

EXECUTIVE SUMMARY

The proposed Yan Oya reservoir project involves the construction of an earth dam across Yan Oya, upstream of the existing Yan Oya diversion weir at Pamburugaswewa, to establish a 169 mcm capacity reservoir. The proposed 2,350m long main dam will be located 30 km upstream of Yan Oya sea outfall at Pulmodai and 1.25 km downstream of the confluence of Kapugollewa Ela and Ebbe Ela with Yan Oya. In addition to the main dam, four saddle dams totaling to the length of 3,594 m will be constructed to complete the proposed Yan Oya Dam at the selected locations, which will give a total dam length of 5,944m. The head works of the project include a spillway with 5 radial gates (12m x 8 m), located at first right bank saddle dam and two tower sluices, located in left bank of the main dam and saddle dam number three for left bank and right bank conveyance canals, respectively. The discharge capacity of concrete lined, 22 km long left bank main canal will be 8.37 m³/ sec and it will directly serve 4190 ha of lands in the left bank irrigable lands of Yan Oya. The right bank main canal will be 11.7 km long with a discharge capacity of 3.25 m³/ sec and will serve 1812 ha of irrigable lands in the right bank area. In addition to main canals, 25.8 km of branch canals, secondary and tertiary irrigation infrastructure including operation and maintenance roads with bridges, culverts etc. will be established under the project.

Yan Oya originates within the hilly areas of Dambulla and Sigiriya. The catchment of Yan Oya (1,538 km² in extent) is located in the North-Eastern region of Sri Lanka between Ma Oya and Mee Oya basins in the north, Pulakuttiaru, Kunchikumban aru, Pankulam aru and Kanthale aru basins in the east, Kala Oya basin in the south, Mahaweli Ganga basin in the south-east, and Malwathu Oya basin in the west. The river flows with a low gradient throughout its journey. It forms a wide flood plain that consists of deposits originated from floods. The surface soil of the project area is mainly Reddish Brown Earth Soils (RBE), which is the predominant type soil found in the Dry Zone.

Four alternative proposals have been studied in detail considering the optimizing the irrigable extent to a maximum limit, minimizing resettlement impacts, cost effectiveness consideration of infrastructure and minimizing the social and environment impacts. Alternate No.4 in this report has been finalized as the best option.

For the earth dams and other infrastructure construction, total of six burrow sites have been identified. Of these sites, three each are located in upstream and downstream of proposed dam structure. The Burrow site – 1 is located in a section of about 6 – 8m high quartzitic ridge structure in downstream of dam in left bank area, while the other burrow sites are located on flat ground, generally about 1 – 2m higher ground than the general ground surface. Five quarry sites have been identified to obtain construction materials (rock) for the project. Of these sites, only one is a surface outcrop while the other four quarry sites are located in ridge structures having 35 – 40m height.

The proposed Yan Oya reservoir project is located within the first peneplain and exists as a vast flat plain with scattered insulburgs. These insulburgs may rise up to 50m above the ground surface. Of these insulburgs, Yakinikanda, Veherabandikanda, Galbuddhakanda and Labukanda will be incorporated for the construction of the main dam and saddle dams. Fractured and

partly or fully detached rock slabs have been identified within the hill slopes of these ridge structures. Landslides or earth slips have not been reported within the proposed project area. Since the entire area has a flat topography, the area covered by the proposed project would not be prone to future landslides as well.

The rainfall pattern in the area is bi-modal with two rainfall peaks occurring during the South West and North East monsoon periods. The catchment area of Yan Oya receives the highest rainfall during the North East Monsoon period (October to February). Mean annual rainfall received by the catchment area of the proposed reservoir is 1645 mm. The average annual runoff of the catchment is estimated to be approximately 7.3 m³ /sec or 232 mcm/ year. The surface drainages take place from the ground through the valleys slopes etc. to the stream network. In addition to the stream network rain water is received and sequestered in several tank cascades and several major reservoirs that are present within the Yan Oya basin.

Flooding takes place in Yan Oya during the months of November and December. These flood waters overflow to the Yan Oya flood plain and inundates the paddy areas in it. The flood impacts are much severe in the downstream areas beyond the proposed dam site up to the sea outfall. The 100 Year flood at the dam site is estimated to be around 2284 m³/sec.

The predominant water use in the river basin is for irrigating cultivated land that takes place mostly during the Maha Season (October-March). Water usage for other domestic purposes including drinking is relatively small when compared to the existing irrigation use. Huruluwewa and Wahalkada irrigation schemes are the main irrigation systems that occur within the Yan Oya river basin.

The rate of the river basin erosion has been estimated at 240m³/km² per year. However, the overall sedimentation rate in the basin is relatively low because of the presence of Huruluwewa reservoir and large number of tanks and paddy lands within the river basin which controls the sediment flow within the river basin.

The main activity is the land preparation during construction stage and will clear out the existing vegetative cover of the ground. Once these areas are cleared, the cleared lands will be subjected to wind erosion as well as erosion during rainy periods and will be transported along the minor stream paths and these stream paths are finally connected to Yan Oya. To avoid these soil erosion and siltation related issues, it is recommended to erect several silt traps along the minor seasonal stream paths. In addition, it is recommended to construct minor check dams, and turf the exposed steep sections to maintain the soil cover and avoid further soil erosion.

Excavated soil materials during construction will not be allowed to accumulate in isolation and will be taken to identify soil dumping sites after excavation. This process will reduce the soil erosion during construction and construction materials could also be controlled and maintained. Although the possibility of impact to groundwater and surface water of the area by the project is negligible and it is recommended that a systematic monitoring program of water quality of surface and groundwater should be carried out periodically.

Changes to air quality can occur due to dust and exhaust fumes. During the construction phase, operation of poorly maintained diesel or petrol driven machinery and equipment will

result in the release of undesirable gaseous emissions such as carbon monoxide, oxides of nitrogen and sulphur to the atmosphere. Also gases like NO_x, CO mainly get in to atmosphere during rock blasting.

Since the reservoir will be located in a sparsely populated area and all quarry sites are located away from human habitations, air pollution caused by the reservoir construction activities would not be severe to the community. Likewise, construction of the RB and LB canals will result in a minimum effect on the air quality of the area. During the operational phase, the areas that would be affected by the construction activities would be free from air pollution and would revert back to its pristine conditions.

Pollution related to dust will also emanate from mobile pollution sources such as construction machinery and transportation vehicles. Further, pollution may also result due to fixed sources such as roads, quarries and borrow pits. This would be more significant during dry weather conditions.

Some of the mitigative measures recommended are to construct temporary dust barriers, wetting of open surfaces regularly, limiting or slowing down of main dust generating activities, have well maintained machinery including motor vehicle and strict enforcement of traffic rules.

The impacts due to noise and vibrations are expected to be of somewhat significant during the construction phase. It also depend on the locations of stationary equipment, locations of quarry sites and canal blasting locations, type and condition of equipment and paths of transport vehicles etc,

There would not be any significant impact due to blasting on surrounding quarry areas and LB intake tunnel since those are not close to residential areas. But the impact would be significant around the canal construction area. Other than the impact due to noise, surrounding residential areas would be effected due to ground vibration, air blast over pressure and fly rocks that arise from rock basting.

Several insulburg structures are observed within the project area, having heights rising up to 50m above general ground surface. Of these insulburg structures, Yakinikanda, Veherabendikanda, Galbuddhakanda, Labukanda are the main dam and saddle dams connected ridge structures. When dam constructions are in progress, the hilly slopes of these insulburg structures will be disturbed in order to construct the abutments of main dam and saddle dams. During this clearing process, initially top soil cover, which is somewhat thin, will have to be removed. Once the top soil cover on the top of the insulburg structures are disturbed, subsequent soil erosion activities will be observed from the disturbed sections of the soil cover. In addition, removed soils will also be subjected to soil erosion. There is a possibility to lose the stability of some of these detached rock slabs currently located on the hill slopes during construction. These unstable rock fragments will remove from the ridge slope by blasting so that the ridge slopes will be stable and will maintain rock falls free ridge slopes. Stabilization of the rock boulders in steep areas may attend with anchoring.

These hill slopes are stable at present. However, when the water is filled in the reservoir, there is a possibility to lose the stability of overburden cover of hilly slopes and may cause slope erosion, minor slope collapsing due to fluctuation of water level of the reservoir water rim areas, especially within the sections of high slope angles. Therefore, it is recommended to place rip rap with selected size of rock and also attending by paving high hill slopes with concrete structures within the reservoir periphery to avoid soil erosion and slope collapsing.

After impoundment of the reservoir with a vast storage water body, will have several favorable impacts such as replenishment of groundwater, promote inland fishing activities and improve aquatic life in the reservoirs, providing drinking water facilities, increase of cropping intensity and flood retention capacity, improvement of health conditions of the community and animals and safe downstream by excessive flood outflows. Furthermore, impounding of water will provide an opportunity to release a controlled flow to the downstream area to satisfy the irrigation requirements as well as other ecological and sociological demands even during the dry periods.

While attending to release water to irrigable lands under command areas by preparing a detail water allocation programme, it will ensure the riparian rights of the downstream water users of the LB and RB canals, downstream village tanks, downstream anicuts such as Yan Oya anicut while releasing the specified amount of environmental flows.

Apart from enhanced water resource benefits, service facilities such as improved road systems connecting the major centers, power supply, drinking water facilities, communication and several indirect benefits will improve the livelihood of the community. Due to the project activities no ancient religious places will be disturbed but recently established one will be relocated after consultation with religious and the community sectors.

The project area is situated in the dry zone of the country within the 'Dry and Arid Lowlands' floristic region. The major natural vegetation formations present in the area includes dry-mixed evergreen forest (undisturbed and degraded), rock outcrop vegetation associated with the scattered insulburgs, scrublands, and riverine forests. The major habitats found in the project area are relatively undisturbed dry-mixed evergreen forest, degraded dry-mixed evergreen forest (secondary forest), rock outcrop vegetation (found on top of insulburgs such as the Yakini Kanda, Weherabendi Kanda, Galbuddhakanda, and Labu Kanda, scrublands and riverine forests found along the banks of Yan Oya and its major tributaries. A total of 187 plant species including 13 endemic, 167 indigenous and 7 introduced species were recorded in all the habitats in the project area. Eight plant species recorded during the field survey are listed as Nationally Threatened. However, none of the recorded plant species are unique or restricted to the project area.

A total number of 289 faunal species was recorded in the project area representing butterflies, dragonflies, inland fishes, amphibians, reptiles, birds and mammals. This included 16 endemic species and 5 species of birds listed as proposed endemics. Further, the faunal assemblage included 13 Nationally Threatened and 23 Nationally Near Threatened species. The faunal assemblage also included 5 Globally Threatened and 8 Globally Near Threatened species. The faunal assemblage recorded in the project area also included two species of exotic fish and ten species of migrant birds that inhabit forest habitats. The floral assemblage recorded in the area

included 187 plant species of which 13 are endemic to Sri Lanka. This also included 167 indigenous and 7 introduced species. Eight plant species recorded during the field survey are listed as Nationally Threatened species. None of the recorded plant or animal species are unique or restricted to the project area.

Impact on biodiversity is another significant negative impact that will arise due to the implementation of the project. The proposed Yan oya reservoir will inundate several natural habitats such as the riverine forest, dry-mixed evergreen forest, degraded dry-mixed evergreen forest and scrubland. These habitats function as rich faunal and floral repositories. About one third of the inundation area is covered by natural habitats that will have to be cleared before the filling of reservoir, once the construction work is completed. Economically valuable trees such as Kaluwara, Milla, Palu, Kumbuk, Dunumadala, Panakka, Wewarana, Godakaduru, Hulanhik, Kirikon, Madan, Kolon, Kon, Burutha, Munamal, Mee, Welan, Mora, Galkuma, Dambu, Halmilla, Nebada, Thunpathkurundu, Dikwenna, Boradaminiya, Daminiya, Gal Kuma, Timbiri, Kunumella, Wira, Bala, and Tammanna are found in these natural habitats. Therefore, establishment of the reservoir will result in habitat loss and fragmentation for a large number of terrestrial plant and animal species. Further, the dam, reservoir and the conveyance system will act as an impediment for the free movement of animals, especially large charismatic species such as Asian Elephant, Sloth bear, threatened and endemic reptiles.

Based on the field observations frequent animal movements occur in the proposed project area that will be inundated due to the proposed Yan oya reservoir. However, no specific migratory paths or routes were identified within the project area. The area is also utilized by migratory bird species, especially the riverine forests and other forest habitats. The proposed development will not have an impact on important flyways of migratory birds. The fish assemblage observed in the Yan oya and Ebbeela included at least two migratory species, *Anguilla nebulosa* (Long finned eel) and *Glossogobiusgiuris* (Bar-eyed goby). Further, many of the fish species observed show local migration for the purpose of feeding or breeding. While the proposed project will impair animal movements in the project area, both aquatic and terrestrial, it will not be a significant impact as it does not block any known critical animal migration paths.

None of the forests that are present in the direct impact zone of the project are declared as forest reserves or wildlife conservation areas. Although it is not declared by the Forest Department or Department of Wildlife Conservation an extent of 1438 ha of undisturbed and degraded dry-mixed evergreen forest will be inundated due to the construction of Yan oya reservoir. It would be recommended to carry out the restoration processes of degraded forests and reforestation in available lands in the upstream to mitigate the impacts, to a certain extent, due to the loss of forest cover in the project area.

At present only a few invasive alien species occur in the project area. However, during the construction stage earth moving machinery as well as construction material such as soil and gravel that are brought into the site can introduce weeds of invasive alien species into the area. Further, the areas cleared of vegetation to extract burrow material as well as construction material storage areas are also potential sites for establishment of alien invasive species. Therefore, during the construction stage there is a strong possibility of introduction and establishment of invasive plant species into the project area which can subsequently spread into surrounding areas.

A major part of the proposed reservoir will inundate human modified habitats such as paddy fields, abandoned lands and home gardens. The species assemblage observed in these habitats was dominated by common species which are generally found in such man made habitats. These species show a high degree of adaptability to changes and therefore will not be affected a great deal by the proposed project other than the fact that they will lose their habitat.

The area covered by the proposed project consists of two parts, namely the area surrounding the reservoir and the areas along the main canals respectively. The total number of 546 families will get affected due to the construction of the reservoir. Out of these 546 families, 289 will get affected for only their paddy lands and 219 will affect for their both houses and paddy lands and the rest of 38 families will lose only their houses with home gardens. In this area most of the families are living with their sibling's families due to security reasons and unavailability of the adequate lands. Therefore according to the sociological study done for the inundation area indicates that 257 families living in 197 houses will get inundated due to the construction of yan oya reservoir (Both houses & paddy affected 219 + only houses affected 38 =257).

The sociological study further indicates that human settlements situated within Pamburugaswewa Grama Niladarai Division (GND) of Gomarankadawela DSD will have to be relocated due to the implementation of the proposed project. Kimbulpatiyawa village in Galkadaweala GND is bordering the proposed reservoir and a section of this village will be inundated due to the project. In the Horowpathana DSD two GNDs namely Pahaladuelwewa and Marandamaduwa and three villages namely Puhudiwulwewa, Alapaththwa and Mawathaweve villages will also be partially inundated.

The LB canal will flow through four DSDs and 09 GNDs from both districts, Anuradhapura and Trincomalee. The RB canal will flow through two DSDs and 06 GNDs in Trincomalee districts. The total number of houses situated in both canal paths was found respectively to be around 14 and 03. If the paths of the canals could be diverted slightly could avoid the disturbances to the existing houses and the necessity to evacuate families could be avoided. According to observations carried out during the sociological investigations, the maximum extent of land that would be incorporated with the construction of the canals would be less than ½ an acre in each case. Some of the affected people are requesting lands from surrounding areas together with a suitable compensation package for the damages to their houses and cultivations.

The selected resettlement site for Anuradapura district consists with two locations: 1).Thekkawatta and 2).Nithurugollawa in Aluth Halmillawa GND in Padaviya DSD and resettlement site for Trincomalee district is Kajuwatta which situated in Morawewa GND of the Gomarankadawala Divisional Secretary Division.

One of the most important tasks associated with the proposed Yan oya reservoir project is the relocation of affected communities from the inundation area of the reservoir. Relocation is bound to have significant impacts on their lifestyles and livelihoods. Pamburugaswewa temple is the only religious place which will be inundated and will be relocated in the new resettlement area. The project is bound to relocate these affected communities elsewhere, totally disturbing and changing their existing culture, livelihoods and lifestyles.

People who reside in the surroundings of the areas coming under the proposed reservoir structures and canal path will continue to be in their residences (and will not be relocated) during the project implementation period. These communities expect some positive economic benefits such as employment opportunities, increased commercial ventures in the area and the development of existing infrastructure facilities etc. from the project. Therefore, during the implementation of the project it would be advisable to give priority to the locals for job

opportunities. Also some positive impacts would be a major road way along the downstream of the dam connecting to both district and communities. Also there is possibility to use this proposed reservoir as an intake to water supply authorities including National water supply and Drainage Board. And also it will help to reduce existing health problems such as kidney disease which is more prominent in the area. Project personnel will have positive interactions with the surrounding communities to maintain project related conflicts to bare minimum.

Agricultural sector dominates the sources of income in the project area. The sociological study indicates that the dwellers in the entire area under review depending mostly on agriculture. Therefore, their major source of income, which is agriculture, will be seriously disturbed with the implementation of the proposed project. The infrastructure facilities in the inundation area such as electricity, telecommunications, water supply and marketing facilities will disappear due to the proposed project.

The project areas were under the terrorist threat during the past war as they are bordering Northern and Eastern Provinces. Therefore infrastructure facilities and socio-economic development had been largely neglected in these areas. Living standards of the people was therefore much below the living standards of people living in other irrigation systems. After the war those communities requested more development assistance to build up their lives. On the other hand they have severe water deficit for cultivation in *Yala Kanna* and as a result cultivation is mainly limited to *Maha Kanna*. As such the majority of dwellers are expecting new lands with sufficient irrigation water for cultivation. If they are given lands with assured water supply as in Mahaweli areas their living standards will definitely improve. Also this project is likely to create more employment opportunities and open up new income generating avenues during the construction phase and thereafter.

The selected resettlements areas in both district, Anuradhapura and Tricomalee were not situated far away and could supply water for agriculture through proposed LB & RB canals. According to the project guide lines and existing regulations, it will provide one and half acre of paddy lands and one acre of high land for houses and home garden per family. It should be developed as new integrated colonization schemes with all necessary infrastructure facilities and a community friendly environment.

However the monitoring the proposed environment management plan is most important factor as far as the sociological point of view. The affected people should receive reasonable and attractive compensation packages due to them on account of land acquisition on time. This process has to be closely monitored to avoid unnecessary delays and discrimination. Resettlement also has to be monitored to avoid unnecessary delays.

One of the key objectives of the proposed Yan Oya Reservoir Project is to improve the cropping intensity to a maximum possible level of the existing irrigation systems under Padaviya and Wahalkada reservoirs and several other minor irrigation systems located in downstream areas. Two sluices of proposed Yan Oya will discharge a maximum of 8.37 m³/sec from the Left Bank canal and 3.25 m³/sec from Right Bank canal to feed a total command area of 6002 Ha. Proposed LB Main Canal of Yan Oya reservoir will feed 3815 Ha of existing irrigable lands and 375 Ha of new lands. The total benefited area under LB Main Canal will be 7590Ha. The RB Main canal will feed 1537 Ha of existing irrigable lands and 275 Ha of new land. Therefore, a total area of 1812 Ha will receive benefits under the RB canal. Accordingly, cropping intensity of 9402 Ha of agriculture land will be improved under the project by cultivating the full extents in both seasons.

Total extent of cultivated lands in the project area is approximately 2235.83 hectares. This comprise mainly of Paddy lands, *Chena* lands and Home gardens with an extent of 1,696.76 ha, 148.79 ha and 390.28 ha respectively. Paddy lands include rain-fed paddy lands and irrigated paddy lands. Out of the total land area that will be inundated due to the reservoir, 42.82% is currently under paddy cultivation (55% are irrigated paddy lands and the remaining 45% are rain-fed paddy lands). Lands used for *Chena* cultivation and home gardens account for 7% and 17% of the total area to be inundated respectively. Prevailing land tenures of these lands are freehold, LDO and encroached. Of the total paddy lands, 17.97%, 35.89% and 46.15% can be classified as freehold, LDO and encroached lands respectively. The construction of the proposed reservoir will affect command areas and water spread areas of 20 tanks. Of these 20 tanks, 15 tanks will be completely inundated (both water spread area and the command area) while only the command areas of other 5 tanks will be partly or completely inundated.

Cultivated extent of paddy lands is 1,696.76 ha during the Maha season and 164 ha during the Yala season. Total paddy production per annum is about 7,671.46 metric tons.

Annual crop production of the *Chena* lands include 233 metric tons of maize, 14 metric tons of cowpea, 9 metric tons of green gram, 6 metric tons of black gram, 27 metric tons of finger millet and 12 metric tons of vegetables. Coconut, mango, lime and orange are the main tree crops cultivated in the home gardens present in the area that will become inundation. These home gardens produce 448,726 nuts of coconuts, 2,778 mango fruits, 148.67 metric tons of lime and 56,746 of orange fruits that is worth about LKR 8.333 million annually. However, the proposed project will support to enhance agricultural development through bringing lager extent of lands under agriculture than extent of lands which will be affected.

Apart from the irrigation water supply, domestic water supply also will be improved under the proposed project. In order to efficient usage of irrigation water releases, Concrete lined canal has been proposed for LB Main Canal and earthen canal for RB Main Canal. In the context of water management for issuing water to vast amount of individual land plots and scattered minor irrigation tanks, there is a need to reach water to irrigable lands in scheduled time as per water issue calendar preparing for seasonal irrigation crops. Lining of primary canals are the most effective way to perform the seasonal water management plan as programmed. Though initial costs are high for the concrete lined canals, but there are several advantages such as, much less sizing of the canal sections due to increase in slope compared to earthen canals, loss of water due percolation and seepage through the canals, timely delivery of water to farm plots, minimum growth of plants and weeds and much less maintenance works. However during the closed seasons there is a need to examine and attend the repair works on settlement, cracking and displaced sections of the lined canals. Manual operations of the outlet gates also need to follow an operational and maintenance programs in association with seasonal water releases plan of the irrigation system.

Surface and ground water and air are some of the key resources that may be impacted due to the project. There is a possibility of increased sediment ingress to Yan Oya from loose soil stockpiles used for filling the main dam or coffer dams and soils eroding from exposed lands resulting due to earth cuts during the construction phase. This impact will operate especially during the rainy season leading to gully erosion. These sediments could flow downstream and get deposited in the river bed especially where the river bed is rocky. The proposed Yan Oya dam is located in a relatively flat area where the gradients are mild and therefore the erosion potential is less. The following mitigatory measures are suggested to minimize the impact arising due to sedimentation of water bodies. These include restricting earthwork to the dry season, avoid disturbance to drainage paths, compact or cover all loose soils, use soil barriers, silt traps etc.

Changes in the surface water flow could happen after the project is implemented. Water storage will take place in the proposed reservoirs resulting in low flows in the river downstream of the dam site. The stored water will be conveyed through number of existing and new channels, streams, tanks etc. to the downstream areas that will alter the flow regimes in this region, mostly positively. It is expected that number of abandoned tanks situated on the channel path of the LB canal will be fed through the water retained in the tank. This water replenishment also will change the surface water flow.

The proposed reservoir will retain a large amount of water, which will disrupt the usual flow in the river. The water users downstream of the dam site, especially those who use the Yan Oya anicut will get affected because of the proposed water retention at the reservoir. It is recommended that an average monthly environmental flow release of 0.7 -0.8 m³/sec (during the dry periods) will be maintained at all times from the dam to meet the ecological and sociological demands of the downstream users.

There is a possibility of increased sediment ingress to Yan Oya as loose soil stockpiles for filling the dam or coffer dams and soils from earth cuts during the rainy season as gully erosion could take place. These sediments could flow to the downstream and get deposited in the river bed especially where the river bed is rocky. The proposed dam is located downstream of Yan Oya basin which is relatively flat and the gradients are mild and the erosion potential is less .

The impoundment will have several favorable impacts such as replenishment of groundwater, promote inland fishing activities, improve aquatic life in the reservoirs and tanks and, increase of cropping intensity and flood reduction. Further, impounding of water will provide an opportunity to release a controlled flow to the downstream area to satisfy the irrigation requirements as well as other ecological and sociological demands even during the dry periods.

A detailed water allocation programme has now been formulated to ensure the riparian rights of the downstream water users of the LB and RB canals, intermediate tanks, downstream anicuts such as Pulmodai anicut and the specified environmental flow.

As water logging in the reservoir, downstream tanks, irrigation canals etc. is a common phenomenon in this type of irrigation development projects, no mitigatory measures are necessary and the impact of water logging will be positive as it will help recharge the groundwater table in the area. However there could be temporary water logging in construction sites and the impact should be mitigated by provision of site specific drainage facilities.

The project is anticipated to have a positive influence on the ground water resource. This would indirectly lead to improvement of irrigation, agriculture activities, and drinking water supply facilities of the area. One of most important indirect positive impact of the project is the improvement of present drinking water supply facilities of the area where there is a prevalence of kidney failures resulting due to unknown etiology.

Therefore, safe drinking water will improve the health conditions of the peoples that live in this area. The only negative impacts on the groundwater will mainly occur during the constructions stage. This could be prevented by avoidance of water contamination due to leakage of contaminants into the environment from construction sites. Therefore, treatment systems for liquid and solid waste should be installed to manage waste water created from workers at the site to ensure that waste water released from the site conforms to the standards specified by the CEA. Even though the impact on groundwater and surface water of the area by the project is negligible, it is recommended that systematic monitoring of water quality of surface and groundwater resources should be carried out periodically to trace any changes in the water quality of surface and groundwater due to construction activities.

Construction of the dam will result in low flows in the downstream of the dam site of Yan oya. The stretch of the river affected by this activity is estimated to be approximately 3 km. However, arrangements will be made to release monthly average of 1.5m³/sec as the environmental flows through the dam. The low flows in the river will impact aquatic species such as inland fishes and dragonflies. Furthermore establishment of the reservoir will result in the inundation of Yan oya and its tributaries located upstream of the dam and several perennial and seasonal tanks. These habitats support a rich fish assemblage including number of endemic, rare and threatened species that will be adversely impacted as the area downstream of the dam will become dry due to impounding while the upstream of the dam will become inundated due to impounding of water which will make this less suitable for some species of fish that prefer flowing water.

Most of these impacts can be mitigated with proper design and following environmental best practices. Therefore development of an environmental monitoring plan that provides detailed mitigation actions as well as defines guidelines for environmental best practices is strongly recommended before the project is launched. In addition the project will invest on a reforestation programme in the upper catchment area of the Yan Oya in collaboration with the Forest department to ensure that natural habitat loss is adequately compensated. Further, the wildlife management plan will invest to mitigate human-wildlife conflicts that may arise in the area downstream of the project due to intensification of agriculture practices under the proposed project. The wildlife management plan will also carry provisions to release an adequate environmental flow to meet the ecological demands of the Yan Oya downstream of the dam site, build structures to facilitate animal movements especially across the RB and LB canal, relocation or translocation of threatened plants and animals during the inundation of the reservoir etc.,

The project is viable with a positive net present value of Rs 10 billion at 10% discount rate. Economic Internal Rate of Return (EIRR) is 14.86% Benefit/cost ratio of the project was computed based on 10% discount rate and it is 1.51.

EIRR of the project is higher than the 10% discount rate adopted by the Government for the evaluation of public investment projects. It indicates that implementation of the project is an effective allocation of resources for irrigation water supply.

The project is viable in the base case and with the increase of construction costs and reduction of benefits by 10% and the combined effects. However, further reduction of benefits may lead to unviable situations. This aspect need to be considered carefully since the project also involves large number of unaccounted costs and benefits.

Implementation of a major water resources project like proposed Yan Oya reservoirProject, will create predominantly on construction and water related negative environmental impacts, which could mitigate to a greater extent by adopting proper planning techniques on construction activities and implementation of environmental monitoring measures as proposed. The objectives of this EIA report would be to implement the proposed mitigative measures during the project design and it's implementing stages. In order to address the negative impacts and formulations of proposals on mitigative measures, a team of eminent consultants conducted field investigations in the identified study area (head works, reservoir inundation area and the command area) of the project considering the following for the preparation of this EIA report;

- Studies conducted on overall status of the present environment and assessed the possible impacts will encounter due to the proposed project
- Assessment of the potential impacts of the project on the existing environment due to construction, inundation and resettlement activities and proposals on alternative of the project components to minimize the impacts
- To propose most appropriate mitigatory measures to overcome adverse environmental impacts due to project implementation and operations afterwards.
- Also introduced key environmental parameters that would be monitored by authorized parties in order to ensure environmental sustainability of the project.

As an overall view, that the rural community of the country is mainly depending on agro based practices to sustain their livelihoods. By implementing Yan Oya storage reservoir project to meet the assured water supply for irrigable lands will console the major grievance of the community. Water for irrigation, domestic purposes, environment, industrial, cultural and religious purposes are the basic needs for the rural community. Several of these requirements may be an intangible benefit which may not reflect in cost benefit calculations but vital for the rural farm community.

Summary of possible impacts and proposed mitigatory measures for the Yan Oya Reservoir project

Project Activity	Possible Impacts	Mitigatory Measures
Dam & canal Construction, Reservoir establishment, operation of burrow pits & quarry sites, Land Degradation due to Vegetation Removal, for Farm Land Development	<ul style="list-style-type: none"> - Soil erosion from cleared lands - Siltation in minor stream paths - Soil erosion from excavated soils - Slope instabilities in hill slopes - Dust generation during transportation of earth, etc - Loss the stability of fractured and loosed rock slabs within the hill slopes of dam abutments - Damages to Archaeological sites - Land Degradation due to Cutting of Trees / Vegetation Removal 	<p>Erection of silttraps; Grass turf the exposed slope sections; Dumping of excavated soils immediately after excavation; Removal of unstable rock fragments from the hill slopes by blasting or clearing during construction; Rock paving disturbed hill slopes with high slope angles. During canal construction, excavated soil materials to be used in canal maintenance road construction work.</p> <p>Sprinkling water along the roads</p> <p>Shape the mined out slopes of gravel pits in 1:3 ratio and either grass turf or rock pave and erect fences covering mined out slope sections.</p> <p>Keep 50m buffer zone from the boundary of any archaeological sites during quarrying</p> <p>Degraded lands will be converted to new farm lands (mainly paddy lands)</p>
Concreting works for spillway, sluices, road structures etc.,	dowelling, grouting ,and application of concrete with form works, may create the spillage of concrete waste, grout, cement and scattering the other items such as reinforcement and other waste materials	Planning and arrangement of the concrete works, after completion of earth work construction to minimize the waste. Transportation of concrete, placing and finishing works to be programmed during off monsoonal periods
Erection of mechanical and electrical works such as gates and power lines to spillway and sluices	Will have effects on heavy machinery travelling and usage of cranes and other items for the erection works. Waste materials, oil spillages with certain other disturbances can be expected.	Transportation of items after completion of final road system to minimize the hazards.
Earthwork related construction works	<p>Change in surface water flow</p> <p>Disruption of surface water flow.</p> 	All the natural drainage paths should be kept free and temporary crossings should be provided to ensure free drainage flow. If some existing drainage paths have to be closed (e.g. for coffer damming) alternative drainage paths should be provided. These mitigation measures should be site specifically carried out.

	Occurrence of water logging and flooding	All possible critical flood areas (usually the flood plain on either side of Yan Oya) should be identified beforehand. Levels of previous critical floods should be marked on ground stakes. Coffor dams should be designed to a suitable return period (say 10 Years) and any flood above that will overtop coffer dams. Construction should be strategically adjusted/limited during flood vulnerable months in flood vulnerable areas. Temporary openings should be provided in the service road to the dam to release the sheet flow in the flood plains. Workers should be made aware of possible flood hazards and it is desirable to have back up boats/dingy etc. to use in case of emergency. There should be close coordination with the Disaster Management Center/District Coordinator.
Construction activities(dam, road, excavation, compaction) Impounding of the dam and channel net work. Development of the new agricultural lands	Water pollution due to the contaminant leakage due to machinery and worker site Changing groundwater level and disruption of groundwater flow. Impact to the surface water quality and groundwater due to nutrient enrichment and pesticides application.	Workshop facilities for corrective and preventive maintainers. Provide liquid and solid waste treatment system Monitoring of the groundwater levels of the area. Best fertilizer and pest management practice.
Dam, Reservoir Canal, access roads construction and Operation of Burrow Pits and quarry sites	Loss of forest habitat	The remaining forest, scrublands and rock outcrop vegetation in the Yan oya catchment should be preserved. The dense forest should be conserved to provide the natural habitats for fauna and flora The open forest and scrublands could be enriched with indigenous species so that the sites would be more useful with increasing the biodiversity in the catchment and also for soil conservation. It is also proposed that 100 m strip from the full supply level of proposed Yan oya reservoir to be preserved as a reservation and kept under the natural vegetation cover. Reforestation of indigenous species would be carried out within the 100 m reservation. Some of the area within 100 m might have natural vegetation cover (forest, scrub etc.) and if it is not disturbed during the construction the reforestation is not required. Planting of indigenous plant species on riverbanks and the banks of newly built canals (LB and RB) and either side of access roads to prevent soil erosion and increase the tree

	<p>Loss of habitat for wildlife</p>	<p>cover for habitat enrichment is proposed. The replanting of indigenous species could be carried out to restore the tree cover and enrich the habitats for fauna and flora. An environmental flow that should adequately meet the ecological demands of the river downstream of the dam site should be released at all times. The operation of borrow pits and quarry sites would degrade the existing vegetation in the site. Once the activities are completed these areas should be restored.</p> <p>Carry out habitat management activities to enhance the carrying capacity of wildlife to compensate for the habitat loss Carryout an animal rescue programme during the inundation period to collect and transport stranded animals to safe locations Adequate number of animal crossings should be included in the channel design to ensure that the movement of animals are not hampered Channel should have provisions such as steps or banks with a lower inclination that can be used by animals falling into the channel to safely exit the channel without external help Establishment of electric fences around resettlement areas or newly identified conflict areas Capture and removal of wild animals that engage in frequent conflict situations</p>
<p>Reservoir and canal construction</p>	<p>Reduction of paddy lands and paddy production Reduction of Chena lands Loss of home gardens Loss of accessible to Horowpathana from Wahalkada</p>	<p>Provision of paddy lands to those who will be affected Provision of high lands to those who will be affected for Chena cultivation. Provision of fruit crops (coconut and mango) and advices to develop home gardens. Compensation for home garden losses. Development of a new road</p>
<p>Rock drilling and blasting during construction</p>	<ul style="list-style-type: none"> - Noise pollution - Air pollution - Generated ground vibration and Air Blast Over Pressure can damage the structures which are closed to the rock basting areas. - Effect of fly rocks 	<p>Use noise and dust barriers as required Compensate/ repair the damages caused by ground vibration Control blasting should be carried out. To avoid the fly rocks effect, cover blasting surface and face. Here proper blasting mat (wire mesh blasting covering mat) with minimum weight of 60kg/m² and/ or minimum height of 0.5m soil layer, etc should be used. For rock excavation at sensitive places and at places where there are evacuation problems chemical blasting should be applied instead of control blasting. To avoid the dust generation from the roads should spread water at least four times a day</p>

