# FEASIBILITY REPORT

## 1.0 INTRODUCTION AND BACKGROUND

India has an extensive network for rivers, lakes and canals, which if developed for shipping and navigation, can provide an efficient network of inland water transportation. An optimal mix of road, rain and inland waterway transport will provide an efficient transport infrastructure that is flexible and cost effective. India has inland waterways with a navigable length of 14,544 km, out of which only 37% (5,700 km) is currently used for navigation by mechanized vessels. Among these navigable waterways, five have been declared as National Waterways.

Government of India (GoI) has declared Kakinada-Puducherry stretch of canal system along with rivers Godavari and Krishna as National Waterway-4 (NW-4) w.e.f. 25$^{th}$ November 2008 through Gazette Notification on approval to NW-4 Act by both the Houses of Parliament. Since then, the responsibility of development, regulation & management of the waterways rests with the Ministry of Shipping (MoS) and Inland Waterways Authority of India (IWAI).

NW-4 forms a very important and crucial link between east coast of Andhra Pradesh and southern coast of Tamil Nadu and Puducherry in Bay of Bengal.

IWAI now would like to develop the stretch between **Thiruvanmiyur to Kalpakkam** in South Buckingham Canal of NW-4 making it suitable for navigation of cargo vessel of maximum 300 tonne as well as movement of tourist and passenger vessels of reasonable size.

## 2.0 DESCRIPTION OF THE WATERWAYS

Total length of National Waterways in Andhra Pradesh is 888 km; in Tamil Nadu, it is 188 km and in Union Territory of Puducherry only 2 km. Detailed Project Report (DPR) of this stretch was prepared by M/s WAPCOS in the year 2010. Based on the findings of the DPR, 50 km stretch of South Buckingham Canal from Ennore sea mouth to Muthukadu flowing through Chennai was exempted for development due to the heavy encroachment of the canal by MRTS (Mass Rapid Transport System). The stretch between Muthukadu and Shollinganallur for a length of 13 kms has been considered for development.

### South Buckingham Canal:

The south Buckingham Canal is a tidal canal which takes off from Cooum river at Chennai and runs along the Eastern coast up to Kovalam North lock near Marakanam

for a total length of 110km. it has sea openings at seven places namely Marina beach, Adyar, Muthukadu, Kalpakkam, Palar, Paramankani Kupam and Marakanam. Locks are provided in the canal near sea opening to control the tide flow and retain the desired water level in the Canal. Sand bars have been provided at these opening due to which it remains closed for about seven months in a year.

The **Buckingham canal in Chennai City** is totally in abandoned condition. It has silted up heavily. Its banks have been heavily encroached where huts and houses have come up. The width of the canal is in the range of 10 to 15m. To add to it, Govt. of Tamil Nadu has allowed MRTS to construct Elevated Railway Station right over the canal as per the recommendations of the Working Group appointed by the Planning Commission in 1976-77 for better connectivity between North South Eastern (NSE) Corridors. The PWD officials and Railway M.T.P officials did not have any other corridor available economically than to follow the Buckingham Canal Stretches. As MRTS had to fallow curves in certain stretches, it has been taken sometime crossing the canal. In many places, the columns of MRTS flyover bridges are within the canal bed itself and in certain places: the pedestal foundation of column is exposed above the canal bed. As revealed from WRO, there is no navigation possible in the Chennai stretch. Alternative suggested by earlier consultants of constructing a Bay pass canal in Chennai City is also ruled out because of non-availability of adequate water coupled with high density of population and space crunch in Chennai City. It is therefore recommended that the Stretch inside Chennai City should not be taken for IWT development.

From Chennai southwards, the canal is heavily silted up upto Marakanam. The banks have been eroded. The East Coast Road runs parallel to the canal. The canal enters from Muthukadu Boat House Lock in backwater zone. It gets spread and is mixed with sea and other water bodies. The depth remains at 0.3m to 1.3m and width is about 25m. The Muthukadu Sea opening remains closed approximately for a period of seven months in a year. The tidal effect is approx. 20cm to 40cm which has influence up to 10km. south. The canal bank remains unprotected up to Mahabalipuram Road Bridge. At around 5km. south of Mahabalipuram, Kalapakkam Atomic Power Plant is situated. Sea opening also exists there. Water is taken from the sea for cooling purposes and part of it is discharged into the canal on North side. This raises the level of water upto 20cm for 20km. length. The next portion is river Palaru confluence south of Kalapakkam. Sea opening exists at Pudupattinam and at the mouth of Paleru River. The canal was found dry at this portion during survey period. The south bank of canal is almost non-existent here. Further south of Kalapakkam near Alambarai Bridge the canal is curved and is widened. The depth is about 0.7m and width is around 90m. Canal gets obstructed by sand heaps for a km. long portion further. It meets Marakanam backwater where a sea opening exists. The sea opening remains closed for about 7 months in a year. The South Buckingham Canal ends hear.

## 3.0 INITIATIVE ON DEVELOPMENTAL ACTIVITIES

Consequent to the declaration of the National Waterways, attempt was made initially to develop the commercially viable stretches through Public Private Partnership (PPT) mode with Viability Gap Funding (VGF) for 323 km covering the stretches from Kakinada to Bhadrachalam and Elluru to Rajahmundry. However, on techno-economic analysis through the transaction advisor engaged by Department of Economic Affairs (DEA) and Asian Development Bank (ADB), the development of the project through PPP mode was not found to be economically viable. Accordingly, Government of India has decided for developing the National Waterways through Government budgetary support. The first phase development of the stretch between **Thiruvanmiyur to Kalpakkam in South Buckingham canal for 45 km with an estimated cost of Rs. 123.40 crore** has been sanctioned followed by launching of the project on 24.01.2014 by Union Minister of Shipping.

## 4.0 DETAILS OF THE PROPOSED DEVELOPMENT

Comprehensive scheme has been worked out for overall development of this stretch (Thiruvanmiyur to Kalpakkam) making it suitable for navigation of cargo vessel of maximum 300 tonne as well as movement of tourist and passenger vessels of reasonable size. The main components of the scheme are as follows:

a) Dredging and excavation work in the canal & bank formation with excavated soil and leveling

b) Dredging and opening of sea mouth at Muthukadu & Kalpakkam and subsequently maintaining the same

c) Construction of Terminal at suitable locations for cargo and passenger operation with facilities like covered shed, open storage, truck parking, canteen, electric sub-station, weigh bridge, water supply and firefighting arrangement

d) Installation of navigational aids

e) Dismantling & removal of existing bridge at Kelambakkam with less navigational clearance & construction of a new bridge with required navigational clearance as per the standard norms of class-II waterways as the replacement

| Chainage (in km) | Name of Bridge | Type of Bridge | Length (in m) | Vertical Clearance (in m) | Horizontal Clearance (in m) |
|---|---|---|---|---|---|
| 348.000 | Kelambakkam Road Bridge | RCC | 25.0 | 2.5 | 16 |

a) Dismantling & removal of 3 nos. existing old & abandoned navigational locks at Muthukadu, Kovalam South & Kalpakkam and construction of new navigational locks of suitable size at these locations

b) Procurement of dredgers and deployment

The canal shall have the fairway with 32 m bottom width, 1.8 m LAD (Least Available Depth) below chart datum with 1:2 slopes on both sides of the canal. The navigational channel shall be developed as per Class-II waterways standard having navigational clearance of 30 m horizontal clearance between the bridge piers and vertical clearance of 5 m between HTL/ HFL and bottom of the deck slab of the bridge / structure across the channel.

The terminal facilities is to be provided for safe berthing of the cargo vessels, tourist / passenger vessels, loading / unloading facilities for cargo, their storage. The sea mouth at Muthukadu & Kalpakkam shall be opened through dredging and maintained thereafter ensuring the adequate water in the channel which will be further regulated by providing the suitable navigational locks.

**Cargo Type:** Salt, Fish & Marine Produce, Fertilizer and Timber

**Vessel Size:** The design vessel size considered is 300 tonne barges. The dimensions of these barges are, length – 40m, width – 9m and depth – 1.6m.

**Land:** The extent of land required for widening of the canal, development of terminal facilities and construction of navigational locks shall be worked out once the fresh delineation land survey for South Buckingham canal is completed by State PWD (WR). M/s WAPCOS is being engaged at the Consultant for the design of terminals, navigational locks and assessment of the land.

**Traffic Volume:** The total traffic movement as projected for different years in the stretch of South Buckingham canal from Chennai to Markanam and Puducherry is presented below:

| Year | Traffic (in Million Tonne) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **2014-15** | **2017-18** | **2022-23** | **2027-28** | **2032-33** | **2037-38** | **2042-43** | **2047-48** |
| Traffic originating at Chennai & destination to Markanam and Puducherry | **0.92** | **1.31** | **1.91** | **2.68** | **3.20** | **3.83** | **4.59** | **5.50** |

**Electricity requirement at Terminal:** A provision of 400 kW is to be allocated. Incoming supply voltage from State Electricity Board can be 3.3 kV or 440 Volts depending on the available state supply point voltage. Power supply can be partly supplemented by 100 kW D.G. Set for terminal operations in the event of stoppage of city supply.

**Water requirement at Terminal:** Daily water requirement is 10,000 litres out of which potable water demand is 5,000 l/day.

## 5.0 INFLUANCEING FACTOR FOR SELECTION OF TERMINAL LOCATIONS

### 5.1 Basic Conditions

The terminals when judiciously located would go a long way in making the waterway operation a success. Thus terminals are to be located near high traffic concentration points which will enable cargo owners to use IWT in preference to rail/road modes. Terminals are the hubs for inter-modal transfer of cargo and act as interface between the waterway and the hinterland. Accordingly, the main aspects requiring careful consideration for efficient traffic management and thereby effecting in the increased traffic capacity of the entire system are.

a) Site condition
b) Water area planning
c) Navigational aids
d) Berths
e) Cargo handling systems
f) Sufficiency of land provision

### 5.2 Site Condition

The location of the inland terminal in general depends on many factors, of which the basic criteria are:

- Terminal to be hub in cargo generation and consumption hinterland.
- River front characteristics to be conducive
- Land area availability behind waterfront at terminal

For planning an IWT terminal, input on following aspects are needed and the same have been obtained as available.

- Meteorological conditions
- Canal/river characteristics
- Geomorphology of the site
- Geo-technical conditions

- Land area requirement and availability
- Availability of construction material

## 5.3 Meteorological Conditions

Inland waterways are land locked and therefor are generally unaffected by extreme meteorological condition except for floods during monsoon. The floods in rivers generally bring in high discharges and associated currents. Therefore although water depth may not be a constraint but navigability under extreme current conditions would be difficult. In addition, the rise in water levels during the floods also would not be conducive to navigation due to unavailability of headroom for barge passage under the bridges. Accordingly, data with regard to river discharge, rainfall and maximum flood would be of vital importance. In addition, such data would also prompt suitable planning and orientation of the terminals.

## 5.4 Data on Canal

In addition of the depth, the other factor, which controls and determines the navigability of a waterway, is

- Width of the waterway
- Location and nature of shoals
- Nature of bends and radii of barge traverse
- Nature of river training works
- Nature of cross-drainage works, bridges, lock gates, culverts, overhead transmission line etc.

## 5.5 Data on Geomorphology of the Site

The stability of the banks and the shoreline would be a per-requisite for any shore based structures, like terminal. The discharge and flow conditions in the river changes seasonally and often on daily depend upon the rain and catchment conditions. Accordingly, the shoreline stability influenced by morphological changes is of paramount importance for the location of the terminal. In so far as the canal portion is concerned, the major problem is that of siltation. Cross drains and rivers joining the canal add to the problem of siltation to a great extent. In addition, the tidal ingress through lock gates provided at the confluence of the canal and the river also deposits considerable amount of silt in to the canal. Most of the built by the local beneficiaries have since collapsed and the canals are mostly filled up causing reduction in water depth. Therefore, in order to avoid such problems from recurrence, the cross-drains as well as the lock gates are to be suitably designed / modified.

## 5.6 Data on Geo-Technical Conditions

Terminal structure, i.e. barge berths, storage, open stockyards, transport equipment areas do require good founding soil. Accordingly, in order to reduce overall cost with regard to foundations, it is essential to select suitable location with good soil bearing capacity to put up the terminals.

WAPCOS was to undertake geotechnical investigation at the proposed terminal locations. Pending IWAI's and concerned State Governments approval, these geotechnical investigations could not be undertaken. Detailed geotechnical investigations are to be undertaken as per IS Code provision during detailed engineering stage, which can be taken up after finalization of terminal locations.

## 5.7 Land Area

For a terminal/location to be firmed up, besides other things leveled land area in the close proximity of the river/canal is necessary. The area surrounding the canals is government land and barren. Either kutcha road or a highway is running along the routes of Buckingham canal. Most of the lands along the canals are given on long term lease to farmers by the Revenue Department, Govt. of Tamil Nadu. These lands are called as Patta land in local language. The land for the terminals would have to be acquired by the A.P. State Government authorities as the acquisition is to be planned is such a manner that, future expansion of the terminal would be easy, contiguous and unimpaired. In addition the connectivity to the terminals has to be planned and if necessary, the land for the same would have to be acquired.

## 5.8 Construction Material Availability

Constructions of terminal structures are required to be carried out using the locally available materials only. Transportation of these materials would not pose any difficulty. Lack of road infrastructure at certain location may exist, but waterways can be used to carry these materials, in smaller crafts. Therefore, no problem on this account is foreseen. The construction material is available in abundance in the close environs of the waterway.

## 5.9 Proposed Terminals

Based on the traffic survey, navigational safety, environmental features, meteorological conditions, land availability and least interference with natural water and sediment flow phenomenon, the following terminal locations have been suggested.

a) Sholinganallur ($12^{o}53'53.13''$ N & $80^{o}14'22.94''$ E)
b) Muthukadu ($12^{o}48'25.47''$ N & $80^{o}14'29.71''$ E)

c) Mahabalipuram (12°37′0.72″ N & 80°11′12.44″ E)

Typical layout of the proposed terminal is given at the end of the report.

## 6.0 PROJECT COST

The sanctioned cost of the project is Rs. 123.40 crores with detailed breakup as follows:

| **Component** | **Rs. in Crores** |
|---|---:|
| Fairway development | 74.20 |
| Terminals | 18.00 |
| Navigation Locks | 19.00 |
| Road Bridge | 12.00 |
| Navigation aids | 0.20 |
| **Total** | **123.40** |

The entire expenditure shall be met out from the budgetary support of Central Government.

## 7.0 ECONOMIC ANALYSIS

M/s WAPCOS has prepared the DPR during 2010 for the development of NW-4 including economic analysis. As per DPR, EIRR of the entire National Waterway – 4 is 22.84%. No separate economic study has been carried out for this stretch. The project on execution will provide more socio-economic benefit rather than EIRR / FIRR.

## 8.0 BENEFITS TO BE ACCRUED

The objective of the project is to revive the inland navigation system in the Tamil Nadu resulting in the reduction of congestion on the road transport. As per the DPR, the cargo projections for this stretch are salt, Fish & Marine products. On completion of the developmental activity up to Puducherry, the cargo projection could be fertilizers, construction materials, general goods & timber from Markanam & Puducherry for local consumption.

Inland Waterway Transport (IWT), being a fuel efficient mode of transport, would generate enormous fuel savings compared to the road transport. Savings on fuel (diesel) consumption have a commensurate savings of $CO_2$ emission. The proposed development will generate employment opportunity for local population.

There are other benefits associated with transportation activities and these benefits have been identified in terms of average external costs due to accidents, noise pollution, infrastructure, wear & tear cost and congestion cost etc. The benefits have been quantified by Inland Navigation Authority of Netherlands in terms of euro/1000 Tkm for road and IWT mode of transportation as given below:

**Average External Cost per mode of Transport – Euro/1000 Tonne-km**

| **Type of Activity** | **Cost (Euro)** | |
|---|---|---|
| | **Road Transport** | **IWT** |
| Accidents | 5.44 | 0 |
| Noise | 2.14 | 0 |
| Pollution | 7.85 | 3 |
| Infrastructure | 2.45 | 1 |
| Traffic jam | 5.45 | Negligible |
| **Total** | **23.33** | **4** |
| Difference of cost compared to road transport | | 19 Euro/1000 tonne-km |
| External cost saved by not transporting 1000 tonne-km on the road | | **19 Euros** |

Source: www.binnenvaart.be

It can be seen from the above table, IWT has significant advantage over road in terms of lower average external costs which is only 4 euros/1000 tonne-km of operations in IWT mode compared to 23 euros for road. In case of road external cost due to accident, air & noise pollution and congestion are quite significant, while IWT mode has negligible cost associated with it. This low marginal average external costs of IWT operation is perhaps is one of the strongest reason that modal shift to IWT from other modes should take place in the interest of the society. In Indian context the statement become more relevant due to higher number of road accidents.

## 9.0 EXECUTION

The execution of the project is scheduled to be completed within a period of 3 years.

Work to be executed by IWAI

- Dredging & excavation in the canal along with bank formation
- Opening of the sea mouth & its maintenance
- Construction & operation of the terminals
- Installation & maintenance of navigational aids

Work to be executed through State Governments

- Dismantling & removal of 3 existing navigational locks & construction of new locks of suitable size
- Dismantling & removal of existing bridge & construction of new bridge with required navigational clearance as per the standard norms of Class-II waterways as the replacement

Operation, maintenance & management of the locks shall be the responsibility of IWAI.