperatures for 2021 to 2050, for A1B scenario. Climate change due to the expected temperature increases is expected to have an adverse impact on irrigated rice productivity which could loose yield by up to 8% according to the scenario.

IV. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS

121. Below are the potential environmental impacts from planned project activities. The legend identifying the type of impact is given at the end of the matrix. This matrix identifies all possible impacts on the environment. However the management of these impacts is given separately in another section of this document.

Environmental Issue	DESIGN IMPACT			
		Positive Impact	Adverse Impact	Mitigation measure
Physical Environment				
Water resources				
River system and environmental flows	(-, p, l)		Increased efficiencies in agriculture and better systems management with intensification of agriculture are likely to result in reduced river flows. Reduced availability of water for downstream uses.	Overall assessment of existing and appropriate water needs for each sector, including environmental flows needs to be made as part of the project's river basin plan
Surface and ground water resources	(+/-, p, w/l)	Better agriculture practices may result in improved health of local water bodies. Improved irrigation practices may reduce waterlogging in areas where practiced.	Increased intensification of irrigation could lead to increased waterlogging	Design of appropriate on-farm drainage structures and training WUCS in improved on-farm water management techniques to avoid over-irrigation
Mining and quarrying			Quarrying, borrow and sediment disposal activities could affect local vegetation, biodiversity, cause erosion, dust and noise, and affect communities	Identify specific borrow, quarry and sediment disposal sites, in consultation with relevant authorities and obtain necessary approvals. Contractor to identify borrow site locations as part of technical bid submission. Contractor must provide a plan for site restoration before opening any quarry or disposal site.

Legend of Impacts

(-)	Adverse	(+)	Positive
(p)	Permanent	(t)	Temporary
(w)	Widespread	(l)	Localised

CONSTRUCTION IMPACT				
Environmental Issue		**Positive Impact**	**Adverse Impact**	**Mitigation Measures**
Physical Environment **Water resources**				
River system and environmental flows	(-, p, w)		Sand mining resulting in changing of river course and river scouring	Identify appropriate areas for taking river sand, based upon existing regulations, but also ensuring that there is no excess sand taken.
Wetlands and local water bodies	(-, p/t, w/l)		Dumping of waste in water bodies causing contamination Washing of vehicles and other activities leading to pollution of water bodies and wetlands	Proper storage and disposal of material, including hazardous material, to avoid contamination, spills and accidents. If there are no waste disposal systems in the area, the material should be sent to a pre-identified disposal site. No dumping in river/water bodies, or labour camps/temporary or material storage sites on river bed. Vehicles properly maintained and serviced – and not washed or serviced, in water bodies. Proper waste storage and disposal. Sites cleared of all debris and restored after work completed.
Water quality	(-, p/t, l)		Construction activities could lead to erosion and increased sediment in the water ways. Washing vehicles etc in river polluting them	Adopt silt control measures at work sites, using sand bags or appropriate methods. Most of the construction is expected to take place during the dry season therefore impact will be minimal. Any construction material stored or stockpiled on site should be covered to avoid spillage into water ways. Vehicles properly maintained and serviced – and not washed or serviced, at site.
Atmospheric Parameters				
Air and Noise	(-, t,l)		Dust, fumes and noise in the vicinity of the worksite	Reduce ambient dust levels by regular spraying of water on exposed earth in construction zone near settlement areas and where there is potential for human exposure. Remove construction debris and spoil piles Use of tarpaulin covers for vehicles transporting

				material to site. Given the nature of construction activity, at a given time there will not be many heavy machinery on site. The magnitude of impact will depend upon specific types of equipment to be used, the construction methods employed and scheduling of the work. Where there are settlements close by work will be permitted only during the day time.
Land Resources				
Soil quality	(-, p/t, l)		Localized pollution due to oil and grease spill and waste. Silt disposal from canal could impact soil and ground water quality. Large volumes of fill will require borrow pits. Approximately 350,000m^3 material is estimated	Where possible try and reuse material. Try to use material excavated from canal cross section restoration for filling. Farmers have requested the excess silt as they are rich in nutrients to be used in their agricultural land. Where suitable it should be reused. Excess to be disposed of in sites identified with local authorities. Proper storage and disposal of material, including hazardous material, to avoid contamination, spills and accidents. Contractor to provide site restoration plan, prior to opening of any borrow sites and restore site in accordance to plan. Borrow site will be commissioned only after obtaining the necessary approvals from the relevant authorities. Borrow pits or quarry sites will not be permitted within forest lands.
Erosion/ compaction	(-, p/t, l)		Stockpiling areas for construction materials material –sheet and gully erosion possible	Rehabilitate all sites after construction/quarrying activities are completed such as ploughing and plantation. Plan site prior to starting excavation activities, including slope stabilization, identify and develop appropriate slope aspect during excavation and contouring to ensure slope stability after earth borrowing activities are completed. Only clear vegetation that must be cleared
Flora and Fauna	(+/-, p/t, w/l)		In certain places there maybe a need to fell some trees. Potential for human elephant conflicts due to	Ensure required permission is taken from the Tree Officer as identified in the Karnataka Preservation of Trees Act, 1976 prior to any tree

			the existence of an elephant corridor in the project area.	cutting activity. For all trees cut/removed, plantation should be at the ratio of 3 planted for every 1 cut. All plantation activities should consist of appropriate species for the area to be planted, in consultation with the Forest Department and also after understanding the local ecological needs. Include in project budget. Need to include in the construction contractor's contract Avoid any activity in elephant corridor during migratory season and do not create any permanent structure to obstruct it towards the tail end of the Gondi Anicut
Settlements	(-, t, l)		Frequent heavy vehicle traffic causing air (dust, exhaust fumes), noise, safety and traffic disruption issues. Disruptions and disturbance due to construction activities	Plan appropriate access routes and maintain speed limits to minimize disturbances within populated areas. Identify appropriate material storage areas in consultation with community to ensure least possible disturbance. Consult with local population on hours of operation and any entry of private land Provide signage, demarcate and cordon off areas to reduce access to construction area and to avoid accidents.
Infrastructure	(-, p/t, l)		Construction vehicles may cause damage to roads and related infrastructure.	Vehicles to take pre-identified routes. Do not overload vehicles or use vehicle loads higher than transport infrastructure capacity or dimensions. Identify possible telecommunication lines or other structures over roads (eg. overpasses, tunnels) in the area prior to starting work to ensure that they are not damaged due to any construction work. If damage to infrastructure occurs, plan for any maintenance that might required. The contractor through the contractor clauses will need to maintain all infrastructure in its original state.
Waste	(-, t, l)		Waste at construction sites and worker camps impacting land and water courses.	Proper storage and disposal of material, including hazardous material, to avoid contamination, spills and accidents. If there are no waste disposal systems in the area, the material should be sent to a pre-identified disposal site. No dumping in river/water bodies, or labour camps/temporary or material storage sites on river bed. Ensure proper sanitation and waste management

				facilities are installed at worker camps, if any. Vehicles properly maintained and serviced – and not washed or serviced, at site. Proper waste storage and disposal. All sites must be cleared of all debris and restored after work completed.
Health and safety	(-, p/t, l)		Accidents due to the proximity of the construction and transport sites to the residential area Accidents at the construction sites resulting in injury to the labour or local population. Labour health and accident concerns	Have a health and safety operational plan on site. All workers on site should be provided with appropriate protective gear. Ensure that all construction sites are cordoned off and only permitted people enter Ensure appropriate signage at construction sites. In case of accident ensure required first aid etc is given immediately. Do not use hazardous materials like asbestos for construction of shelters or temporary housing. Ensure prior mass awareness and consultation with local population to facilitate locations of labour camps and avoid potential conflicts Provide suitable sanitation and waste management facilities at labor camps. Do not develop any construction site – material storage, labour camps etc without consultation with the local population. Where possible do not use grazing lands etc for labour and material storage
Archaeological, cultural sites, paleontological sites and aesthetics	(-,p/ t, l)		Chance findings could exist and may be damaged if not cared for adequately	In the event that such sites are encountered, all work that may be underway or planned in the area should be stopped and discussed with District Commissioner for further action Ensure that the construction company and supervising consultants have an understanding of archaeological concerns in the area Ensure that any important archaeological area is well identified and demarcated and that required actions are specified in a detailed management and mitigation plan so that no damage takes place to it

				Quarrying within forest sites should not be permitted

Legend of Impacts

(-)	Adverse	(+)	Positive	(p)	Permanent	(t)	Temporary	(w)	Widespread	(l)	Localised

OPERATION IMPACTS				
Environmental Issue		**Positive Impact**	**Adverse Impact**	**Mitigation Measures**
Physical Environment				
Water resources				
River system and environmental flows	(-, p, l)	Improved on-farm management resulting in lowering agrichemical usage,	Improved irrigation efficiency may reduce return flows to river, impacting any environmental flows. Degradation of water bodies due to agrichemical use and dumping of agrichemical wastes containers	Overall assessment and specification of appropriate water needs for each sector, including environmental flows as part of river basin plans and monitored accordingly WUCS capacity building on proper use and management of agrichemicals, including their waste and use of IPM to reduce reliance on agrochemicals Ensuring a farmer-friendly method for disposal of agrichemical waste, as identified during project design
Groundwater	(+/-, p, l)	Improved agricultural practices resulting in lowering agri-chemical usage, improving aquifers health Improved irrigation practices may reduce, with positive impact on aquifer quality	Poor drainage management leading to silting and choking, resulting in waterlogging and rising water table Poor agricultural practices – like excessive irrigation leading to rising water table and waterlogging Agri-chemicals leaching into aquifer causing contamination	WUCS capacity building on more efficient irrigation practices and cropping patterns WUCS capacity building proper use and management of agrichemicals, including their waste Ensuring a farmer-friendly method for disposal of agrichemical waste, as identified during project design
Land resources				
Soil quality	(+, p, w/l)	Effective agriculture extension improves soil quality		Identify appropriate soil management and soil testing systems and educate farmers. Ensure that farmers remember through repeated information sharing on good agriculture and soil management practices Farmers education on proper use and management of agrichemicals, including their waste
Erosion/ compaction	(+, p/t, l)	Better awareness due to agriculture extension resulting in reduced erosion along waterways Improved soil management with improved agricultural extension systems resulting		Identify appropriate soil management and soil testing systems and educate farmers. Ensure that farmers remember through repeated information sharing on good agriculture and soil management practices

		in better soil health and reduced erosion		
Salinity, alkalinity	(+/-, p, w/ l)	Improved soil, water, irrigation and drainage management will ensure soil salinity and alkalinity is reduced and improve soil health	Inadequate drainage management resulting in poor irrigation and drainage practices	Engage WUCS on improved maintenance of on field irrigation systems. Identify appropriate soil management and soil testing systems and educate farmers on it. Ensure that farmers remember through repeated information sharing on good agriculture and soil management practices Education to farmers on improved agricultural practices, on-farm land management practices
Natural and Biological environment				
Terrestrial Flora and Fauna	(+/-, p, w/l)	Reduced toxicity in the environment with better on-farm management practices	Poor management of agriculture waste – especially agri-chemicals and their waste products, contaminates the area and impacts local or migratory species. Potential to expand cultivation areas	WUCS capacity building proper use and management of agrichemicals, including their waste Work with local community to ensure that cultivation is not extended into areas environmental assets Demarcate all areas through an IWRM plan for conservation and limitation of areas for agriculture. Identify important wetlands and monitor land use and condition Through the IWRM activities identify appropriate land management and conservation methods, and work with farmers to educate and ensure that wetlands are not degraded
Aquatic flora and fauna	(+/-, p/t, w/l)	Improved irrigation, agriculture and on-farm practices resulting in improved aquatic habitats and reduced proliferation of aquatic weeds	Agrichemical waste and increased toxicity of the local aquatic environment	Work through a community system to identify wetlands, other habitats and local environmental assets Work with local community to ensure that cultivation is not extended into areas environmental assets Educate community on management of soil and agrichemical usage Demarcate all areas though an IWRM plan for conservation and limitation of areas for agriculture.
Sensitive areas	(t,l)		Agriculture and irrigation intensification and use of	Work through a community system to

			new species may have an impact on area of influence of sensitive area	identify wetlands, other habitats and local environmental assets Work with local community to ensure that cultivation is not extended to forest reserves or sensitive areas Educate community on management of soil and agrichemical usage Demarcate all areas though an IWRM plan for conservation and limitation of areas for agriculture.
Economic and Infrastructure				
Agriculture	(+/-, p, l)	Improvement in yields and productivity with improved agriculture extension /agricultural practices, more reliable water supply, higher water use efficiency and reduced waterlogging. There is likely to be a positive impact on agriculture due to a move to higher value and more efficient crops. Improved livelihood opportunities in agriculture and better returns	Possible loss of agri-biodiversity due to introduction of other species and high yielding varieties	Identify methods of preserving and cultivating local agricultural species and cultivars. Education to farmers on improved agricultural practices, on-farm land management practices
Social				
Population and livelihoods	(+, p, l)	Overall improvement in livelihood opportunities due to increased productivity and improved information on agriculture		
Vector borne diseases	(+/-, p, l)	Reduced area of paddy rice and waterlogging reduced habitats for various vectors both due to reduced humidity and waterlogging	Additional storage reservoirs increase vector habitats	Existing storage areas to be developed and improvements in understanding of inflow and outflows to improve system management
Water borne diseases	(+/, p, l)	Improved drainage and better water supply through canal rather than overland flow	Increased human activity during construction near canal locations - introduction of waste in to the canal system	Provide suitable latrine facilities for construction workforce. Capacity building of WUCS and women population in safe usage of water
Nutrition and other health problems	(+/-, p/t, l)	Better food and nutritional levels due to better yields and food availability and incomes	Toxicity and other health risks due to use of agrichemicals without adequate protection Reuse of agrichemical packages for food and	Work with and educate farmers on the best management of agrichemicals Consider options for improving quality of

			other storage purposes Burning of agrichemical plastic packaging Increased agri-industry waste disposal without adequate treatment and management	NPS runoff

Legend of Impacts

(-)	Adverse	(+)	Positive
(p)	Permanent	(t)	Temporary
(w)	Widespread	(l)	Localised

V. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

122. The consultative process for this subproject has identified a number of issues, such as the interest of 95% of villagers supporting the canal being lined mainly for livelihood and health related reasons. These include reduced waterlogging, improved and more efficient availability of irrigation water. Another benefit identified by the villagers from the project was of reduced damage and dampness to houses caused by waterlogging in the area. This section discusses the relevant environment related issues which came up during the discussions.

123. **Agrichemical usage:** Discussions on the use of agrichemicals – both fertilisers and pesticides show that understanding of agrichemical usage is poor. Most information is either from their friends, family or neighbours or from agrichemical shops. Therefore in many cases it seems to be a trial and error process. Discussion with both farmers and agrichemical shops showed that the chemicals suggested for a specific pest do not always work and therefore another is tried until the appropriate one is found and the problem is solved. It was also noted that organophosphates are being used by the farmers, which is of concern both due to their impact on health and bio-diversity, and the poor understanding of dosage and disposal of unused agrichemicals and their waste.

124. **Management of agrichemicals:** Another issue identified was the poor understanding of agrichemical storage and management of the waste. Discussions show that there is no proper disposal of agrichemical waste. Therefore, waste such as empty containers and partly used chemicals are disposed in the village itself. This includes burning the waste containers, burning the chemicals, or reusing containers. Reuse includes for storage of food stuff.

125. Most people mention that agrichemicals are stored in the house, in places often easily accessed by all family members and also not necessarily separately in order to avoid contamination.

126. **Soil health:** Soil testing is not common in the area. The result is agrichemical usage is based on what the farmers consider to be appropriate. This inadequate information, according to the agricultural specialist of CADA has resulted in micro-nutrient deficiencies in some areas and apparently high application of nitrogen, phosphorus and potassium.

127. **Organic farming and IPNM:** At present organic farming is limited as the common understanding is that there is little value added and often crop productivity suffers. Therefore, most farmers prefer not to undertake organic farming. Equally, organic farming is only seen as the use of organic manures. The use of integrated pest and nutrient management is not common in the area. Nonetheless, there are a few progressive farmers who experiment with vermi-compost, integrated pest management and integrated pest and nutrient management, though because of the common understanding that yields reduce with use of organic manures these practices have not been adopted by many farmers.

128. Recently there has been an increase in the use of micronutrients. While the agrichemical shops identify these as ‘organic inputs’ farmers see these as fertilizers. This usage is however limited at present.

129. **Access to information on on-farm management:** Access to information on agrichemicals, their use and management is limited. Most information is from the shops that sell

agrichemicals. The shop owners are informed mainly by the chemical companies who supply the various chemicals and tell them what to use and how. Discussions on the use of organic fertilizers or biocides among shopkeepers, shows their limited understanding on the subject. Shop keepers mainly see organic farming as the use of micronutrients.

130. Some farmers access government extension services – the Agriculture Department officials at Hublil. However, this is limited to only those who are living close to the area. The others mainly consult shopkeepers for any agrichemical information.

131. Management of soil health, soil testing and other farmland management activities are largely limited to existing knowledge of farmers and information from neighbours and relatives, as access to information is limited. While farmers understand that soil testing can improve their soil health, they do not have sufficient information or access to appropriate systems to undertake soil testing activities.

132. **Water hyacinth management:** In some areas, farmers have mentioned the use of the water hyacinth as manure. This is confined to areas and periods when water hyacinth is easily available. Farmers understand that the use of water hyacinth improves productivity. Also, farmers seem to be happy to use this resource where available. Therefore, possibilities could be explored how the weed could be managed through farmer's participation. However, this cannot be assumed as a shift towards organic farming but just an available opportunity in selected areas.

133. **Canal water usage:** Discussions with villagers highlight that they use the canals for various purposes other than just for irrigation. They wash their clothes and animals with the water, animals also drink from the canal directly. Therefore, there is a need to consider these issues while designing any modernization activities for the project.

134. All information will be available in the local language, Kannada apart from being discussed in the project villages as part of the mass awareness and subproject specific communication campaigns. Copies of the project outline and key findings the draft environment assessment report would be made available in the local language and will be available with the KNNL engineer in-charge of the sub-project, the District Commissioner. As per ADB's disclosure policy the IEE will be disclosed on ADB's website.

135. During detailed design and project implementation the Program Management Unit and PIOs established will continue to consult with the public and beneficiaries of the project.

VI. GRIEVANCE REDRESSAL MECHANISM

136. Grievance redressal needs to be considered to ensure any unintended consequences, or violations of planned actions and activities is brought to the notice of the authorities to ensure compliance and resolution of problems and issues faced by the local population. The grievance redressal mechanism must,

(i) Be accessible to the local population and therefore should be present close to the area where project activities are under implementation.
(ii) Ensure fairness and transparency in any grievance system planned. This could include making information on project activities available at the impacted areas itself, keeping a register of complaints and a system to identify progress of complaint and resolution taken, providing for a higher level authority for any problem resolution that has not be solved at the local level, ensure that contact information on the existing grievance redressal mechanism is available at the project implementation/construction sites.
(iii) Ensure there are time limits set for solving all issues at each level of the system and is adhered to.
(iv) Also, if any adverse impact is identified by the local population, they need to be immediately addressed and the grievance redressal system should be able to include any such complaints into project design.
(v) It must be a dynamic process that is able to help correct any adverse impact that project activities occur

137. All sub projects must have a detailed grievance redressal process for ensuring community and individual concerns arising from project activities can be heard and addressed adequately. It is suggested that the grievance redress mechanism have three levels. These levels would be to ensure that complaints if not resolved at the preliminary level can be addressed at a higher level, with all complaints getting a possibility of being resolved, depending upon the jurisdiction and capacity of the different levels.

12. The SGOK has published a Citizens Charter[6] providing names and other details of officers responsible for various projects, where citizens can send their grievances. The existing grievance redressal mechanism for KNNL, which is for all grievances not just environment-specific, will be adopted for environmental grievances. The procedure is described below.

13. The first level for grievance redress will be the WUCS, who would be the easiest to contact for farmers and villagers, given their proximity to the subproject area. In case the management board of the WUCS is unable to satisfactorily resolve the problem within a period of 3 to 5 days, the WUCS will assist the complainant register the concern with the Executive Engineer (EE) of the PIO who will satisfactorily resolve the complaint within a week of the complaint being registered. Beyond a week the complaint will need to be forwarded to the Project Manager of the PIO who will be the zonal Chief Engineer of the irrigation subproject. If the complaint is not satisfactorily dealt with within two weeks then it is recommended that the matter may be brought to the notice of the PD PMU. If the matter is not resolved by the PMU it will be taken up by the Grievance redress committee (GRC). The GRC will comprise the Deputy Commissioner as Chairman, a member from the Revenue and Agriculture Department, a representative of KNNL, Panchayat and WUC members and representatives of affected persons, including women and vulnerable groups. However, at any stage, an aggrieved person

[6] Reference WRD:158:SAV:2011 dated 21st Oct. 2011

will be free to access the country's legal system and that this is not conditional upon the perceived unsatisfactory outcome of the GRM. At each level a register documenting the grievance and action taken will be maintained. At a minimum the following must be recorded: (i) basic information about the affected person (name, address, contact number); (ii) category of grievance filed (legal, social, environmental, technical/engineering, financial, etc.); (iii) detailed description of grievance; and (v) type of action taken or to be taken (whether resolved at the specific level or submitted to a higher level). The register will be signed by the officer receiving a grievance and the affected party and the receiver of the complaint

14. Through the process, the complainant has access to the state and national legal system and that this is not conditional upon the perceived unsatisfactory outcome of the grievance redress mechanism.. The program website and PIO website may also provide suitable mechanisms for complaints registering. These may be compiled monthly by the EE and monitored with the support of the Environment Specialist of PSC.

VII. ENVIRONMENTAL MANAGEMENT PLAN

138. The program management unit (PMU) will be located within the KNNL and Managing Director, KNNL will be the PD. The PMU staff will be based in the PD office in Bangalore. The PD will operate under the overall guidance and with the support of the Principle Secretary WRD and the PSC. The PMU will comprise the following units: (i) monitoring and communication, (ii) budget and administration, (iii) irrigation management, (iv) CADA, and (v) institutional support. The PMU will be supported by program support consulting (PSC) services. They will jointly monitor environmental performance of this subproject and undertake safeguard assessment for subprojects under Project 2..

139. For field implementation (Output 2), each irrigation project to be modernized will have a dedicated PIO under a program implementation officer of the rank of the Chief Engineer of that zone reporting to the PD. The program implementation officer will be supported by the zonal Superintending and Executive Engineers.

140. Dedicated irrigation sub-divisions will be established under each field PIO with the full compliment of required staffing which will be dedicated for implementation of program activities. These will include Assistant Executive Engineers, Assistant Engineers, Junior Engineers and other technical staff. The number of dedicated sub-divisions under the PIO will be determined by the extent of command area and quantum of works to be undertaken. The CADA staff deputed to the PIO will be an Assistant Engineer, Assistant Agriculture Officer and the Senior Inspector of Cooperative Society. The PIO will be provided with WUCS support service teams to maximize field outreach.[7]The engineering staff will be trained by the Environment Specialist of the PSC on environmental monitoring and reporting.

141. Below is the EMP for the Gondi irrigation subproject. This is based upon the findings of the impact assessment, a public consultative process, review of existing legislation and review of secondary information. All of these are given in earlier sections of this document.

Environmental Issue	Mitigation Action	Project Responsible

[7] The organization arrangement of PMU and PIO may be adjusted in later tranches based on implementation experiences.

		Authorities
Project Design and Location		
Reduced environmental flows due to increased efficiency	Overall assessment of appropriate water needs for each sector, including environmental flows	AC-IWRM and WRD
Waterlogging or aquifer degradation due to project activities	Development of appropriate drainage structures and management measures, on-farm land management.	KNNL, PIO, WUCS capacity building with PSC
	Consult with farmers to identify appropriate cropping patterns and agrichemical usage given existing soils and drainage conditions.	PIO and PSC for WUCS strengthening
	Identify and manage quarries such that they cause minimum if any damage to surface and ground water systems, and ensure that during quarrying there is minimum if any damage to aquifers and surface water systems	KNNL, PIO and contractors
Water quality degradation due to existing agricultural practices – agrichemicals and land management practices	Capacity building of WUCS on improved agricultural practices and use of agrichemicals, on-farm land management practices	PIO with PSC support and Department of Agriculture Extension
Lowering groundwater table	Identify appropriate groundwater management and conjunctive use plans and local level regulation systems based upon local aquifer needs.	AC-IWRM's IWRM plans, Minor Irrigation Department, Mines and Geology Deaprtment
Construction stage		
Reduced aesthetics due to quarries on river bed, hills etc.	Rehabilitation of all sites must be undertaken once work is completed. The contractor must present a site restoration plan prior to undertaking work and get it approved by the PIO/Engineer. Avoid any quarrying work in an aesthetically important/significant place	Contractor responsible to implement with monitoring by PIO with PSC support
Loss of local agri-biodiversity	Identify methods of preserving and cultivating local agricultural species and cultivars. Work towards breed improvement of local agricultural species and possible methods to improve income from the sale of produce of local agri-biodiversity	PIO with PSC support
Increase in agricultural waste such as agrichemical waste	Undertake farm management education for farmers to ensure that they know how to dispose agrichemical waste in most appropriate way Explore with KVK's, Agriculture Department, local agrichemical shops and agrichemical companies possibilities of buy back system for agrichemical containers etc	PIO with PSC support WUCS and Department of Agriculture Extension
Erosion due to sand and murram mining and material procurement methods	Plan mining and procurement sites before starting work to keep in mind any erosion issues that may occur Rehabilitate site after finishing work, as appropriate	Contractor monitored by PIO with PSC support

Occupational safety and construction hazards.	Provision of protective gear and safety equipment as required. Signage, site plan, lighting and restricted entry. Vaccination and preventive health measures as required, and first aid at site. Facilities for handling emergencies at site. Restricted access to hazardous materials. Personnel handling hazardous material properly trained, licensed and with sufficient experience. As needed have toilet and drinking water infrastructure, at construction sites.	To be ensured by construction company through contractual clauses both for work carried out by them and for any procurement form other agencies, monitoring by PIO
Pollution from construction activities	Proper storage and disposal of material, including hazardous material, to avoid contamination, spills and accidents. If there are no waste disposal systems in the area, the material should be sent to a pre-identified disposal site. No dumping in river/water bodies, or labour camps/temporary or material storage sites on river bed. Vehicles properly maintained and serviced – and not washed or serviced, at site. Proper waste storage and disposal. Sites restored after work completed. Ensure vehicles are covered when carrying raw material Use sprinklers etc to settle dust where needed	To be ensured by construction company through contractual clauses both for work carried out by them and for any procurement form other agencies, monitoring by PIO
Accidents and health concerns of local population	Ensure that all work areas are cordoned off and only permitted people enter Ensure appropriate signage at construction sites Ensure that where blasting takes place (if any), such as at mines, timings are known and followed In case of accident ensure required first aid etc is given immediately	To be ensured by construction company through contract clauses both for work carried out by them and for any procurement form other agencies, monitoring by PIO
Compaction of soil/soil erosion for access to various sites and quarries – such as metal quarries for aggregate, murram quarries and sand mining areas	Rehabilitate all sites after construction/quarrying activities are completed such as ploughing and plantation. Plan site prior to starting excavation activities, including slope stabilization, identify and develop appropriate slope aspect during excavation and contouring to ensure slope stability after earth borrowing activities are completed. Only clear vegetation that must be cleared As far as possible use already identified roads and routes to access various sites	To be ensured by construction company through contract clauses both for work carried out by them and for any procurement form other agencies, monitoring by PIO
Disturbance to local population.	Identify and enforce appropriate access routes, speed limits and timings with community. Identify appropriate material storage areas to ensure least possible disturbance. Consult with local population on hours of operation and any entry of private land Provide signage, demarcate and cordoning of areas to reduce access to construction site and to avoid accidents. Control traffic dust Ensure appropriate site drainage. Restore areas after work is over. Minimize transportation of material through heavily	To be ensured by construction company through contract clauses both for work carried out by them and for any procurement form other agencies, monitoring by PIO

	populated areas. Only use road worthy vehicles.	
Damage to infrastructure.	Vehicles to take pre-identified routes. Do not overload vehicles or use vehicle loads higher than transport infrastructure capacity or dimensions. Identify possible telecommunication lines or other structures over roads (eg. overpasses, tunnels) in the area prior to starting work to ensure that they are not damaged due to any construction work. If damage to infrastructure occurs, plan for any repair and maintenance that might be required. The contractor through the contractor clauses will need to maintain all infrastructure in its original state.	To be ensured by construction company through contract clauses, monitored by PIO
Workers / labour camps and facilities.	Provide appropriate shelter and other facility for any labour brought from outside. Do not use hazardous materials like asbestos for construction of shelters or temporary housing. Ensure no conflict with local population due to labour camp. Provide sanitation and waste management faculties	To be ensured by construction company through contract clauses – monitored by PIO
Chance findings – archaeological sites.	Stop all work that may be underway or planned in the area and discuss with District Commissioner for further action Ensure that the construction company and supervising consultants have an understanding of archaeological concerns in the area Ensure that any important archaeological area is well identified and demarcated and that required actions are specified in a detailed management and mitigation plan so that no damage takes place to it	To be ensured by construction company through contract clauses, monitoring PMU environmental specialist
Project Operation		
Increased agricultural waste in water and water bodies	Ensure through farmer's education that waste is not disposed in water bodies and appropriate waste disposal systems are found and used	PIO with WUCS Service Support Teams (SST)
Increased agrichemicals in surface and ground water systems, and reduced quality of return flows	Farmers education on proper use and management of agrichemicals, including their waste Ensuring a farmer-friendly method for disposal of agrichemical waste, as identified during project design	PIO with WUCS SST
Waterlogging and reduced drainage	Identify appropriate cleaning and maintenance of drainage system, including disposal of waste removed. Improved agriculture practices – understanding plant needs and use of irrigation water as required through improved understanding of the system Identify appropriate systems for the management of drains and disposal of silt Ensure there is a budget for the management of drains and the budget is spent on it	PIO with WUCS SSTs
Soil degradation due to poor on-farm management, intensive agriculture, soil exhaustion and soil toxicity due to chemical usage and lack of knowledge among	Identify appropriate soil management and soil testing systems and educate farmers on it. Ensure that farmers remember through repeated information sharing on good agriculture and soil management practices	PIO and WUCS

farmers		
Increased aquatic weeds	Ensure appropriate drainage management to keep the canals and drains silt free and not allowing the disposal of any waste Work with farmers through farmer's education system to ensure appropriate application of agrichemicals, including fertilizers Educate farmers on proper soil management and testing	PIO and WUCS
Multi-objective use of tanks and off line storages	Consult with users, study existing and planned uses and consider options for best management of the tank areas recognising their multiple uses (eg. environment, irrigation water supply/control, weed collection, fishing, fringe grazing etc	PMU AC-IWRM IWRM plans

A. Monitoring Plan for Sub-Project

142. Prior to developing a monitoring plan there is a need to develop a baseline for some activities to help with the monitoring activities. The baseline is described below along with monitoring needs and responsibilities. Annual Environmental monitoring reports will be submitted to ADB by the PMO supported by the environment specialist. However, the quarterly progress report of the project will need to include a a short section giving the present status of implementation of environmental safeguards, and report any environmental concerns, if they exist.

Project Phase	Parameter	Frequency to monitor	Action	Responsible authority
Construction	Site for quarries and borrow pits	Before work baseline and end of work prior to making final payment for work to contractor.	Photographic baseline (pre-construction) of original site. Submit site restoration plan and following completion of activities- to be reviewed by PIO and environment specialist as to if site restoration completed as stated.	The construction company to take the photographs and submit them to the PIO. The PMU environment specialist will monitor implementation, Only after the rehabilitation is completed will the related payment to contractor be released.
	Removal of vegetative cover and trees	Prior to initiating construction work identify number of trees and type of species to be cut. Based on the number to be felled identify number to be planted and liase with respective local office on replanting activities.	Confirmation that trees have been replanted as stated and monitoring of survival rates.	Contractor responsible for preparation of list of trees to be felled and replanting and obtaining necessary approval. The PIO and environment specialist to monitor.
	Water quality (total suspended solids, BOD, DO)	Upstream and downstream of worker camps (every 6 months) In 6 locations to be identified based on		Contractor responsible to monitor

		construction sequence		
	Waste management at sites	At random at sites, but report compiled on a monthly basis.	Review if the waste management plan is in place and being followed properly.	PIO engineers to monitor that contractor has proer waste management procedures in palceduring site inspections.
	Site management- ensure erosion control measure are in place, health and safety measures are in place.	During entire period of construction.	Adopt measures described in the mitigatory measures table.	Contractor to comply and monitored by PIO engineers
	Site restoration	At completion of work in any area.	To ensure that restoration is undertaken appropriately. Photographic evidence	To be done by the construction contractor, monitored by PIO.
Project Operation	IPMN implementation	Six monthly	Review progress of knowledge and use of IPNM by farmers and access to required facilities.	Based upon the activities identified by the PMU and in the subproject documents
	Water Quality	Annually, at the same time each year (to include pH, EC, Na^+, dissolved solids, BOD, COD,	Baseline to identify the quality of water and and monitor in seven locations annually s for changes in water quality for the duration of the MFF (7 years). Monitoring locations to include upstream of project command and downstream area, and if any return flows exist, monitoring of water quality of return flow quality	The baseline to be developed and included in the DPR. Monitored by the PIO as part of the MIS and effects monitoring. The annual monitoring should be based upon the activities identified by the PMU and should include the PMU environmental specialist to review and provide any corrective measures if needed and where possible
	Soil Quality	Annually, at the same time each year	Baseline to identify four locations to monitor soil quality for the duration of the MFF (7 years).	The baseline to be developed and included in the DPR. Monitored by the PIO as part of the MIS and effects monitoring.

B. INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING

143. Presently the KNNL needs to outsource any environment related activities and does not have any internal capacity to handle environment related activities. Discussions also did not identify any specific nodal officer who is assigned to look at environment related issues in the

organisation. They are therefore largely dependent on consulting companies for any advice and actions required to manage environmental issues that they may need to address. Discussions also identified that consultants are mainly hired if any legal need to undertake an environmental assessment or some environmental monitoring activities are to be undertaken, as identified by the Government of India regulations. Therefore, if there are any specific environment issues that would need to be addressed during regular project activities the capacity of the KNNL is weak.

144. The PSC will consist of an environment specialist who will provide capacity building to the engineers of PIO on ADB's and GOI's safeguard requirements and environmental monitoring. One of the assistant executive engineers of the PMU will be specifically assigned to undertake environmental safeguards monitoring and will work closely with the environment specialist of the PSC. They will also participate in ADB safeguards training which are conducted regularly by the ADB India Resident Mission.

145. Most project activities associated with output-2 are focused on improving agriculture and therefore directly working at the farm level. However, discussions in villages show that there is a lack of awareness on the management of land resources and use of agricultural inputs like fertilizers and pesticides. Therefore, the project will need to undertake capacity building of farmers to ensure that they purchase, store, use, and dispose of chemicals and their waste (eg. wrappings, containers, etc) appropriately.

Capacity Building Activity	Frequency	Type of training	Who will be trained
Awareness on ADB environmental procedures, monitoring and EMP needs	Once project start	Half day workshop led by environment specialist of the PSC	All stakeholders involved in project design and implementation – KNNL (MD) and PIO staff for all irrigation zones associated with the program
Programme awareness training	Annually	Half day workshop	All stakeholders involved in project design and implementation – KNNL (MD) and PIO staff for all irrigation zones associated with the program
Identification of possible environmental issues and possible mitigation actions	At project start	2 days – including both field visits and group discussions	Field level staff – CE/SE, EE and WUCS
Identification of environmental impacts and possible mitigation actions	Annually	Half day, workshop	Field level staff – CE/SE, EE and WUCS
Monitoring of environmental actions, development and filling of monitoring formats	Once at project start	Half day, workshop	All stakeholders involved in project implementation – KNNL (head in-charge of project implementation at head office and project office engineer in-charge of implementation at the field and person overseeing implementation of IEE level – CE/SE and EE)

The cost of implementation of the EMP is estimated to be cost of the environment specialist (which is included in the project consultancy budget and therefore not repeated here) and costs of water quality monitoring and soil quality monitoring and adoption of mitigatory measures. It is expected that mitigatory measures to be adopted during construction (such as erosion control, rehabilitation of borrow and disposal sites, waste management on site etc.,) are included in the engineering costs of the contractor.

The parameters selected for water quality monitoring will basically monitor nutrient enrichment and sediments and turbidity. This will be useful to check for assessing improvements in agricultural land management – reduction in soil erosion and subsequent turbidity in water, and appropriate application of fertilizers which would reduce nutrient enrichment of the river and water bodies. While some samples will be continued during operations, during construction SS, BOD and DO will be measured in six locations bi-annually. In addition a budget of INR 200,000 will be allocated for any tree replanting activities that need to be undertaken.

Water Quality Testing Parameters and Costs for Monitoring and Baseline

Parameter	Rate per sample[8] (INR)	No of samples in a year	Total no of years	Total no of samples	Total cost
During construction (responsibility of contractor)					
Suspended Solids (SS)	100.00	12	3	36	3600.00
BOD	600.00	12	3	36	21600.00
DO	100.00	12	3	36	3600.00
During operations (responsibility of KNNL)					
Suspended Solids (SS)	100.00	7	6	42	4200.00
TDS	100.00	7	6	42	4200.00
BOD	600.00	7	6	42	25200.00
COD	350.00	7	6	42	14700.00
DO	100.00	7	6	42	4200.00
pH	60.00	7	6	42	2520.00
Nitrates	200.00	7	6	42	8400.00
Phosphates (total)	350.00	7	6	42	14700.00
Totals baseline + 5 year monitoring		90	54		**103,320.00**

Soil quality testing

Parameter	No of locations	frequency	Cost per sample (INR)	Total cost (INR)
Soil- phyiso- chemical, micro and macro nutrients and pesticide residue Total 27 parameters including 4	4	Annually for seven years	12,100	338,800

[8] All tests rates for water quality are taken from the Central Pollution Control Board's Schedule of Rates dated 15th June, 2008

pesticide residue				

VIII. CONCLUSION AND RECOMMENDATIONS

146. While there are sensitive areas in Shimoga district where the Gondi subproject is located, none of them fall in the planned subproject area. The proposed development activities of subproject modernization are also unlikely to have an adverse impact on these sensitive areas. The project will support modernization of an existing canal, and therefore there are no key impacts on any sensitive areas or land use.

147. The IEE has screened the range of potential environmental impacts, prepared a proposed Environmental Management Plan and sub-Project Monitoring Plan.

148. In addition to these plans there are a number of areas requiring further attention and these are:

(i) Appropriate mechanisms to improve on-farm soil and land management and to introduce IPNM and other mechanisms to ensure reduced use of agrichemicals need to be developed and implemented. It is expected that intensification of agriculture will be tend to increase agrichemical usage.

(ii) Care also is needed to prevent the introduction of invasive alien plant species that may be transported by migrating animals to the Western Ghat forests.

(iii) Consideration for allocation of environmental flows will be developed under Output 1- the IWRM process. The envisaged plan to improve efficiencies of the system, save water for upstream consumption, will reduce return flows to the river. Therefore allocation of environmental flows is a key consideration under the project.

(iv) There is thought to be little scope for expansion of the irrigated area as the command area is now fully irrigated and on one side is bordered by the Bhadra river and on the other by the Bhadra command area. Internally there could be some minor scope however by encroaching upon tank areas which have some ecological value. It is suggested that local land use plans be developed in discussion with the local populations to protect any such important areas including along the river and waterways. This perhaps again is an area where the IWRM project could assist.

The main area where there is a need for close monitoring is during the construction period – where issues of material procurement, site planning, management of any labour camps and labour needs, noise and dust control, disposal of waste, vegetation clearance, and the restoration of sites after the work is completed need to be ensured.

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Annexure B: Public consultation dates and list of participants
Stakeholders consultation and profile of participants in Gondi Project

Place	Dates	Stakeholder Profile						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Thallikatte	06/08/12		10	5	1	1		2
Dasarakallahalli	07/08/12		10	4	2			4
Dayanakpura	08/08/12		15	4	2	2		
Barandoor	08/08/12	1	15	6	2	3	2	
Korekoddegahalli	09/08/12		21	4	1	2	5	
Doddagopenhalli	28/08/12		20	4	1	1	3	4
TOTAL		**1**	**91**	**27**	**9**	**9**	**10**	**10**

The stakeholder profile correspond to 1 - state government, 2 – villagers, 3 - local government/ Gram Panchayat/ WUCs /Aanganwadi members, 4 - SOE (KNNL, CADA), 5 – civil society organisations, 6 - female, and 7 – consultants