SHORE LINE CHANGE ATLAS OF THE INDIAN COAST

(Volume – 5)

Odisha and West Bengal

Space Applications Centre (ISRO)
Ahmedabad 380015
and
Coastal Erosion Directorate, Central Water Commission, Ministry of Water Resources, Govt. of India, New Delhi

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Abstract	This Atlas comprises of shoreline change maps prepared using satellite data of 1989-91 and 2004-06 time frame on 1:25,000 scale for the entire country (Volume – 5 shows maps of Odisha and West Bengal). The maps show eroding, stable and accreting coast. Data used, methodology, results, area under erosion and accretion and status of coastal protection measures are briefly described.
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PREFACE

Coastal erosion is one of the most significant coastal hazards leading to loss of valuable land and property along the coastal zone. It is serious problem for the Indian coast, especially during monsoon and cyclonic storms and storm surge events. Developmental activities along the coast as well in the catchment areas of rivers draining into the sea cause changes in the equilibrium of sediment transport along the coast and induce coastal erosion. Climate Change and consequent threat due to predicted sea level rise is expected to further accelerate coastal erosion. Measures have been undertaken for protecting the coast by maritime States and Union Territories of the country at several places. It is required that a proper inventory of current status of coastal erosion and protection measures undertaken so far be made, so that effective planning for protecting the coast can be carried out.

Due to dynamic nature of the coast, baseline data at National level on current status of coastal erosion as well measures taken by maritime States and UTs is lacking and it is in this context and based on recommendations of Coastal Protection and Development Advisory Committee (CPDAC), present work of preparation of Shoreline Change Atlas of India has been undertaken by the Space Applications Centre (ISRO), Ahmedabad and Coastal Erosion Directorate of Central Water Commission (CWC), Ministry of Water Resources, New Delhi. The shoreline change maps depict changes mapped on 1:25, 000 scale using satellite images of 1989-91 and 2004-06 time frame and status of coastal protection measures taken up by maritime states and Union Territories. The entire database is digitized and put under GIS platform. The Atlas is brought out in Six Volumes and highlights type of satellite data used, methodology adopted and salient observations.

This Atlas provides a baseline data for initiating appropriate action for protecting the Indian coast by concerned maritime States and Union Territories besides use by the scientific community as well decision makers of the country. I appreciate efforts put by all those who have made contributions to this significant task.

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Foreword

Coastal Zone is one of the most fragile and dynamic ecosystem having the interface of sea and land. Interactions between various natural processes and human activities are important factors in the coastal areas. About 40% of the world's population lives within 100 km of the coastline and this proportion is increasing. There has been increasing anthropogenic pressure on the coastal ecosystem. In addition, the coastal ecosystems are vulnerable to natural phenomenon such as waves, tides, storm surges, erosion etc.

India has a long coastline of 7516 km including that of its Island territories. Coastal Zone in India, assumes its importance because of high population pressure, development of various industries and spurt in recreational activities, exploitation of renewable and non renewable natural resources, discharge of waste effluents and municipal sewage etc. Periodic storms and cyclones as well as erosion further adds to the problems in the coastal areas. In view of the dynamic nature of the coast, it needs to be monitored regularly.

Taking appropriate coastal protection measures require spatial information on the status of the shoreline and its dynamic behavior including the areas undergoing erosion and accretion. The spatial information on the change in shoreline over a period of time and the associated processes active along the Indian coast are not available. Thus, Space Applications Centre, at the behest of Central Water Commission, Ministry of Water Resources, Government of India has taken up the task of preparation of shoreline change inventory of Indian coast based on maps prepared using satellite data of 1989-91 and 2004-06 on 1:25,000 scale. These maps depict areas under erosion, accretion as well as stable coast. In addition, the status of coastal protection measures taken by states are also depicted. This is for the first time a spatial inventory on shoreline changes using satellite data has been created for the entire country.

I am sure, the present atlas will be useful to the scientific community and decision makers in investigating the coastal changes as well as in taking appropriate action for protecting the Indian coast and thus will go a long way in conserving the coastal environment of the country. I would like to place on record my deep appreciation to all those who have made contributions for the success of this project.

(A.S. Kiran Kumar)

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The baseline data on coastal landuse including delineation of HTL and LTL on 1:25,000 scale has been prepared for 1989-91 and 2004-06 time-frames using satellite data under two separate projects funded by Ministry of Environment and Forests (MoEF), Government of India, New Delhi. We gratefully acknowledge the funding support provided by MoEF and to all the participating agencies who have contributed in these projects.

The project on preparation of shoreline change for the Indian coast has been carried out jointly by Space Applications Centre and Central Water Commission, Ministry of Water Resources (MWR), Government of India. Ministry of Water Resources (MWR), Government of India is thankfully acknowledged for providing funds for preparing A-3 size Shoreline change Atlas of India using the available baseline data. We are thankful to Chairman CWC for his guidance and support. Our special thanks are due to Chairman and Members of Coastal Protection and Development Advisory Committee (CPDAC) for necessary support. Sub-Committee members of the Coastal Atlas are acknowledged for their useful suggestions and time to time guidance. Special thanks are to Director, Coastal Erosion Directorate, Central Water Commission, Ministry of Water Resources for his constant support and organizing collection of coastal protection measures data from all the maritime States and U.T. of India.

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INTRODUCTION

Coastal zone is the area of interaction between land and sea. It includes both terrestrial as well as marine resources, which are renewable as well as non-renewable. In addition, interactions between various natural processes and human activities are important factors in the coastal area. India has a long shoreline of about 7500 km including its island territories. Coastal zone in India assumes its importance because of high productivity of its ecosystems, concentration of population, exploitation of natural resources, discharge of waste effluent and municipal sewage, development of various industries, increasing load on harbors, spurt in recreational activities and above all petroleum exploration activities.

The destruction and loss of land due to sea erosion is a severe problem, particularly for a country like India facing explosive population growth. Shoreline is a dynamic geomorphological entity, which responds to the external forces exerted by waves, tides, nearshore currents and the resultant sediment transport. When the resultant sediment transport entering a particular area is greater than the sediment going out from the area, accretion or beach development takes place. On the other hand, when there is a deficit of the incoming sediment supply into a particular area with reference to the sediment going out of the same area, beach erosion takes place. Beaches act as constant absorbers of the wave energy of water and though subject to small disturbances, remain in equilibrium. However, sometimes this equilibrium gets disturbed due to either natural phenomena or human intervention. When shore structures are constructed, it is quite likely that equilibrium condition is altered. Since this can cause considerable damage and reduce the effectiveness of such structures, it is necessary to study the equilibrium condition of shores before constructing such structures. Therefore, it is of utmost importance to get information on accreting, eroding and stable coasts so that effective measures to combat sea erosion may be taken.

Major concern of coastal zone management is to ensure a rational development of area and judicious use of its resources, which is consistent with the surrounding natural systems and environment. Environmentally effective policy decisions pertaining to coastal zone management depends upon accurate and comprehensive scientific data. A basic problem confronting our country is limited availability of geographic data on coastal zone. Accurate and updated scientific data is required on coastal wetlands/landform/land use, shoreline changes, sediment transport and water quality of near shore waters.

Satellite data have proved to be extremely useful in creating baseline inventory of the entire Indian shoreline at 1:250,000, 1:50,000 and 1:25,000 scale (Nayak et al. 1991, SAC, 2012). The prepared landuse/wetland maps show

wetland features between high and low water lines and land use features of the adjoining shore (up to 1.5 km from high waterline).

Coastal Protection and Development Advisory Committee (CPDAC) constituted by Ministry of Water Resources, Govt. of India in April, 1995 is the apex body responsible for formulating policies/ programmes, providing technical guidelines, monitoring, reviewing and co-ordinating coastal zone protection and developmental activities executed by different Central and State Departments along the Indian coastline. The committee recommended the need for preparation of Coastal Atlas showing information related to coastal erosion derived from satellite data and protection measures undertaken by all maritime states of India. A subcommittee was constituted for the purpose. The subcommittee met several times, discussed and finalised the contents of the Atlas. It was decided that shoreline change atlas of the entire Indian coast would be prepared based on Highest High Tide Line depicted on coastal landuse/landcover maps of 1989-91 and 2004-06 time-frame on 1:25,000 scale The baseline data has been generated under two projects funded by Ministry of Environment and Forests (MoEF) with Space Applications Centre, Ahmedabad as a nodal agency with active participation of several related Central & State Government Departments and Academic Institutes.

The entire database of coastal thematic maps prepared using satellite data for the period 1989-91 and 2004-06 time-frames has been digitised and put as part of Coastal Zone Information System (CZIS) in GIS environment developed at Space Applications Centre (ISRO), Ahmedabad. Coastal Zone Information System for entire India (CZIS-India) is developed to include and update all the coastal information viz. landuse, wetland, shoreline, coral reef etc. for all maritime states including Union Territories in ARC/INFO environment. The information is catalogued as per Survey of India topographical map indexing. This data has been used as a baseline data for preparing the shoreline change atlas of India.

The major task involved preparation of a digital shoreline change atlas in GIS environment using existing databases of coastal landuse/landcover maps prepared on 1:25,000 scale (1989-91 and 2004-06 time-frame), depict and quantify shoreline changes as eroding/accreting/stable, show status of shoreline protection measures taken by respective States and generate A3 size State-wise Coastal Atlas of all the maritime states of India.

The detailed tasks taken up are:

i. Quantify and classify the shoreline as shoreline under erosion, stable and accretion for all the maritime states by integrating shoreline using existing database of 1989-91 and 2004-06 period.

ii. Integrate the field information on coastal erosion and shoreline protection measures of all the maritime states of India in GIS environment.

iii. Analyse satellite data of 2011-12 period for selected hotspot areas (areas showing large shoreline changes) and understand coastal processes responsible for such changes.

iv. Generate Six Volumes of A-3 size coloured digital as well as hard copy Coastal Atlas of India (Volume 1 covering Gujarat, Daman & Diu, Volume 2 covering Maharashtra & Goa, Volume 3 covering Karnataka & Kerala, Volume 4 covering Tamilnadu, Puducherry & Andhra Pradesh, Volume 5 covering Odisha & West Bengal and Volume 6 covering Lakshadweep & Andaman & Nicobar islands).

DATA USED

Primarily, landuse/landcover maps on 1:25,000 prepared using IRS-P6 LISS-IV data of 2004-06 period and SPOT-1 & 2 Multispectral and IRS-1A & IRS-1B LISS-II data of 1989-91 period available at Space Applications Centre, Ahmedabad have been utilized. In few cases where suitable data were not available, the data of nearest time frame were used. These maps depict shoreline as Highest High Tide Line (HTL) and Low Tide Line (LTL). Shoreline changes with respect to Highest High Tide Line have been taken up for the present work. The entire database has been put in GIS environment as part of Coastal Zone Information System (CZIS) developed at Space Applications Centre (ISRO), Ahmedabad. Landsat TM, ETM and Resourcesat-1 AWiFS data of corresponding time frames was used for rechecking and confirming the continuity of HTL in adjoining map sheets. Status of coastal protection measures taken up by respective maritime states and UT were prepared in spatial format and were put in the GIS database.

List of the satellite data used is summarised in the Annexure-III (Table 3-6).

The status of coastal protection measures taken up by maritime states and UTs was provided by them through Central Water Commission (CWC), New Delhi. These were prepared in spatial format and were put in the GIS database. Details are provided in Annexure-III (Table 7-10).

METHODOLOGY

Following steps were undertaken:

i. The existing Coastal Zone Information System (CZIS) developed at Space Applications Centre (ISRO), Ahmedabad has been primarily used. Coastal landuse maps for the entire Indian coast prepared on 1:25, 000 scale for 1989-91 and 2004-06 time-frame available in CZIS have been used for shoreline change mapping.

ii. National Spatial framework from NRDB has been used for organizing and creating the database. The basic framework of CZIS-India is prepared for all maritime states and Union territories of India on 1:25,000 scale. One degree consists of 8X8 rectangular grids or cells. Each rectangular grid or cell represents one SOI topographic area on 1:25,000 scale (M.C Gupta et al., 2000).

iii. Spatial layer of Line (LN25) of 1989-91 time-frame (containing High Water Line, rail, road, drainage) has been taken from the CZIS database.

iv. Spatial layer of Line (LN25N) of 2004-06 (containing High Water Line, rail, road, drainage) has been taken from CZIS database.

v. Spatial layer of Point of habitation has been taken from CZIS database.

vi. Registration of two time-frame data sets considering rail, road and HTL of 1989-91 as base has been done.

vii. Output spatial layer showing shoreline changes using overlay of rectified coverage and base coverage is created.

viii. Maps were rechecked using Landsat TM, ETM, AWiFS and LISS-IV data to make it seamless in database.

ix. Polygons for areas under erosion and accretion were created.

x. Areas under erosion and accretion were measured for the main shoreline (excluding creeks, river mouths, estuaries). Shore length under erosion, accretion and stable categories were measured for the main shoreline (excluding creeks, river mouths, estuaries).

xi. A table containing all the above statistics has been generated for each maritime state and U.T.

xii. Status of shoreline protection measures have been depicted as per the information provided by the maritime State/UT agencies through Central Water Commission.

xiii. A standard map composition and layout were finalised and have been used for final map composition of each map.

xiv. Field checks were carried out and based on field observations, corrections were incorporated while finalizing the map. Field photographs were also taken during the field visits.

Accuracy Assessment: Classification as well as planimetric accuracy of the maps was assessed while carrying out the filed work. Overall the classification accuracy of these maps range from 90-95% at 90% confidence level. The Planimetric Accuracy of these maps is 6.25 m as per Survey of India (SOI) standard.

xv. Hotspots were identified based on the magnitude of shoreline dynamics. Recent satellite images (2011-12) were acquired and analysed.

xvi. Finalised maps depicting shoreline changes were utilized for preparing shore line change Atlas of the Indian coast (Six Volumes). Volume 1 covers Gujarat, Daman & Diu, Volume 2 covers Maharashtra & Goa, Volume 3 covers Karnataka & Kerala, Volume 4 covers Tamilnadu, Puducherry & Andhra Pradesh, Volume 5 covers Odisha & West Bengal and Volume 6 covers Lakshadweep & Andaman & Nicobar islands. Digital Atlas in form of CD was prepared.

RESULTS

Odisha

The Odisha coast extends from 18^0 56' N to 21^0 38' N and 84^0 41' E to 87^0 28' E along the eastern coast of India. The Odisha coast is mainly deltaic in nature, formed by the Mahanadi and the Brahmani- Baiterani rivers. Odisha coast has some of the excellent mangroves, in particular around its central and northern parts. The Chilka lagoon located on the southern parts of the Odisha coast is the largest natural water body in the country spread for around 830 sq km area. The pear shaped lagoon is around 65 km long and broadens towards north-east part, which is around 16 km. The lagoon has been declared as a "Ramsar site", i.e., a wetland of International importance based on its rich biodiversity. It is connected to the Bay of Bengal by a long and narrow channel. Siltation is a major problem in the lagoon due to the long constricted outer channel. Sandy beaches are well marked along the shoreline from the Bahuda estuary near the Andhra Pradesh border to the Devi river mouth. The sandy beach of the southern coast of Odisha is enriched with rare earth minerals like monazite, ilmenite, zircon, rutile, sillimanite etc. The sandy beach of Puri is a tourist attraction. Spits are well developed along the coastline near major estuaries. The mangrove occurring near the mouth of the Mahanadi river have creek network of the Luna, the Jambu, the Kharnasi, the Khola and the Batighar jora creek. These creeks are almost parallel to the coast. The Brahmani and the Baitarani rivers and their distributaries and creeks provide a congenial ecological niche for the growth of mangrove vegetation. The mangrove of Bhitarkanika is the second largest mangal formation in the Indian subcontinent. It harbours high concentration of typical mangrove species and a wide spectrum of genetic diversity. Important mangrove species includes *Avicennia alba, A. officinalis, Excoecaria agallocha, Heritiera minor, Sonneratia apetala, Rizophora mucronata, R. candlena* etc. Vast stretches of subtidal mudflats are observed from the Dhamra River to Chandipur along northern parts of the Odisha coast.

The total length of the Odisha shoreline is 436.1 km, which does not include the mouth of the river/estuary and creeks. It is observed that 199 km length of Odisha coast has eroded, 205 km has accreted and 32.1 km has been stable during the time frame 1989-91 and 2004-06 (Table 1, Fig. 1). The total area eroded is 13.78 sq. km and area accreted is 13.3 sq. km (Table 1). Details of each individual map sheet are provided in Table 1.

The shoreline of the Odisha coast is sub divided into three zones viz., the southern zone, the central zone and the northern zone based on the coastal configuration, geological and geomorphological characteristics.

The southern zone comprises of the linear sandy beaches from the Bahuda estuary near Andhra Pradesh border (Map Sheet No. 74A16SW) to the Devi estuary (Map Sheet No. 74I05NE). In general, casuarina plantation is observed all along the coast on the dune ridges formed parallel to the coast. Within this zone the area and length of the accreting coast is observed to exceed the area of eroding coast. Wide beaches are observed at a number of places, however at few locations beaches are under erosion.

The southern parts of the Odisha coast from the Bahuda estuary upto the south-western parts of the Chilika lagoon shows accretion to stable coast in general. However, at few locations beach erosion is observed. Wide beach is observed at Ramyapeta (Map Sheet No. 74A16NW, Plate 7) north of the Bahuda estuary. This beach is observed to be under severe erosion as evident by vertical scarp (Plate 8) of beach sand exposed to the wave action (Plate 9). This wide beach is ideal for turtle nesting camp (Plate 10 & 11). Stable to slightly accreting coast is observed upto Baksipalli (Map sheet No. 74A16NE). Field observations show stable to accreting coast in area north of Markandi (Map Sheet No. 74A16NW) north of the Bahuda estuary (Plate 12). Beach erosion at Gopalpur, south of Haripur creek (Map Sheet No. 74A15SE and Plate 13 & 14) is observed. Sea wall is constructed to protect the nearby Hotels and other buildings. Coastal segment between Gopalpur beach upto the Rushikulya estuary forms one of the hotspot area along the Odisha coast due to developmental activities i.e., construction of new Gopalpur Port and its impact on the shoreline. Field observations south of New Gopalpur Port show accretion (Plate 15) due to blockage of littoral transport northwards by construction of southern breakwater. Erosion is observed north of old Gopalpur Port (Map Sheet No. 74A15SE & Plate 1). A series of groynes are under construction north of old Gopalpur Port for arresting the erosion and beach nourishment (Map Sheet No. 74A15SE & Plate 16 & 17). It is observed that coast on both sides of the Rushikulya estuary (Map sheet No. 74E03SW & 74 E03NW) is of accreting nature in general. Wide beach is observed at Naliyanuagan (Map sheet No. 74 E03SW and Plate 18). During field visits it is observed that the beach is eroding (Plate 19). A long spit is developing northwards from the southern bank of the Rushikulya mouth and area north of the Rushikulya mouth shows accretion (Plate 20 & 21). However, area further NE upto the SW parts of the Chilika lagoon shows eroding coast (Map Sheet No. 74E03NE).

Coast parallel to the Chilika lagoon shows segments under erosion as well under accretion. Erosion is observed at coast near Prayagi, south of Paikarapur (southernmost part of the Chilika lagoon (Map Sheet No. 74E03 NE & Plate 22). During field checks, local people informed that casuarina plantation along the coast has been destroyed by the erosion. Presently highest high tide line is parallel to the casuarina plantation on very steep sloping sand dune ridge. Erosion is observed upto Map Sheet No. 74E02SE,

south of Kandeswar on the outer spit of the Chilika lagoon. Further NE upto the coast south of Nalipatna (Map Sheet No. 74E06SW) accretion is observed on the outer spit of the Chilika lagoon. Coast south of the southern Chilika inlet is stable to accreting (Map Sheet No. 74E06NE & Plate 23). Casuarina plantation on very steep sloping sand dune ridge marks the highest high tide line.

Area around Chilika mouth shoreline is highly dynamic and forms one of the hotspots along the Odisha coast due to its impact on the Chilika eco-system (Map Sheet No. 74E10NW, Plate No. 2). Chilika Development Authority made an artificial opening (new mouth) with an initial cut of 80 m on 23rd September, 2000 near village Sipakuda on the spit of the Chilika lagoon to improve the salinity levels and tidal flux in the lagoon. A channel within the lagoon was also made by dredging for maintaining the tidal flux. It resulted in reduction of 18 km distance for the tidal flux to enter the lagoon from its previous natural opening and thereby the salinity levels along with tidal flux improved. Strong tidal currents could enter the lagoon and ebb currents eroded the northern bank and inner part of the southern bank at the new mouth and it initially widened by eroding the NE parts, however a spit started to develop from its western bank (Plate 24). The previous Chilika inlet around 18 km NE of this location on the outer channel of the Chilika lagoon naturally closed (Plate 25). Large amount of sediments are being flushed out of the new mouth as evident by formation of a large sediment plume offshore wards. This plume is acting as a barrier for the predominant northerly drift along the east coast and therefore accretion is observed on the western bank and erosion is observed on the eastern side of the new mouth. The process has resulted in closing of the new mouth and its gradual shifting in the NE direction (Plate 2, 26 & 27). Since the year 2000 upto 2010-11, there is around 1.5 km shift of the Sipakuda inlet towards NE (Plate 2), which was observed to have further shifted around 0.5 km during field checks (Plate 27). Large accretion has led to growth of an extensive balloon shaped spit (Plate 28) closing the previous Sipakuda inlet and its shifting towards NE (Plate 2 & 29). The shoreline configuration is observed to have developed southwards towards the Bay of Bengal. The outer spit of the Chilika lagoon, further NE of the Sipakuda inlet eroded and another inlet naturally opened and is named as Gabakunda inlet (Plate 30). The reduced longshore transport further NE of Sipakuda inlet has led to formation of Gabakunda Inlet. The spit on the southern side of the Gabakunda inlet shows northwards shifting as observed by its erosion (Plate 31). The shoreline configuration is observed to be developing northwards towards the lagoon.

The shoreline further NE wards from the naturally closed previous inlet in the outer channel of the Chilika lagoon upto the Devi estuary trends ENE-WSW and is linear in nature with narrow sandy beaches through Puri and area south of Konark near Chandrabhaga. Coastal segment west of Puri (Map Sheet No. 74E13SW, Plate 32) is eroding. The eroding trend is observed to continue

upto Chandrabhaga (Map Sheet No. 74I01SW, Plate 33, 34 & 35). Accretion is observed along coastal segment south of Devi estuary (Map Sheet No. 74I05NW & Plate 36). The southern bank of the Devi estuary is severely eroding (Map Sheet No. 74I05NW).

The central zone along the Odisha coast comprises of the compound delta of the Mahanadi-Brahmani-Baitarani river systems and exhibit a dynamic geomorphological scenario shaped by fluvio-marine and aeolian agencies. Mahanadi river and its tributaries like the Devi, the Bhitikolia, the Santra, the Jambu and the Hansua along with the Brahmani, the Baitarani and the Dhamra are the major rivers within the zone. The delta region is observed to have highly complex dynamics of shoreline resulting into segments of erosion and accretion with different shapes. The area is prone to floods, storm surges and cyclones. It extends from the Devi estuary (Map Sheet No. 74I05NE) upto the Dhamra mouth (Map Sheet No. 73L13SE). The central Odisha coast comprises of coastal segment from the Devi river mouth (Map Sheet No. 74I05NE) upto the Mahanadi river mouth (Map Sheet No. 73L11SE), from the Mahanadi river mouth (Map Sheet No. 73L11SE) upto the Hansua river mouth (Map Sheet No. 73L14SW) and from the Hansua river mouth (Map Sheet No. 73L14SW) upto the Dhamra river mouth (Map Sheet no. 73L13SE). In this zone the eroding area and length is observed to exceed the accreting area.

At Devi river mouth, the southern coast is eroding, whereas significant deposition is observed to its north (Map Sheet No. 74I05NW & 74I05NE). The coastal segment from the Bhitikolia river mouth (Plate 3 & Map Sheet No. 73L08SE), Jatadharmuhan river mouth (Map Sheet No. 73L12NW) upto the Mahanadi river mouth (Map Sheet No. 73L08SE, 73L08NE, 73L12NW, 73L12NE, 73L11SE) shows severe coastal erosion except some accretion observed towards the southern breakwater of the Paradip Port (Map Sheet No. 73L11SE). Sea wall has been constructed for protecting the area north of Jatadharmuhan river mouth (Map Sheet No. 73L12NW) upto the Santra river mouth (Map Sheet No. 73L12NE) and area north of the northern breakwater of the Paradip Port (Map Sheet No. 73L11SE).

Coastal segment forming the northern bank of the Mahanadi river mouth (Map Sheet No. 73L11SE) shows accretion, which continues further NE wards upto the mouth of the Jambu river (Map Sheet No. 73L11NE). Accretion is observed on the northern bank of the Jambu river mouth, however further northwards the coastal segment changes its orientation and trends N-S upto the Kandrapatia river mouth and is eroding (Map Sheet No. 73L11NE). Erosion is observed on both sides of the Kendrapatia river mouth (Map Sheet No. 73L11NE). Several spits and offshore barrier islands developed NE of the Mahanadi river mouth and east of the Kendrapatia and the Jambu river mouths in the Bay of Bengal are oriented in NE-SW (Map Sheet No. 73L15SW) and in N-S direction (Map Sheet No. 73L15NW). While the spits

and barrier islands in Map Sheet No. 73L15SW and 73L15NW show shoreline changes around them. The entire area between these barrier islands and main coast line is known as Hukitola Bay comprising of intricate system of creeks and distributaries of the Mahanadi River with dense mangrove cover and swampy area.

Coastal segment between the Hansua river mouth upto the Dhamra river mouth comprises of the intricate system of creeks and distributaries of the Brahmani, the Baitrani and the Dhamra River associated with dense mangrove cover of the Bhitarkanika Reserved Forest. Sediments from the Dhamra river mouth form extensive sediment plumes. The entire coast from the Hansua river mouth upto the southern parts of the Dhamra river mouth is observed to be remarkably straight and is oriented NE-SW. Area just adjoining the northern bank of the Hansua river mouth is accreting. However, further NE wards the entire coastline is severely eroding and forms one of the hotspot area along the central parts of the Odisha coast. Severe erosion near Pentha village located north of Hansua river mouth in Cuttack district along Odisha coast (Plate 4, 37 & Map Sheet No. 73 L14SW) is observed. During field checks steep scarps of the beach carved by waves (Plate 38), destruction of protection measures (Plate 39) and destruction of terrestrial vegetation (Plate 40) has been observed. Around 400 m width of land is observed to have eroded from the region. As per the information provided by the local people, sea has eroded ~ 1-2 km of the coastline during last few decades. Presently, an embankment along with protection measures has been made (Plate 41 & 42) to protect the village.

The northern zone of the Odisha coast extends from the Dhamra river mouth (Map Sheet No. 73L13 SE) to coastline bordering the state of West Bengal (Map Sheet No. 73O06SE). The region is characterised by gently sloping, crescent shaped coastline, extensive mudflats with marshes and mangrove vegetation, aquaculture ponds and casuarina plantation. The entire coastal segment is observed to have area and length of accreting shoreline to be more compared to the eroding shoreline. The Gamai, the Khandia, the Burhabalang, the Panchpara, the Dubdubi and the Subarnarekha are rivers debouching into the Sea within the zone.

The coastal segment near the northern parts of the Dhamra river mouth is oriented NNW-SSE (Map Sheet No. 73L13SE) upto the mouth of the Gamai river (Map Sheet No. 73K16NW) and is observed to be stable to slightly eroding in general. The entire coastal segment shows extensive aquaculture ponds, mangroves, marshes and mudflats. The coastal segment is flood prone due to extremely gentle slope and all along the coast earthen bund demarcates the highest high tide line. Plate 43 shows field photograph of the earthen bund at Kasia Village, Baleshwar District (Map Sheet No. 73K16SW) along the northern parts of the Odisha coast. Fishing harbor is located near to

the earthen bund at Kasia village (Plate 44). Extensive mud flats, marshes and mangrove along the creek are observed at this location (Plate 45 & 46). Northern parts of the Dhamra river mouth are observed to be eroding (Map Sheet No. 73L13SE). Area further northwards upto the coast near Karanpalli (Map Sheet No. 73L13NE) is stable.

Coastal segment from the northern parts of the Gamai river mouth changes its orientation to N-S and then NNE-SSW upto the southern bank of the Panchpara river mouth (Map Sheet No. 73O02SW). This coastal segment is observed to be accreting in general. Gently sloping beach, extensive tidal mudflats and mangroves are observed during field checks near village Talapad in Baleshwar district, Odisha (Map Sheet No. 73K15SE, Plate 47, 48 & 49). Casuarina plantation is observed on gently sloping beach in contrast to those on sand dune ridges along the southern Odisha coast. The coast near Chandipur (Map Sheet No. 73O03NW) is observed to be eroding and sea walls are constructed for protection (Plate 50, 51 & 52). Extensive mudflats are observed at this location (Plate 52 & 53).

Coastal segment from the northern bank of the Panchpara river mouth upto the Subarnarekha river mouth (Map Sheet No. 73O06SW) is oriented ENE-WSW, E-W, ESW-WNW and exhibits an arcuate shape. The entire region is observed to be accreting. Area north of the Subarnarekha river mouth is observed to be oriented ENE-WSW and is eroding (Plate 5 & Map Sheet No. 73O06SE). This region is identified as hotspot region along the northern Odisha coast. Reduced supply of sediments from the Subarnarekha has probably led to erosion along the coastal segment trending ENE-WSW, north of the Subarnarekha river mouth.

The map sheet wise shoreline changes along the Odisha coast are shown in Table 1.

Table 1: Map sheet wise results of shoreline changes for 1989-91 and 2004-06 time-frame for Odisha coast

Serial No.	Map No.	Erosion Area (in Sq km)	Erosion Length (km)	Accretion Area (in Sq km)	Accretion Length (km)	Stable Length (km)
1	74A16SW	0.06	0.91	0.16	3.45	0
2	74A16NW	0.01	0.15	0.49	13	0
3	74A16NE	0	0	0.13	4.64	0
4	74A15SE	0.22	5.81	0.36	9.73	0
5	74E03SW	0.07	4.38	0.18	4.08	0
6	74E03NW	0.02	0.8	0.99	6.89	0
7	74E03NE	0.35	8.59	0.1	4	0
8	74E02SE	0.07	1.39	0.14	2.32	0
9	74E06SW	0.09	3.35	0.74	11.6	0
10	74E06SE	0.07	2.54	0.07	2.53	0
11	74E06NE	0.01	0.28	0.3	8.1	0
12	74E10NW	0.78	10.2	0.35	5.4	0
13	74E10NE	0.1	2.31	1.06	6.04	0
14	74E09SE	0	0	0.2	5.96	0
15	74E13SW	0.13	5.62	0.18	6.84	0
16	74E13SE	0.12	7.83	0.04	3.27	0
17	74I01SW	0.21	10.2	0.03	1.68	0
18	74I01SE	0.08	2.58	0	0	0
19	74I01NE	0.4	10.2	0.01	0.29	0
20	74I05NW	0.68	8.17	0.11	5.13	0
21	74I05NE	0.43	2.39	0.42	3.39	0
22	73L08SE	2.47	13	0.34	2.4	0
23	73L08NE	0.03	0.35	0	0	0
24	73L12NW	1.57	17.1	0.01	0.48	0
25	73L12NE	0	0	0.15	1.95	0
26	73L11SE	0.06	2.99	1	8.71	0
27	73L15SW	0.06	1.45	0.13	3.42	0
28	73L15NW	0.06	2.71	0	0.37	0
29	73L11NE	0.3	6.67	0.19	2.38	0
30	73L14SW	1.77	13	0.44	3.43	0
31	73L14SE	0.77	5.33	0	0	0
32	73L14NE	1.05	14.4	0	0	0
33	73P02NW	0.12	6.45	0.19	1.87	0
34	73L13SE	0.36	9.9	0.04	2.45	0
35	73L13NE	0	0	0	0	15.6
36	73K16SE	0	0	0	0	0.15
37	73K16SW	0	0	0	0	14.7
38	73K16NW	0.06	3.42	0.44	9.8	1.72

39	73K15SW	0.01	0.72	0.09	3.31	0
40	73K15SE	0.01	0.36	0.77	11.7	0
41	73K15NE	0.01	0.56	0.42	5.81	0
42	73O03NW	0.13	3.53	0.36	9.18	0
43	73O02SW	0.27	1.55	0.11	0.91	0
44	73O02SE	0.15	1.49	0.73	11.4	0
45	73O06SW	0.41	1.48	1.61	11.5	0
46	73O06SE	0.22	4.63	0.25	5.21	0
	Total	13.8	199	13.3	205	32.1

Figure 1 shows the length of eroding, accreting and stable coast of Odisha.

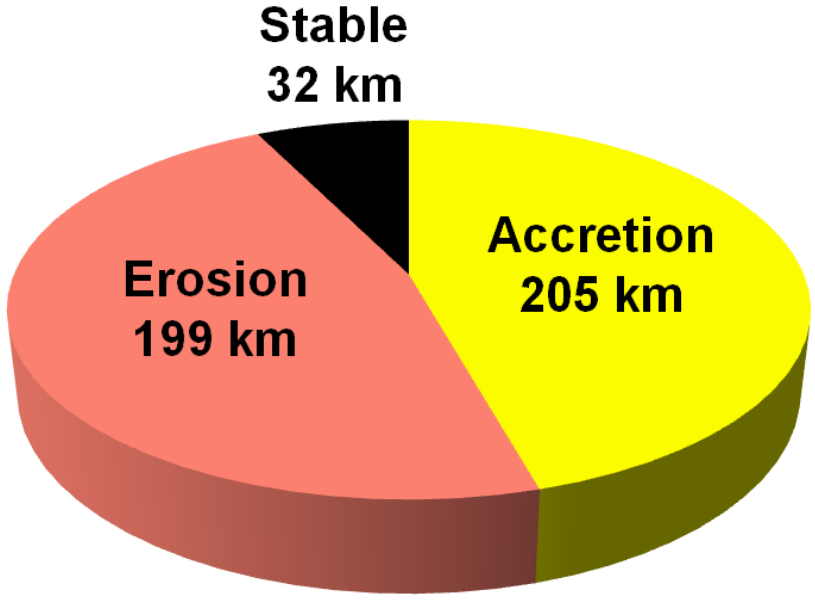


Figure 1: Status of coastal erosion, accretion and stable nature of Odisha Coast (Total coastal length of 436.1 km does not include length of mouth of estuary, rivers, creeks and their inner parts).

West Bengal

The West Bengal coast extends from 21^0 36' N to 21^0 56' N and 87^0 27' E to 89^0 8' E. Coastline of the West Bengal along the Bay of Bengal from west to east is spread over Purba Medinipur, South 24-Parganas and North 24-Parganas districts lying on either side of the funnel shaped Hoogly estuary. The eastern boundary borders Bangladesh and the western boundary is near Digha (21° 37.012'N) on the state border with Odisha. The land–sea boundary of the Purba Medinipur district which is wave dominated, is relatively less indented and is characterized by sand dunes, beaches, aquaculture/salt pans activities, longshore currents, minor river discharges, less turbid but high saline sea water influence and cuspate delta of the Subarnarekha. This part of the coast is largely inhabited and cultivated. Fishing is the main occupation at Digha/Sankarpur and tourism places include Mandarbani and Digha. High tide mudflats are well noticed near Khajuri and north east of Kanthi. In some areas intertidal mudflats are being used for the development of salt pans. Sandy beaches are located at few locations, where as vast extension of muddy beach is found along the Hoogli estuarine area and the Sundarbans.

The Sundarban area is fed with numerous rivers which form network of creeks. These are always affected by daily tides. The creeks are erosive in nature and have been affected by cyclones and storm surges. These creeks are gradually filled with sediments from the upper reaches. Many small sandy islands and mudflats mark the river channels and the coast and most of them get completely inundated during high tide. The mangroves in the West Bengal coast mainly colonies in the Sundarban area which is the largest single block of tidal halophytic mangroves of the world. The major species of the dense mangrove forest include *Heeritiera fomes*, *Rhizophora apiculata*, *R. mucronata*, *Bruguiera gymnorhiza*, *B. parviflora*, *Ceriops decandra*, *Sonneratia apetala*, *S. caseolaris* and *Avicennia spp*. *Nypa fruticans* is the major species found on the creek side and found on the sparse categories. *Phonix paludosa* almost covers all the tidal zones of the Sunderbans.

The total length of the West Bengal shoreline is 282.2 km, which does not include the mouth and inner parts of the river/estuary and creeks. It is observed that 115.06 km length of West Bengal coast has eroded, 19.46 km has accreted and 147.68 km has been stable during the time frame 1989-91 and 2004-06 (Table 2, Fig. 2). The total area eroded is 11.63 sq. km and area accreted is 1.52 sq. km (Table-2). Details of each individual map sheet are provided in Table 2.

The West Bengal coastal region is divided into four segments based on coastal configuration, geological and geomorphological characteristics, viz; the coastal segment west of the Hugli river upto Digha near Odisha border (located in the Purba Medinipur district), the coastal segment east of the Hugli

river upto Duaragra Gang creek, north of Namkhana (located in the South 24-Parganas district), coastal segment from the eastern parts of the Pitt's creek upto western bank of the Kalindi river near Samsernagar (located in the South 24-Parganas district and North 24-Parganas district) and the coastal region comprising of Sagar island and small islands around it in the Hugli estuary (located in the South 24-Parganas district).

The coastal segment west of the Hugli river extends from area south to Digha in Purba Medinipur district (Map Sheet no. 73O06SE) upto the confluence of the Rupnarayan river and the Hugli river, north of Suklapur in Purba Medinipur district (Map Sheet No. 79B04NW). Changes in shoreline have been mapped for the entire coastal segment oriented in arcuate shape forming western coast of the West Bengal and western bank of the Hugli river covered in Map Sheet No. 79B04NW, 79B04NE, 79B04SE, 79B04SW, 73N16SE, 79C01NW, 73O13NE, 73O13SE, 73O13SW, 73O14NW, 73O10NE, 73O10NW, 73O10SW, 73O06SE from north to south. Erosion, accretion and stable nature of the coast is quantified for Map Sheet No. 73O06SE, 73O10SW, 73O10NW, 73O10NE & 73O14NW by excluding Map Sheets covering inner parts of creeks and Hugli estuary. Severe erosion is observed along westernmost parts of the West Bengal coast around Digha, in particular ENE of Digha (Map Sheet No. 73O10SW, 73O10NW and 73O10NE) including beaches at Sankarpur and Mandarbani and efforts to protect the coast from erosion by constructing various protection measures are observed (Plate 6 & Plate 58 to 70). This coastal segment is one of the hotspot regions along the West Bengal coast. These beaches are most popular along West Bengal coast for tourism. The major cause of the erosion is due to anthropogenic activities in the Subarnarekha estuary leading to reduced discharge resulting into less supply of sediments NE wards and erosion of the coast by wave action. Further ENE wards at the mouth of the Pichaboni Khal (Map Sheet No. 73O14NW, Plate 71 & 72) accretion as well eroding is observed on both banks. Coastal segment NE of Pichaboni Khal (Map Sheet No. 73O14NW, 73013SW, 73O13SE) upto coast near Sahibnagar (Map Sheet No. 73O13NE) is observed to be stable to accreting. Erosion is observed for the coastal segment near to Sahibnagar and Gangra (Map Sheet No. 73O13NE). Further NE wards accretion is observed for coast near Saudkhali Lalpai (Map Sheet No. C01NW). Northern parts of the Haldi river mouth are observed to be stable and erosion is observed on its southern bank (Map Sheet No. 79B04SW). Coast near Baneswar Chak forming western bank of the Hugli River is observed to be accreting (Map Sheet No. 79B04SE). Erosion is observed south of Horkhali on the western bank of the Hugli river (Map Sheet No. 79B04NE). The coastal segment along Hugli in this part is oriented NW-SE. The western bank of the Hugli river between Kukrahati and Suklapur is oriented E-W and is stable (Map Sheet No. 79B04NW).

The coastal segment east of the Hugli river extends from area near the confluence of the Rupnarayan river and the Hugli river, north of Simulbaria in South 24-Parganas district (Map Sheet No. 79B04NW) upto Duaragra Gang creek, north of Namkhana in South 24-Parganas district (Map Sheet No. 79C01SE). The coastal segment is on the eastern bank of the Hugli river and on the eastern bank of the Muriganga river, east of the Sagar island. The entire segment from north to south is covered in Map Sheet No. 79B04NW, 79B04NE, 79B04SE, 79C01NE, 79C01SE. Changes in the shoreline have been mapped for the entire coastal segment, however as the area forms inner parts of the Hugli estuary, quantification for this coastal segment has been excluded. Stable coast is observed from Simulbaria (Map Sheet No. 79B04NW) upto area north of Ganpara (Map Sheet No. 79B04NE) along the northern parts of the eastern bank of the Hugli river. Area south of Ganpara (Map Sheet No. 79B04NE) upto Raytala (Map Sheet No. 79B04SE) is eroding. Coastal segment from Raytala (Map Sheet No. 79B04SE) upto Uttar Chandannagar (Map Sheet No. 79C01NE) is observed to be stable along the northern parts of the eastern bank of the Hugli river. Coastal segment south of the Uttarchandannagar orients N-S in general and forms southern parts of this segment. Erosion is observed for the coastal segment near Uttam Chandannagar, Sibkalinagar, Tilakmandal Chak (Map Sheet No. 79C01NE), Charergheri and upto Duragra Gang creek, north of Namkhana (Map Sheet No. 79C01SE) along the southern parts of the eastern bank of the Hugli river bifurcated as Muriganga river in this region.

The coastal segment from the Mahisani island (Map Sheet No. 79C02NE) upto western bank of the Kalindi river near Samsernagar (Map Sheet No. 79F04NW), located in the South 24-Parganas district and North 24-Parganas district comprises of intricate system of creeks, rivers and marshes of the Sundarban Biosphere Reserve. It is part of the largest prograding delta with largest mangrove cover in the world, covered by quaternary sediments carried and deposited by the rivers Ganges, Matla & Bidyadhari. The region is characterized with number of anatomising distributaries such as the Bartala, the Matla, the Muri Ganga, the Saptamukhi, the Thakuran matta, the Ichhamati, the Kalinadi, the Harinbari, the Bidya and the Gosaba. It is the largest coastal zone in West Bengal and is covered in 26 Map Sheets. The area is bound on the west by river Muriganga and on the east by rivers Harinbhahga and Raimangal. It is recognized as a Ramsar Site (a wetland of international importance) and includes Sundarban Tiger Reserve having the highest tiger population in the world. The eco-system has extremely rich diversity of aquatic and terrestrial flora and fauna acting as a natural fish nursery. The mangrove cover reduces the fury of cyclonic storms and prevents erosion due to tidal action. Millions of people depend on Sundarban Ecosystem for their livelihood and sustenance through fishing, collection of honey and fuelwood/timber. Changes in the shoreline have been mapped for

the entire coastal segment, however as the area forms intricate system of creeks and rivers, quantification for the inner parts of creeks and rivers has been excluded and areas under erosion, accretion and stable nature of the coast are quantified by following the general orientation of the coastline.

Severe erosion is observed on the coast around the Mahisani and Patibunia islands (Map Sheet No. 79C02NE and 79C02SE), along the coastal stretch near Bijaybati, Fraserganj (Map Sheet No. 79C06SW), around Gobardhanpur and area north as well south of Sitarampur (Map Sheet No. 79C06SE and 79C06NE), western bank of the Saptamukhi river (Map Sheet No. 79C06NW), NW of Harekrishnapur on the eastern bank of the Saptamukhi river (Map Sheet No. 79C05SW), eastern parts of island around Paschim Sripatinagar (Map Sheet No. 79C05SE), south of Kishorimohanpur (Map Sheet No. 79C09SW), area SE of Deulbari (Map Sheet No. 79B12SW), area on both sides of the Matla river mouth (Map Sheet No. 79B12SE), island between Sara Gang and Raimangal river mouths (Map Sheet No. 79B16NE) and area near Samsernagar (Map Sheet No. 79F04NW). Rest of the coastal segments in the Sundarbans region is observed to be stable to accreting in nature except few small segments.

The coastal segment forming Sagar island and other islands around it is located in the South 24-Parganas district. Changes in the shoreline have been mapped for the entire coastal segment covered in Map Sheet No. 79C01NW, 79C01NE, 79C01SE, 79C01SW, 79C02NW, 79C02NE, however as the area forms inner parts of the Hugli estuary, quantification for this coastal segment has been excluded except the southern coast of the Sagar island. The entire coastline of the Ghormara island (Map Sheet No. 79C01NW & 79C01NE) is observed to be eroding. The entire north-western (Map Sheet No. 79C01SW), north-eastern (Map Sheet No. 79C01SE) and southern (Map Sheet No. 79C02NW and 79C02SE) parts of the Sagar island, in particular area near Chandipur, Beguakhali, Basantpur and Shibpur is observed to be severely eroding.

The map sheet wise shoreline changes along the West Bengal coast are shown in Table 2.

Table 2: Map sheet wise results of shoreline changes for 1989-91 and 2004-06 time-frame for West Bengal coast.

Sr. No.	Map Sheet No.	Erosion Area (in sq. km)	Erosion Length (In km)	Accretion Area (in sq km)	Accretion length (in km)	Stable Length (In km)
1	73O06SE	0.00	0.00	0.00	0.00	0.79
2	73O10SW	0.01	0.28	0.00	0.00	3.31
3	73O10NE	0.53	8.46	0.12	0.98	3.62
4	73O10NW	0.51	8.76	0.00	0.00	0.00
5	73O14NW	0.10	1.78	0.66	5.44	4.16
6	79B12SE	0.37	5.08	0.03	0.83	11.52
7	79B12SW	0.13	2.97	0.00	0.00	0.28
8	79B16NW	0.00	0.00	0.00	0.00	3.23
9	79B16NE	0.72	10.94	0.00	0.00	7.38
10	79B16SE	0.11	3.74	0.09	2.33	2.64
11	79B16SW	0.15	0.83	0.00	0.00	11.46
12	79C02NE	0.92	5.48	0.05	1.00	0.00
13	79C02NW	1.00	4.13	0.20	4.10	0.00
14	79C02SE	0.57	7.77	0.00	0.00	1.22
15	79C05SW	0.27	4.03	0.00	0.00	28.50
16	79C05SE	0.63	4.64	0.00	0.00	8.71
17	79C06NE	1.05	13.45	0.28	2.98	6.02
18	79C06NW	0.77	8.42	0.00	0.00	12.75
19	79C06SE	2.55	5.23	0.09	0.62	0.00
20	79C06SW	0.81	13.34	0.01	1.18	4.18
21	79C09NW	0.00	0.00	0.00	0.00	26.35
22	79C09SW	0.24	2.55	0.00	0.00	3.52
23	79F04NW	0.20	3.19	0.00	0.00	8.03
	TOTAL	11.63	115.06	1.52	19.46	147.68

Figure 2 shows the length of eroding, accreting and stable coast of West Bengal.

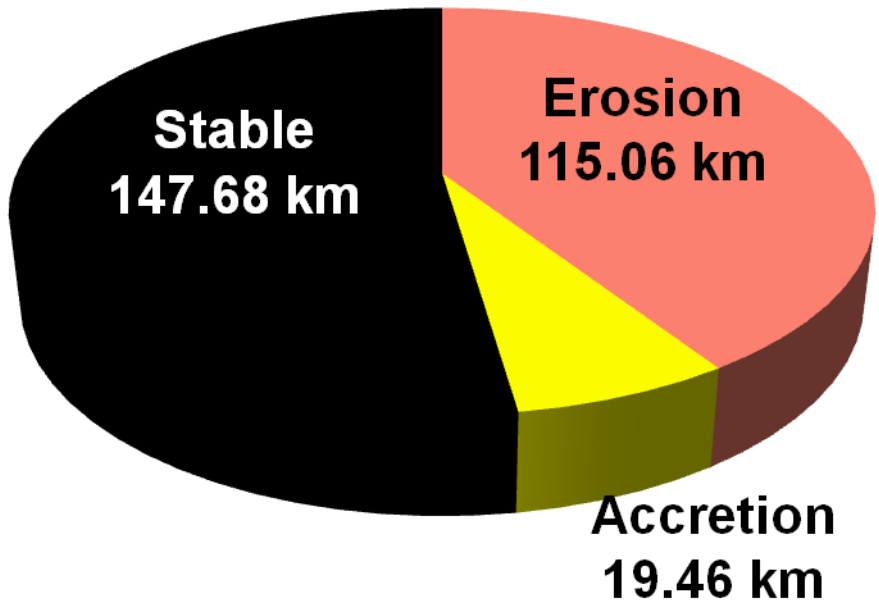


Figure 2: Status of coastal erosion, accretion and stable nature of West Bengal coast (Total coastal length of 282.2 km does not include length of mouth of estuary, rivers, creeks and their inner parts).

END USE

The Atlas can be used as a reference material for obtaining information on status of shoreline changes during 1989-91 and 2004-06 time-frames along entire Indian coastline. Areas under coastal erosion and status of coastal protection measures taken up by respective maritime State and Union Territory are depicted and can be used for planning coastal protection measures.

The Atlas is extremely useful to Coastal Erosion Directorate, Central Water Commission for providing guidance towards coastal protection works in maritime states of India.

All the State Public Works Departments, Ports and Harbour Authorities, Coastal Regulation Zone Authorities shall be able to have better management of the shorelines in respective states.

REFERENCES

Gupta M.C. et. al., 2000, Coastal Zone Management Information System for Gujarat, Technical Report, SAC/MWRD/TR/04/2000.

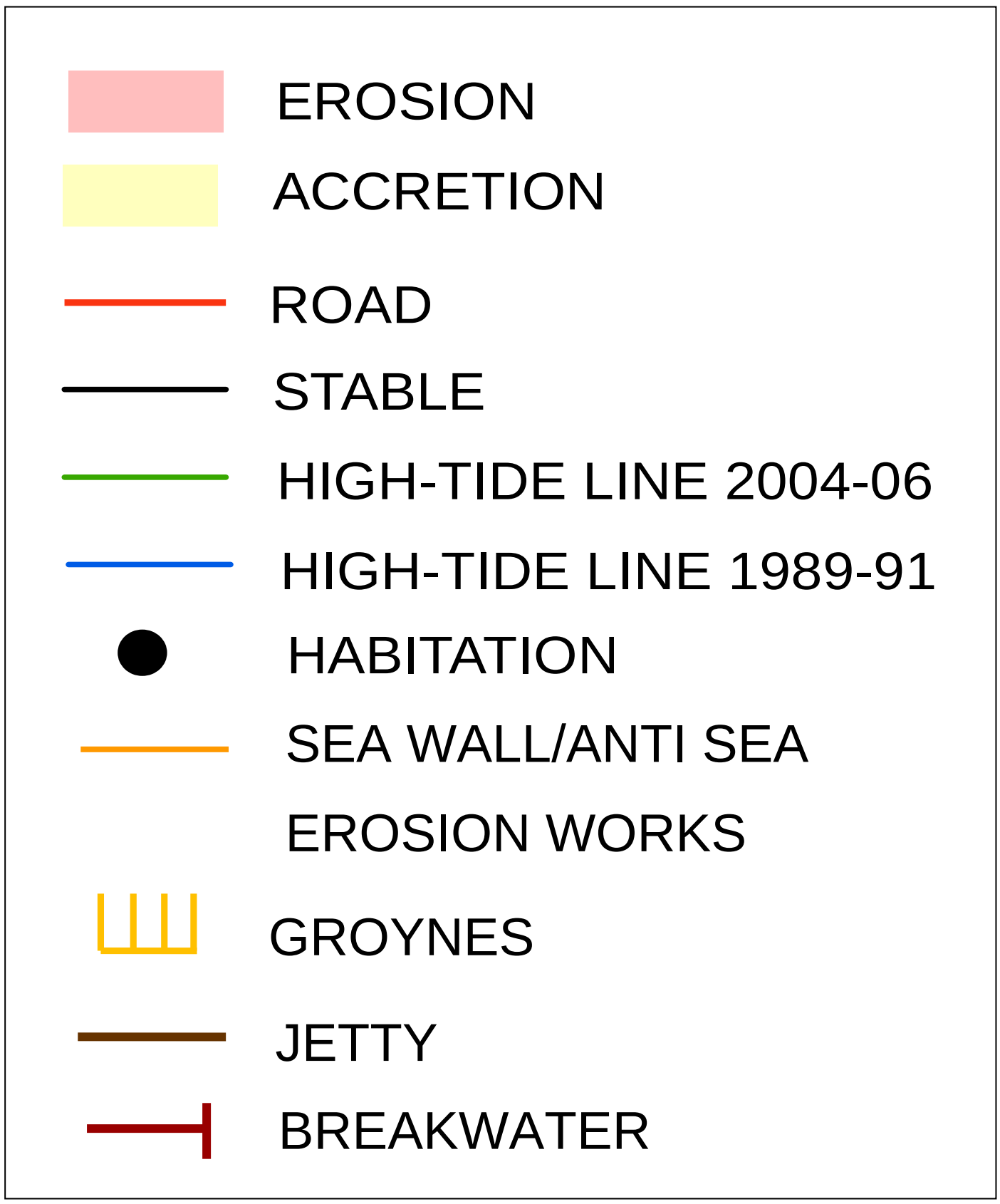
Nayak, S. R., Bahuguna, A., Shaikh, M., Rao, R. S., Trivedi, C. R., Prasad, K. N., Kadri, S. A., Vaidya, P. H., Patel, V. B., Oza, S. H., Patel, S. S., Rao, T. A., Shereiff, A. N. and Suresh, P. V., 1991, *Manual for mapping of coastal wetlands/landforms and shoreline changes using satellite data*: Technical Note, IRS-UP/SAC/MCE/TN/32/91 (Space Applications Centre, Ahmedabad), 63 p.

SAC, 2012, *Coastal Zones of India*, Space Applications Centre (ISRO), 2012, 597 p. ISBN: 978-81-909978-9-8.

Annexure-I

(Shoreline Change Maps)

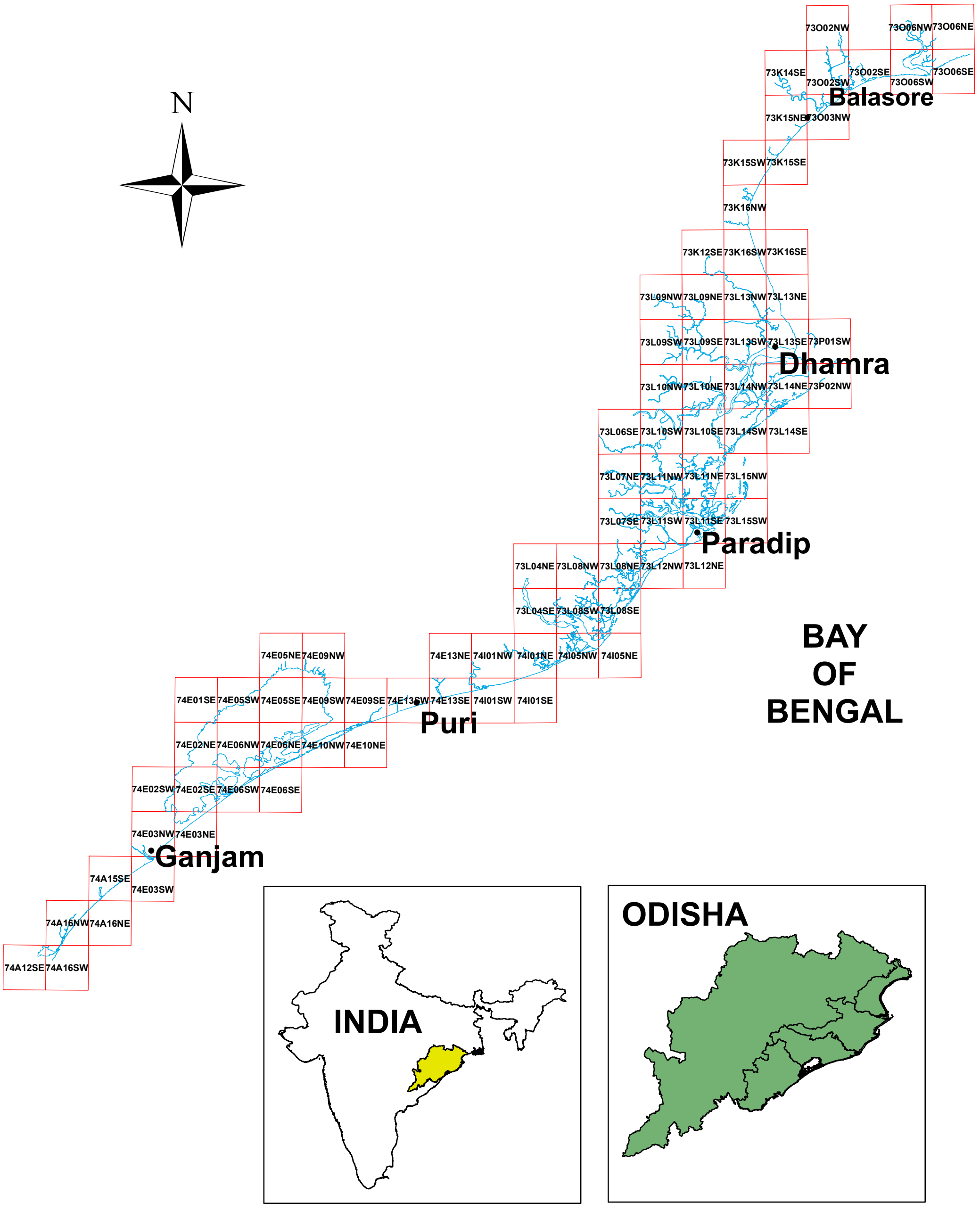
COMPLETE LEGEND TO SHORELINE CHANGE MAPS



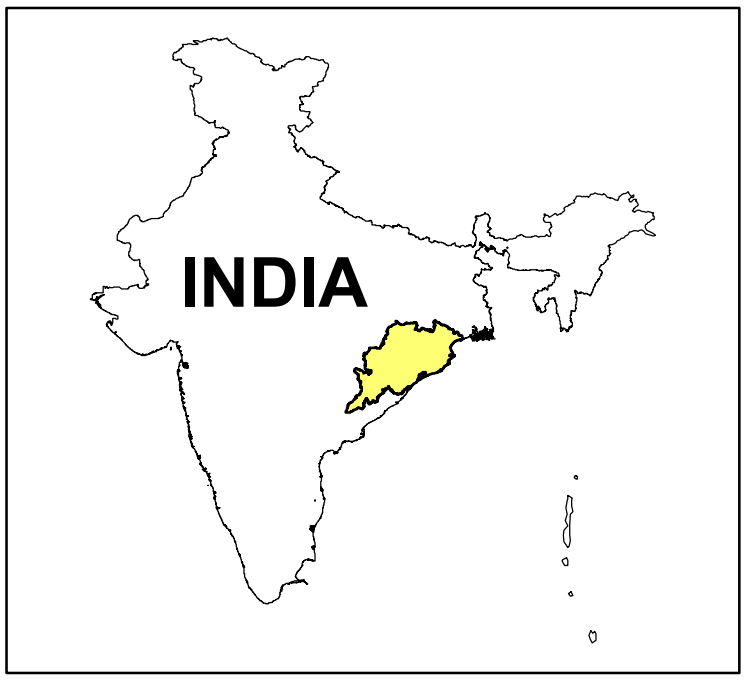
SHORELINE CHANGE MAPS

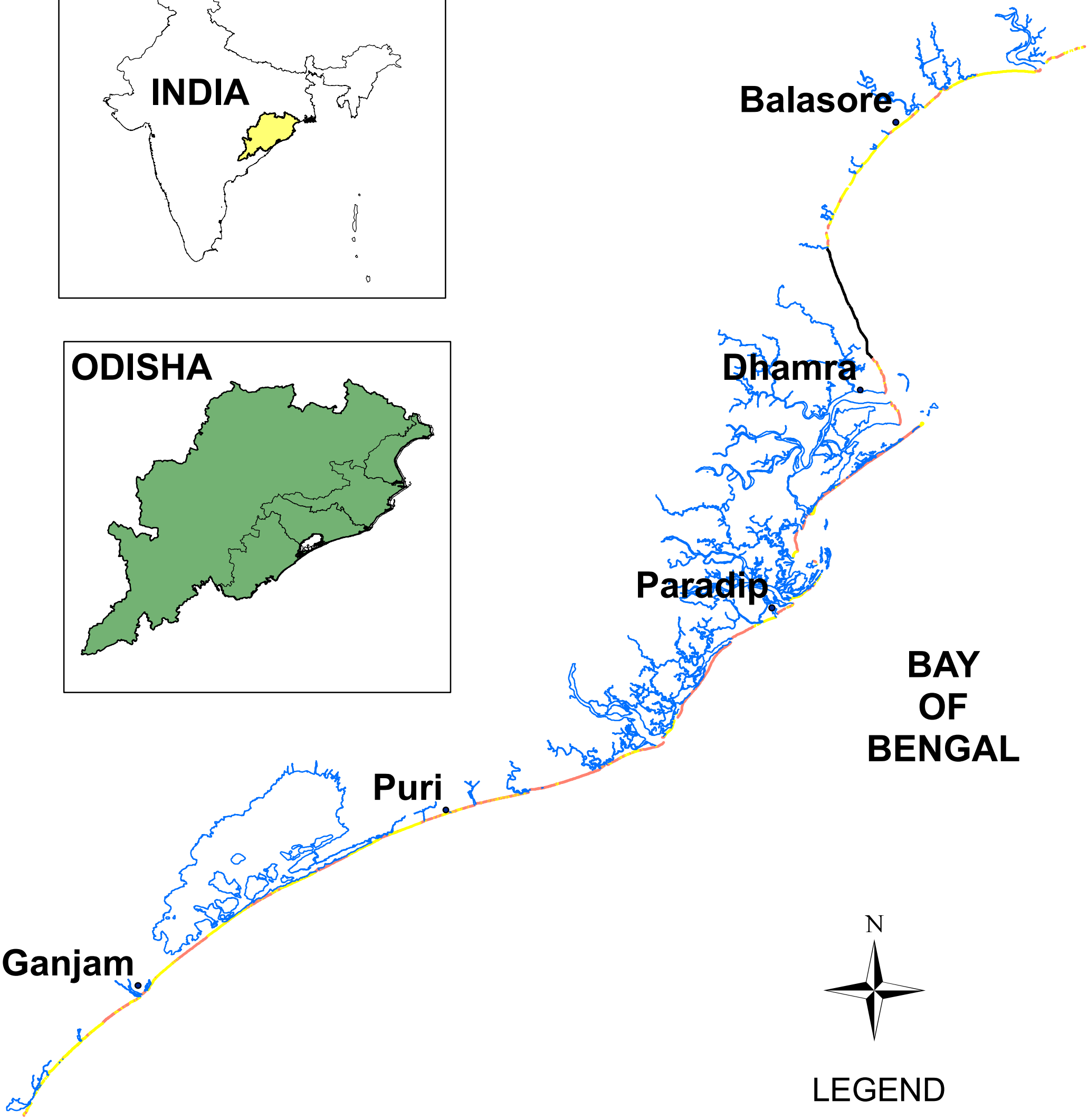
ODISHA

INDEX MAP OF ODISHA



SHORELINE CHANGES - ODISHA





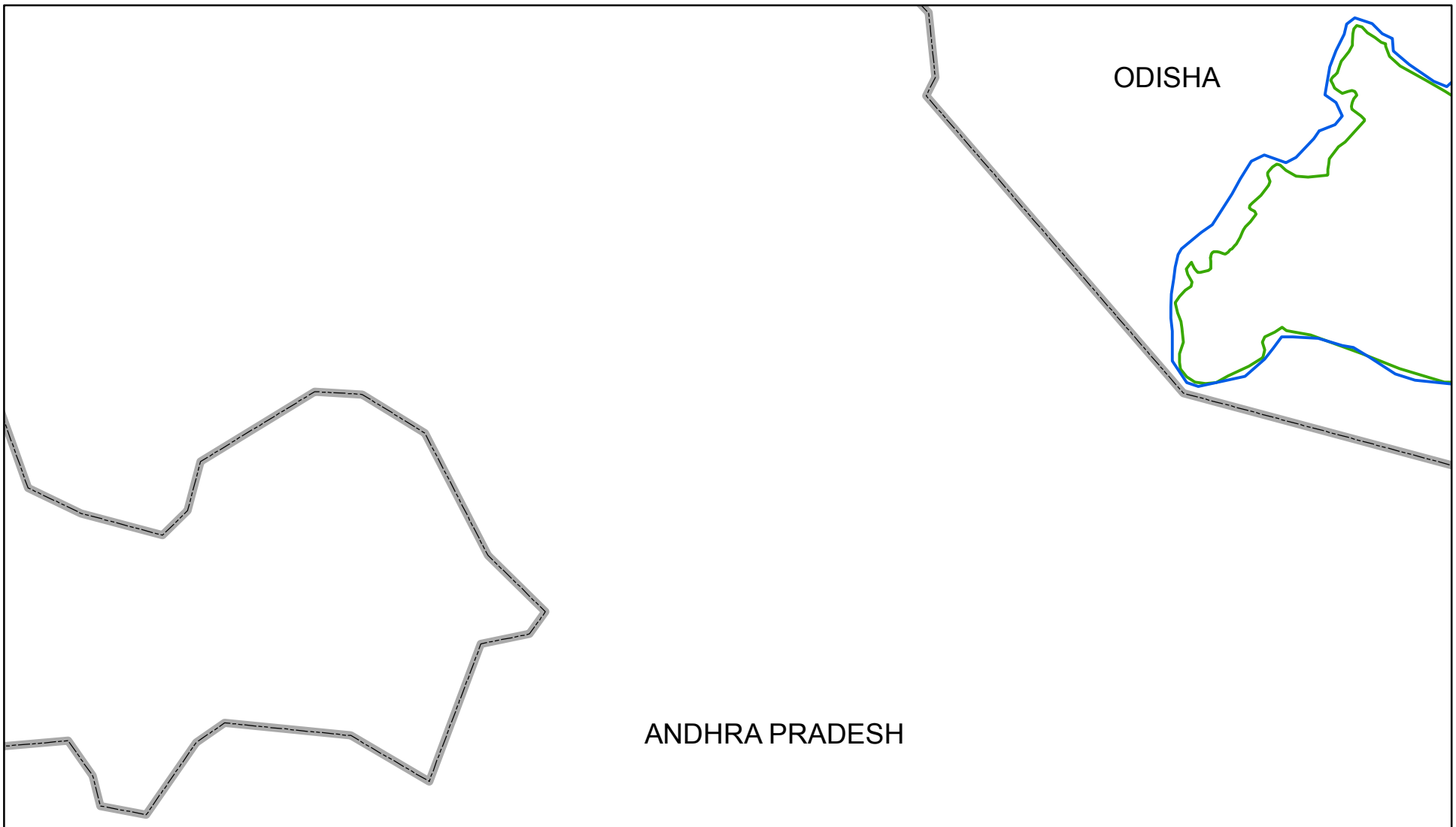
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

GANJAM DISTRICT

SHEET NO. 74A12SE



Legend

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

STATE BOUNDARY

N

W E

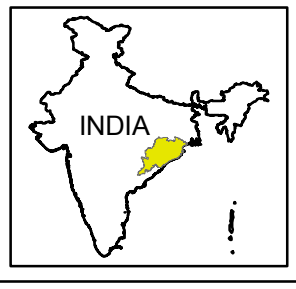
S

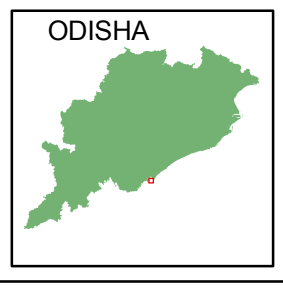
0 2

Scale in Km

INDEX TO SHEETS

74A12NW	74A12NE	74A16NW
74A12SW		74A16SW
74A12SW	74A12SE	74A08SE





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

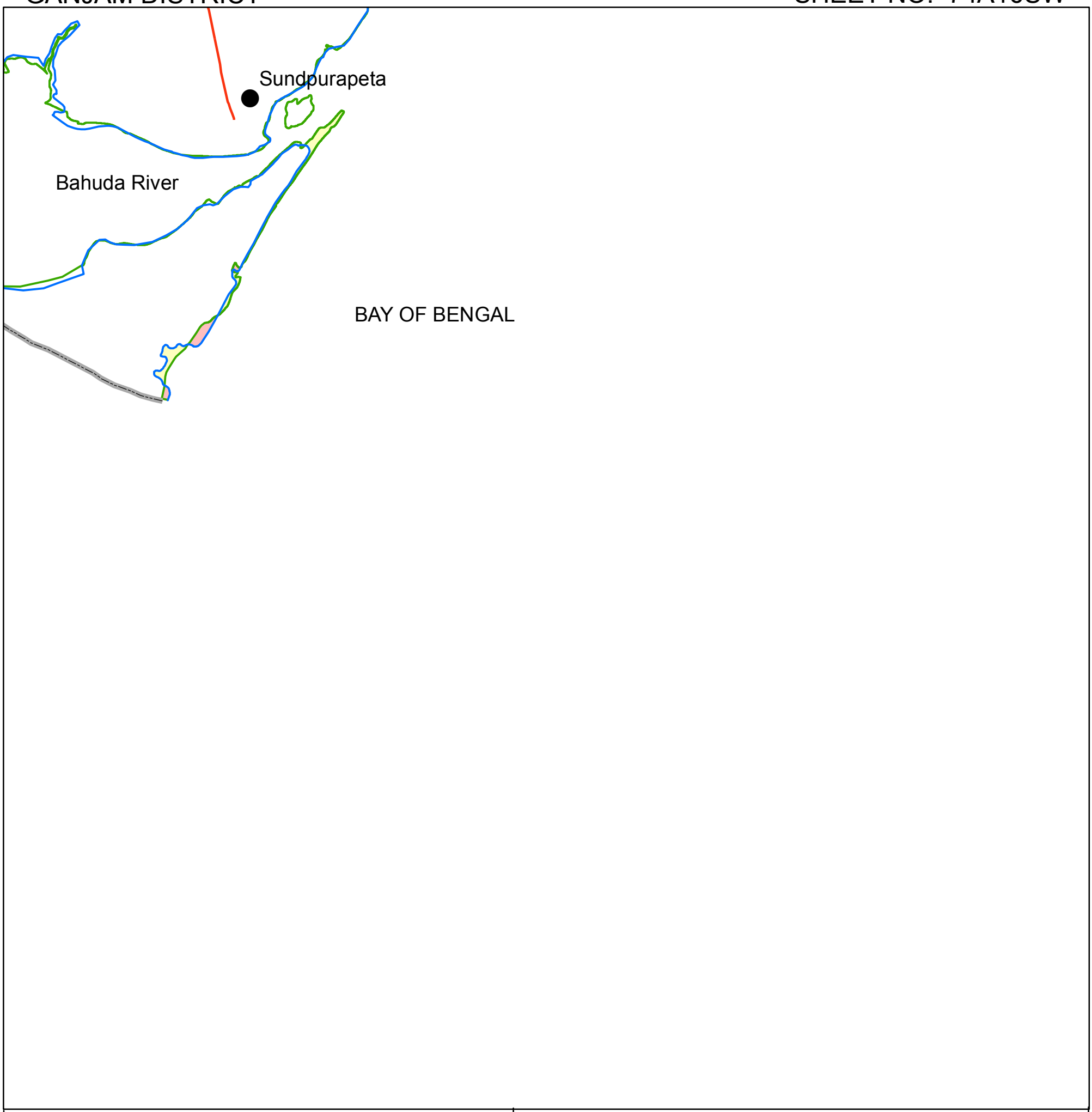
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

GANJAM DISTRICT

SHEET NO. 74A16SW



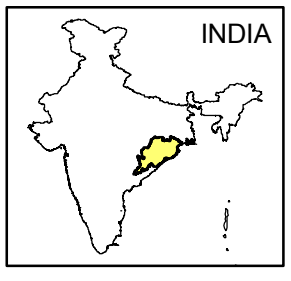
Legend

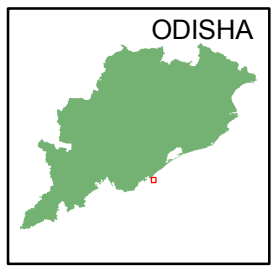
- EROSION
- ACCRETION
- STATE BOUNDARY
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74A12NE	74A16NW	74A16SW
74A12SE		SEA
SEA	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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GANJAM DISTRICT

SHEET NO. 74A16NW

Chhelia

Markandi

Remayapetta

BAY OF BENGAL

Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

74A11SE	74A15SW	74A15SE
74A12NE		74A16NE
74A12SE	74A16SW	SEA

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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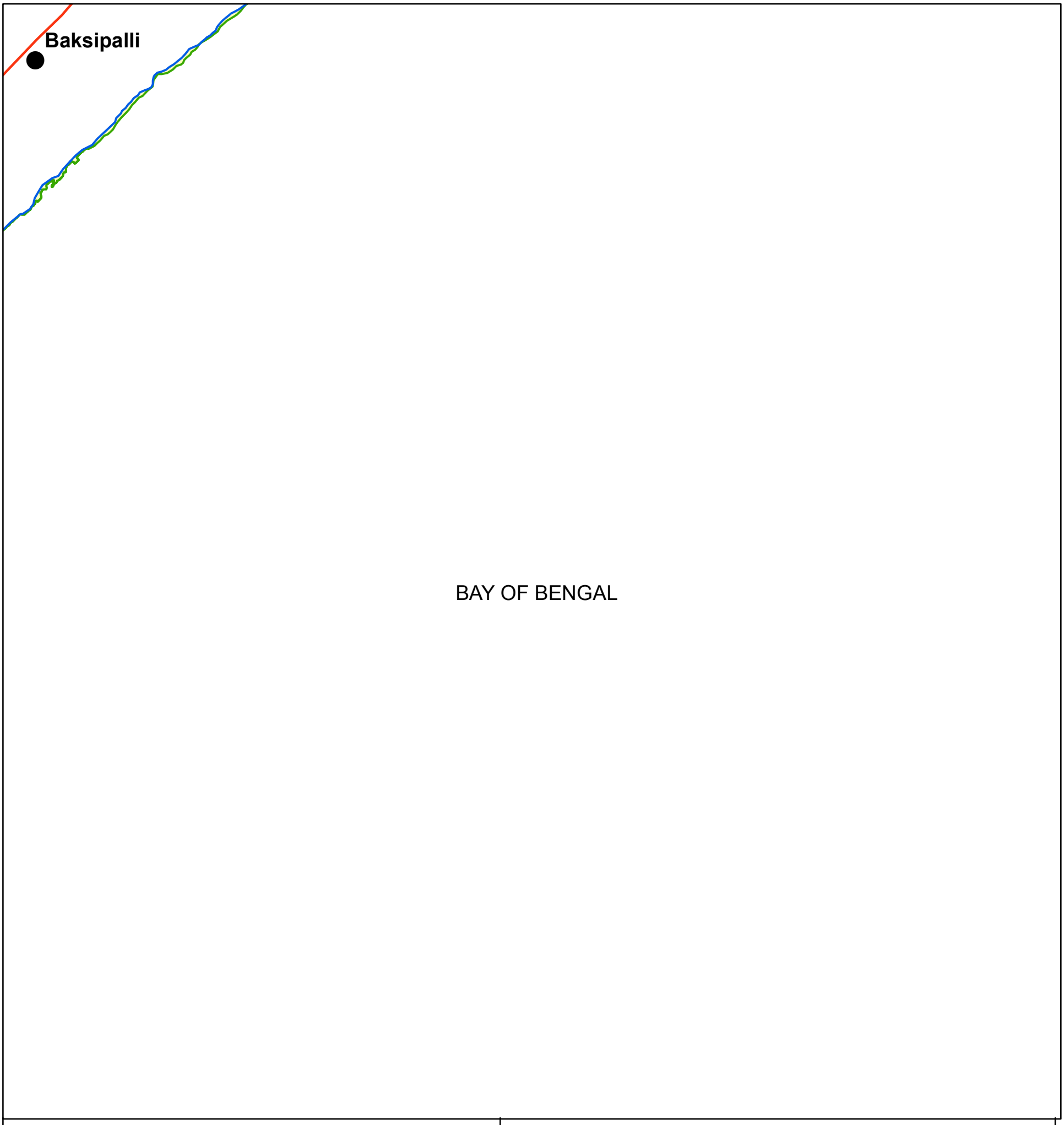
GANJAM DISTRICT

SHEET NO. 74A16NE



Legend

- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ROAD
- HABITATION

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W E
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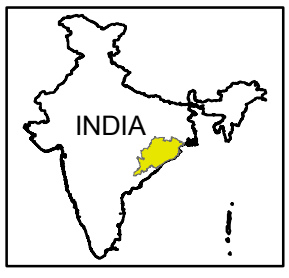
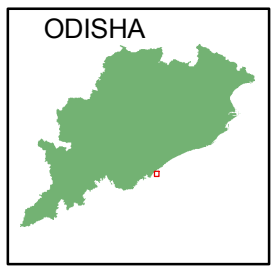
0 2
Scale in Km

INDEX TO SHEETS

74A15SW	74A15SE	74E03SW
74A16NW		SEA
74A16SW	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

GANJAM DISTRICT

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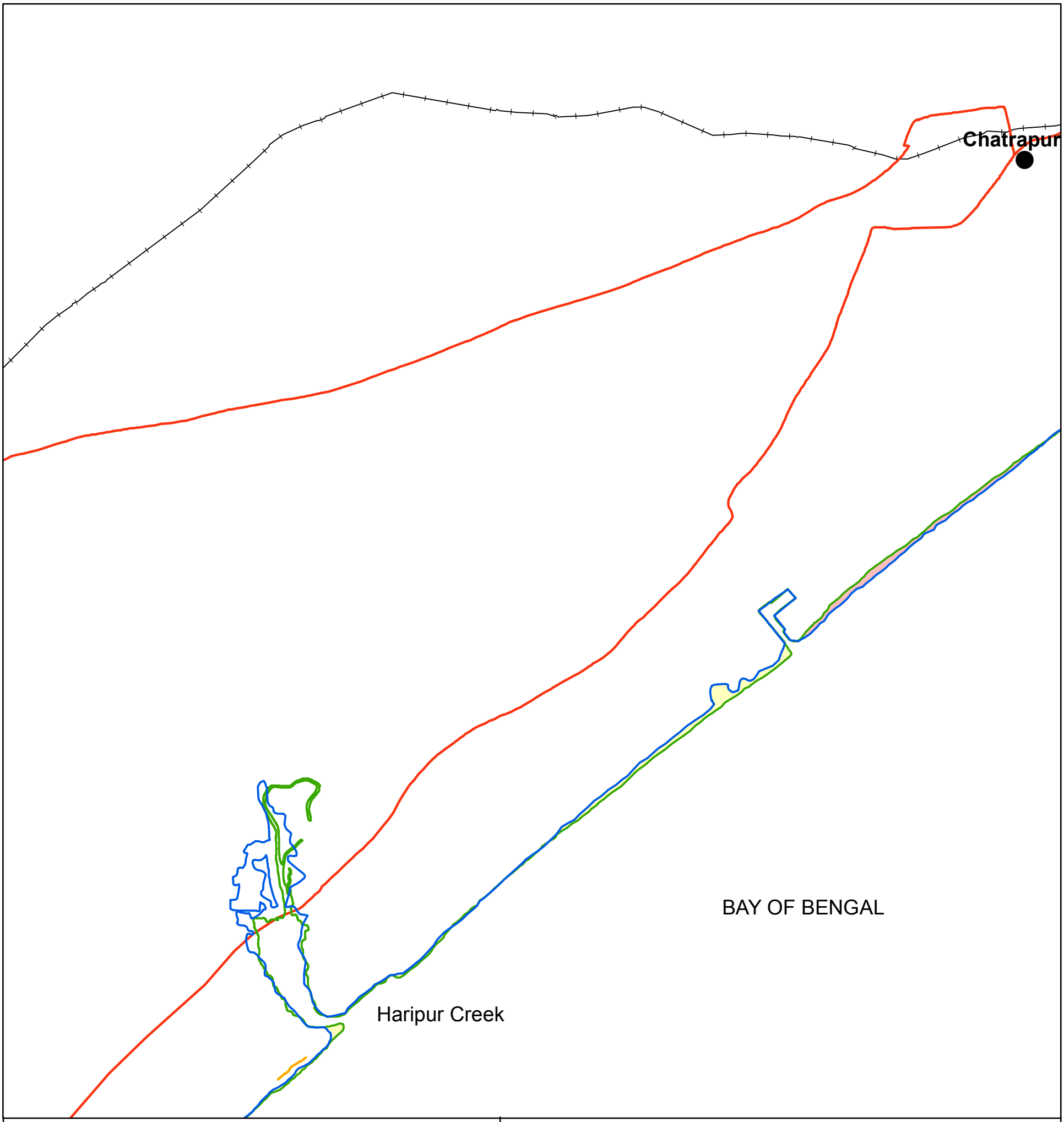
SHEET NO. 74A15SE



Legend

- EROSION
- ACCRETION
- SEA WALL
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

S

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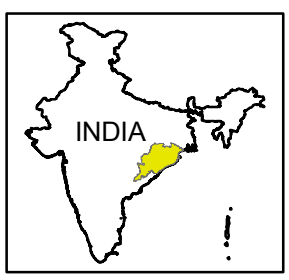
Scale in Km

INDEX TO SHEETS

74A15NW	74A15NE	74E03NW
74A15SW		74E03SW
74A16NW	74A16NE	SEA



DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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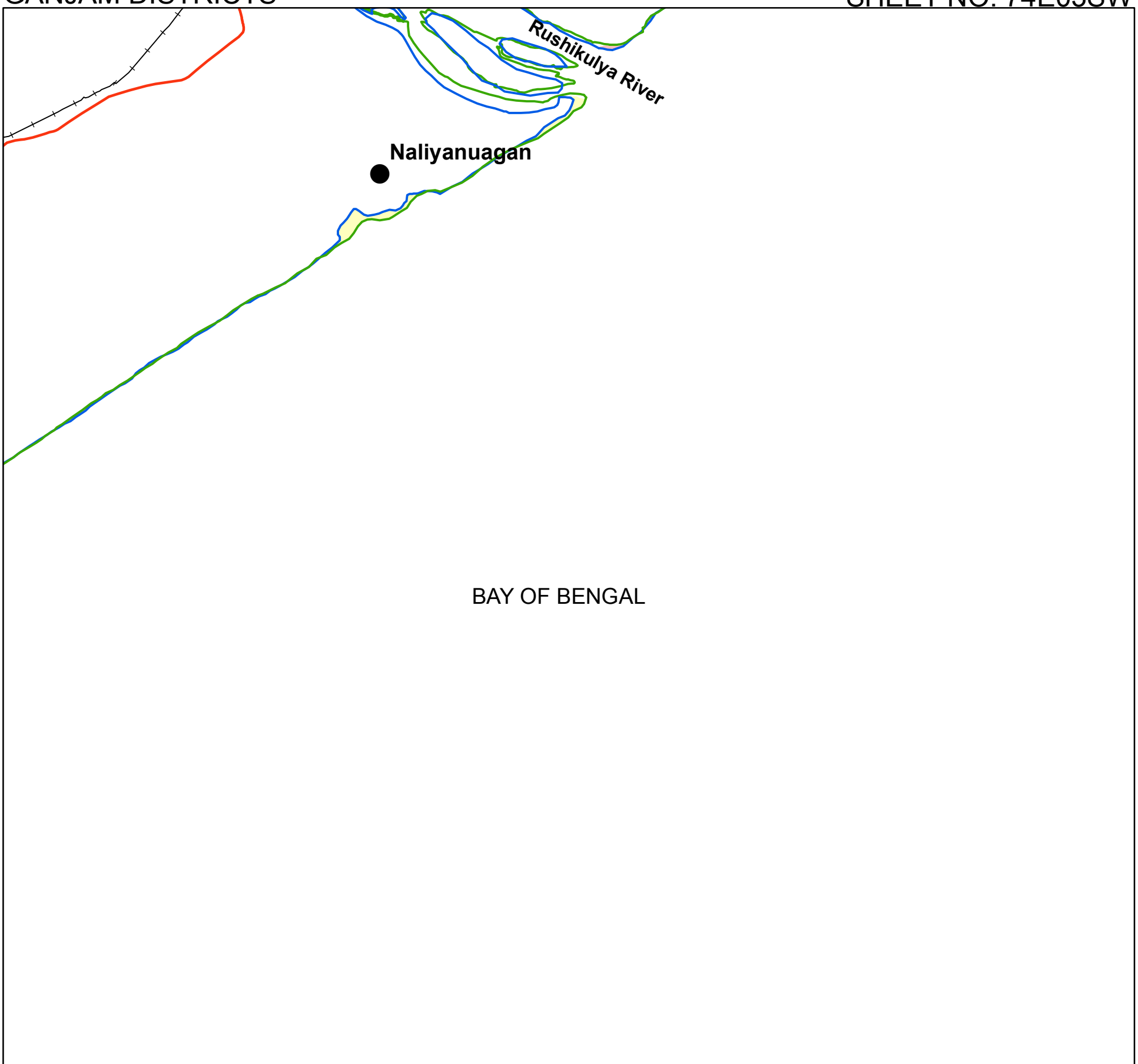
GANJAM DISTRICTS

SHEET NO. 74E03SW



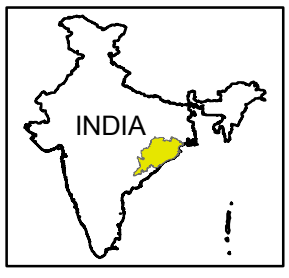
Legend

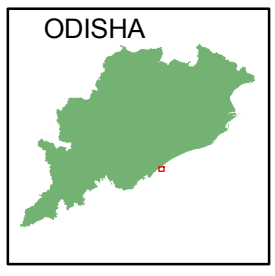
- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74A15NE	74E03NW	74E03NE
74A15SE		SEA
74A16NE	SEA	SEA





DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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GANJAM DISTRICTS

SHEET NO. 74E03NW

Ganjam

BAY OF BENGAL

Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74A14SE	74E02SW	74E02SE
74A15NE		74E03NE
74A15SE	74E03SW	SEA

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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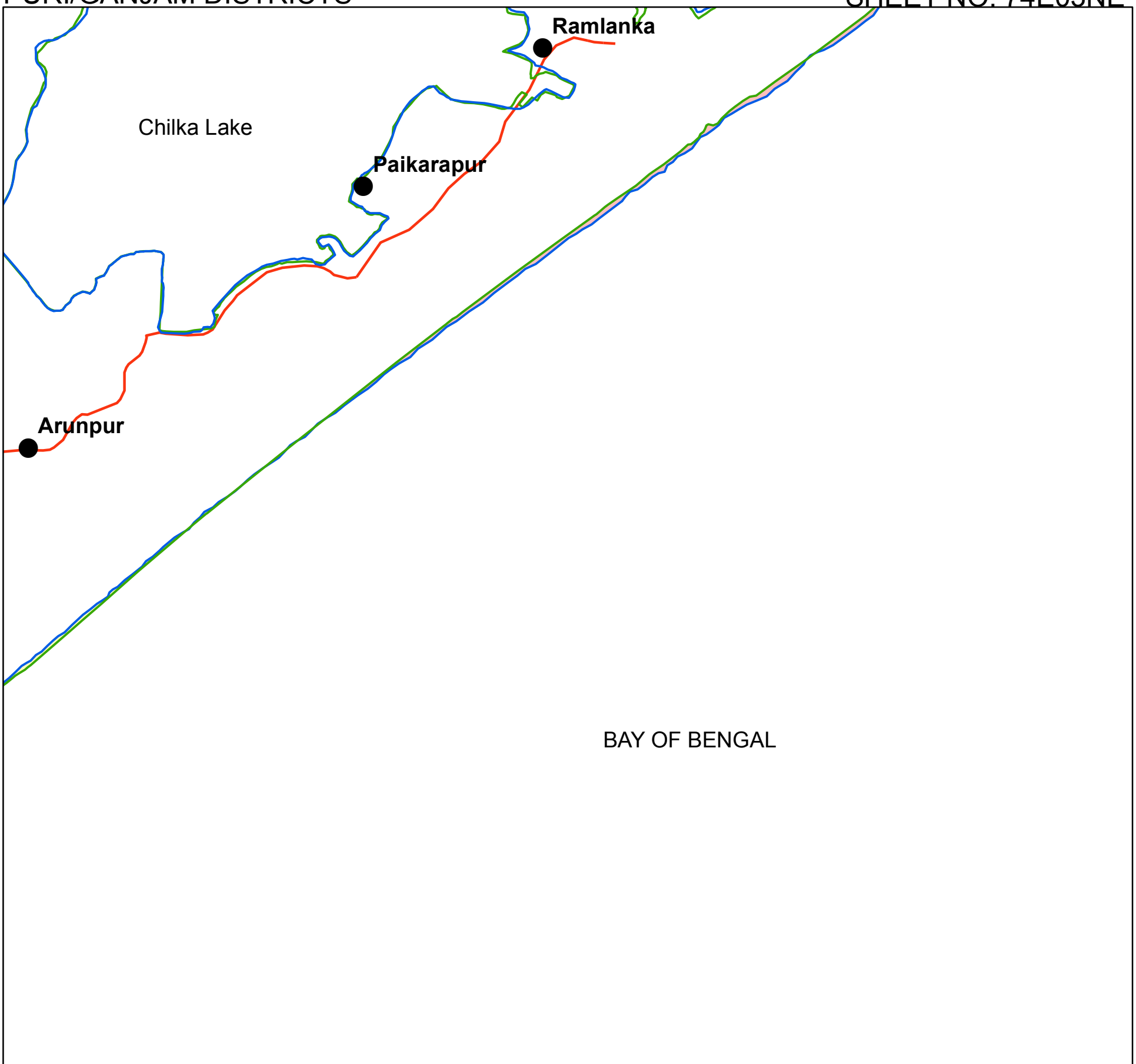
PURI/GANJAM DISTRICTS

SHEET NO. 74E03NE



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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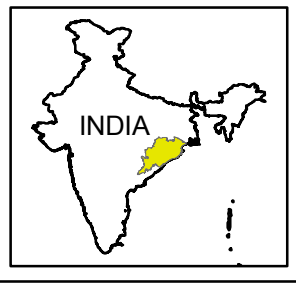
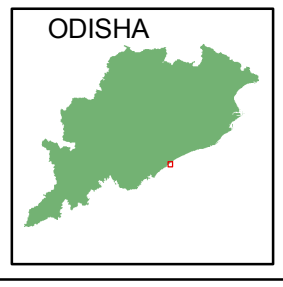
0 2

Scale in Km

INDEX TO SHEETS

74E02SW	74E02SE	74E06SW
74E03NW		SEA
74E03SW	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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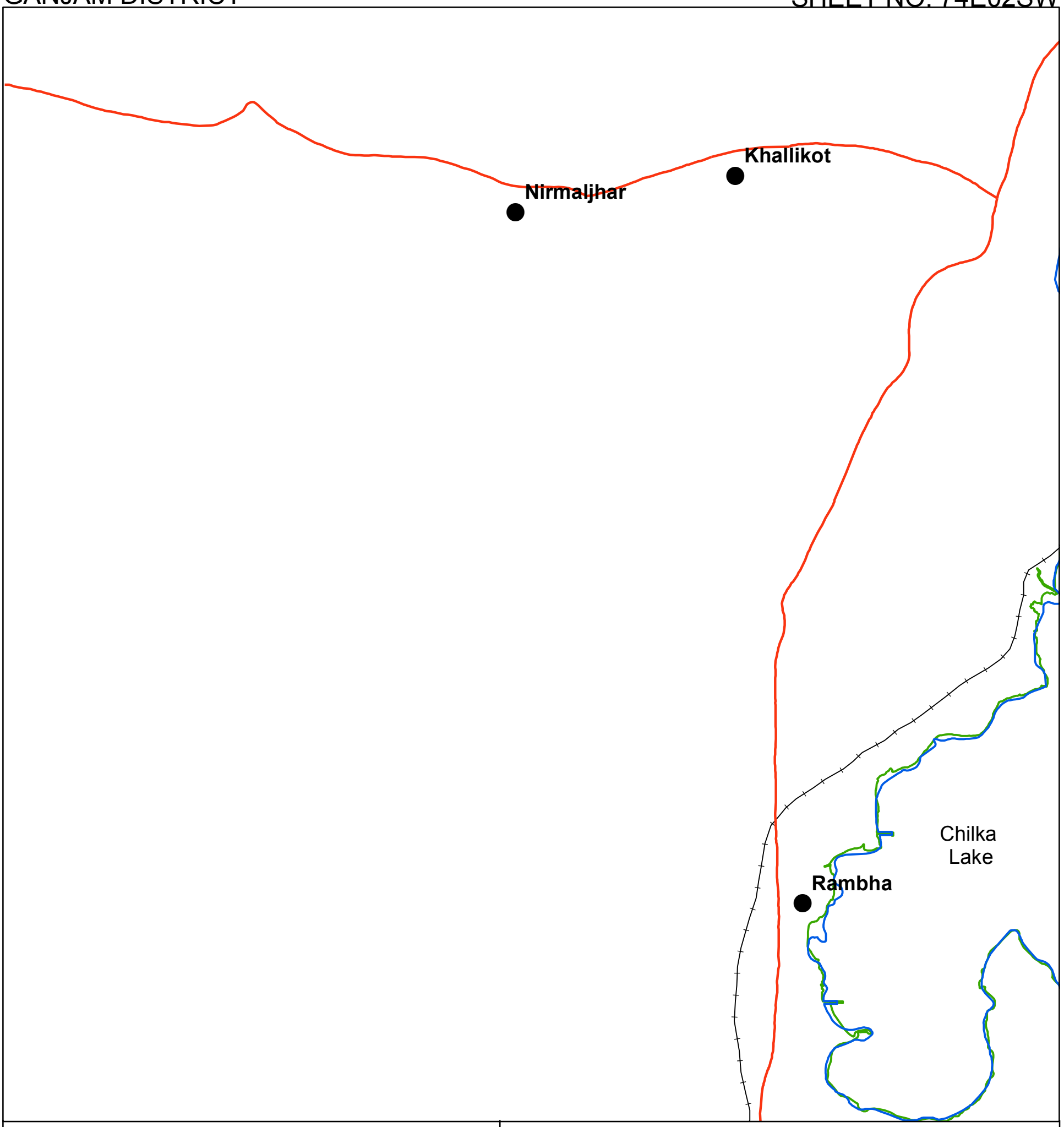
GANJAM DISTRICT

SHEET NO. 74E02SW



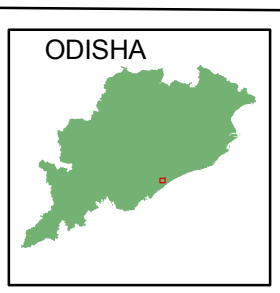
Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74A14NE	74E02NW	74E02NE
74A14SE		74E02SE
74A15NE	74E03NW	74E03NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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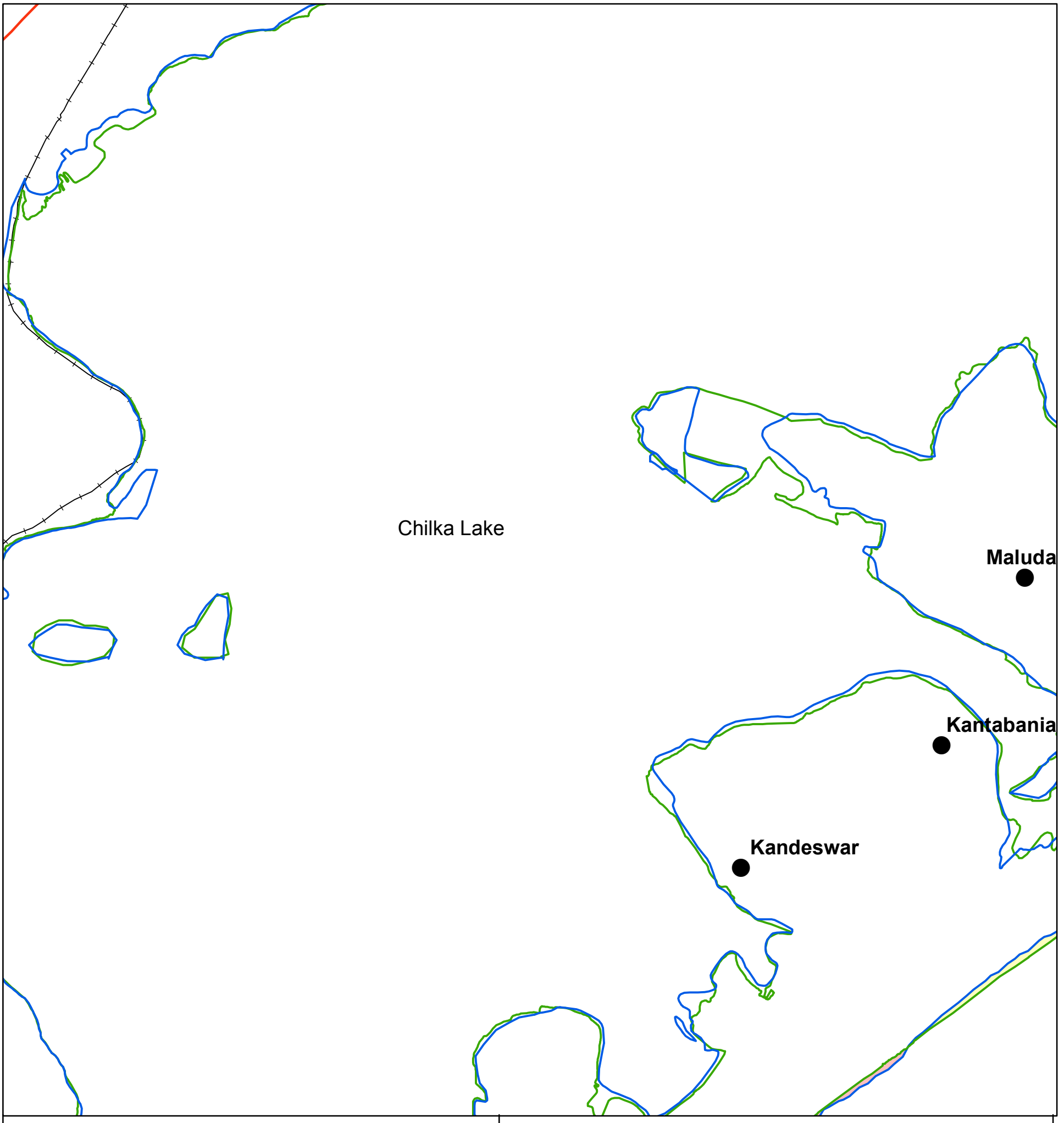
PURI/GANJAM DISTRICTS

SHEET NO. 74E02SE



Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

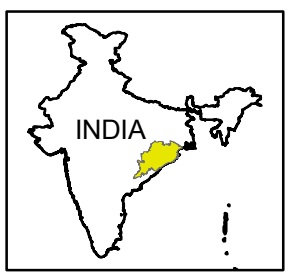
S

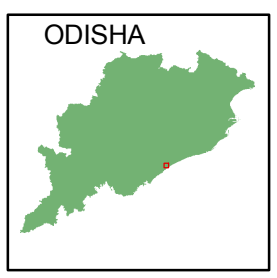
0 2

Scale in Km

INDEX TO SHEETS

74E02NW	74E02NE	74E06NW
74E02SW		74E06SW
74E03NW	74E03NE	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

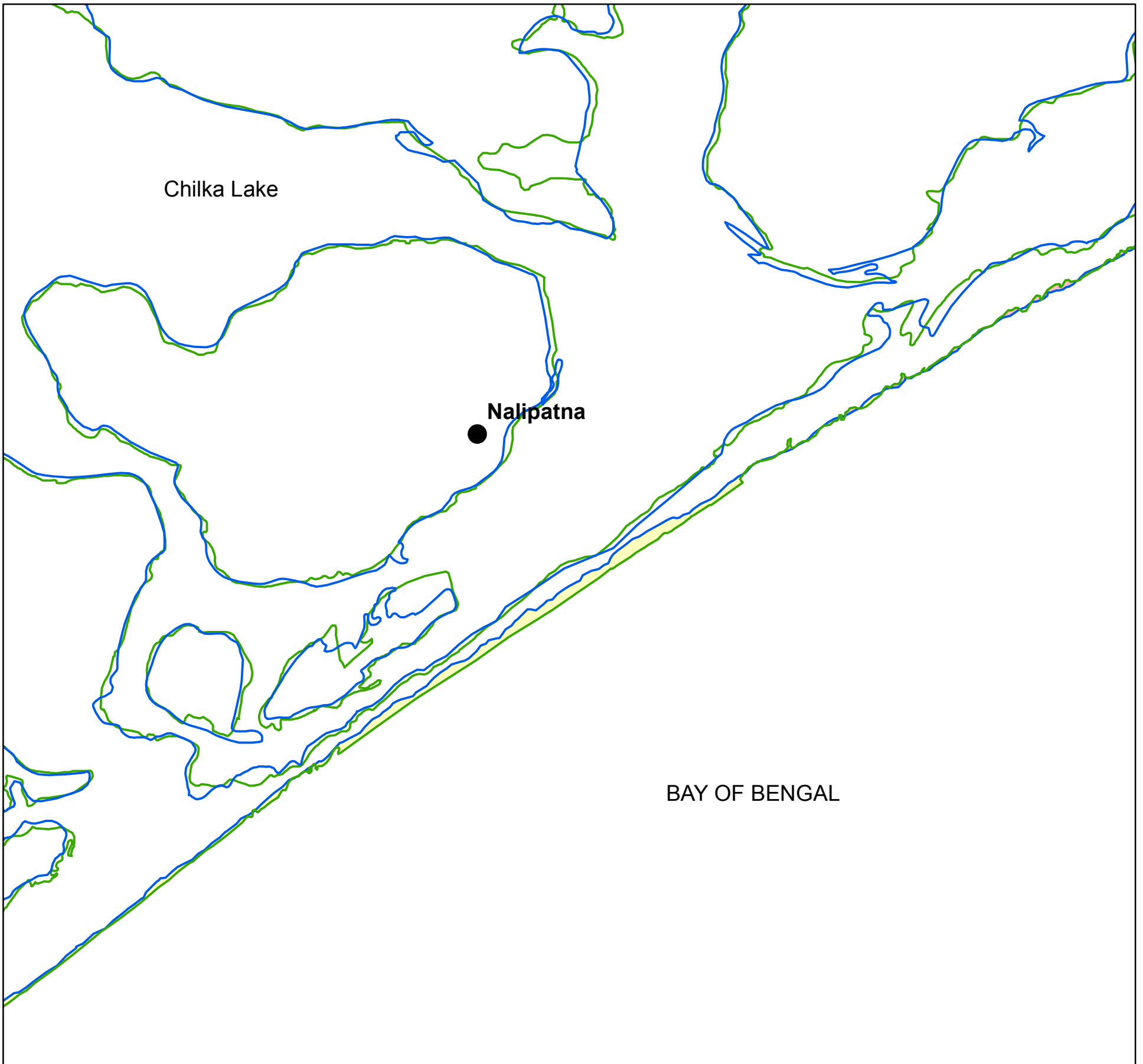
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

PURI DISTRICT

SHEET NO. 74E06SW



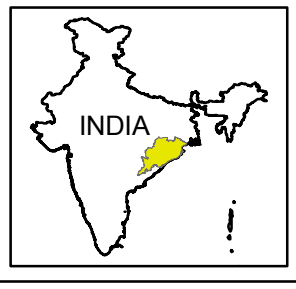
Legend

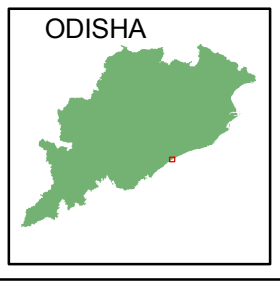
- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E02NE	74E06NW	74E06NE
74E02SE		74E06SE
74E03NE	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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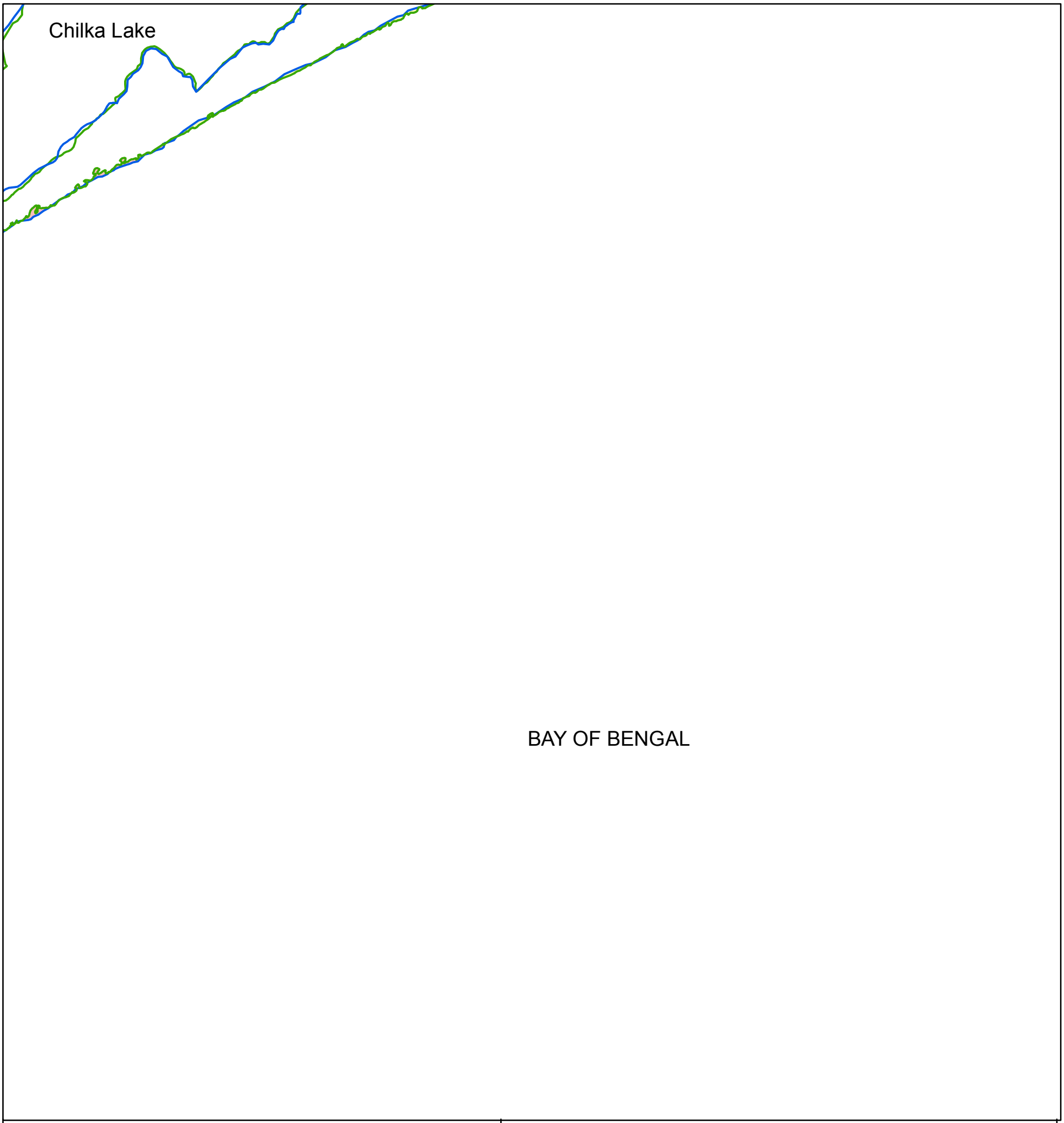
PURI DISTRICT

SHEET NO. 74E06SE



Legend

EROSION

ACCRETION

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

N

W E

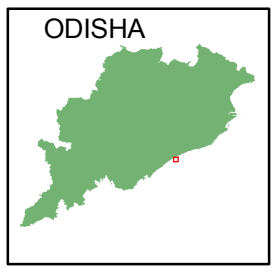
S

0 2

Scale in Km

INDEX TO SHEETS

74E06NW	74E06NE	74E10NW
74E06SW		SEA
SEA	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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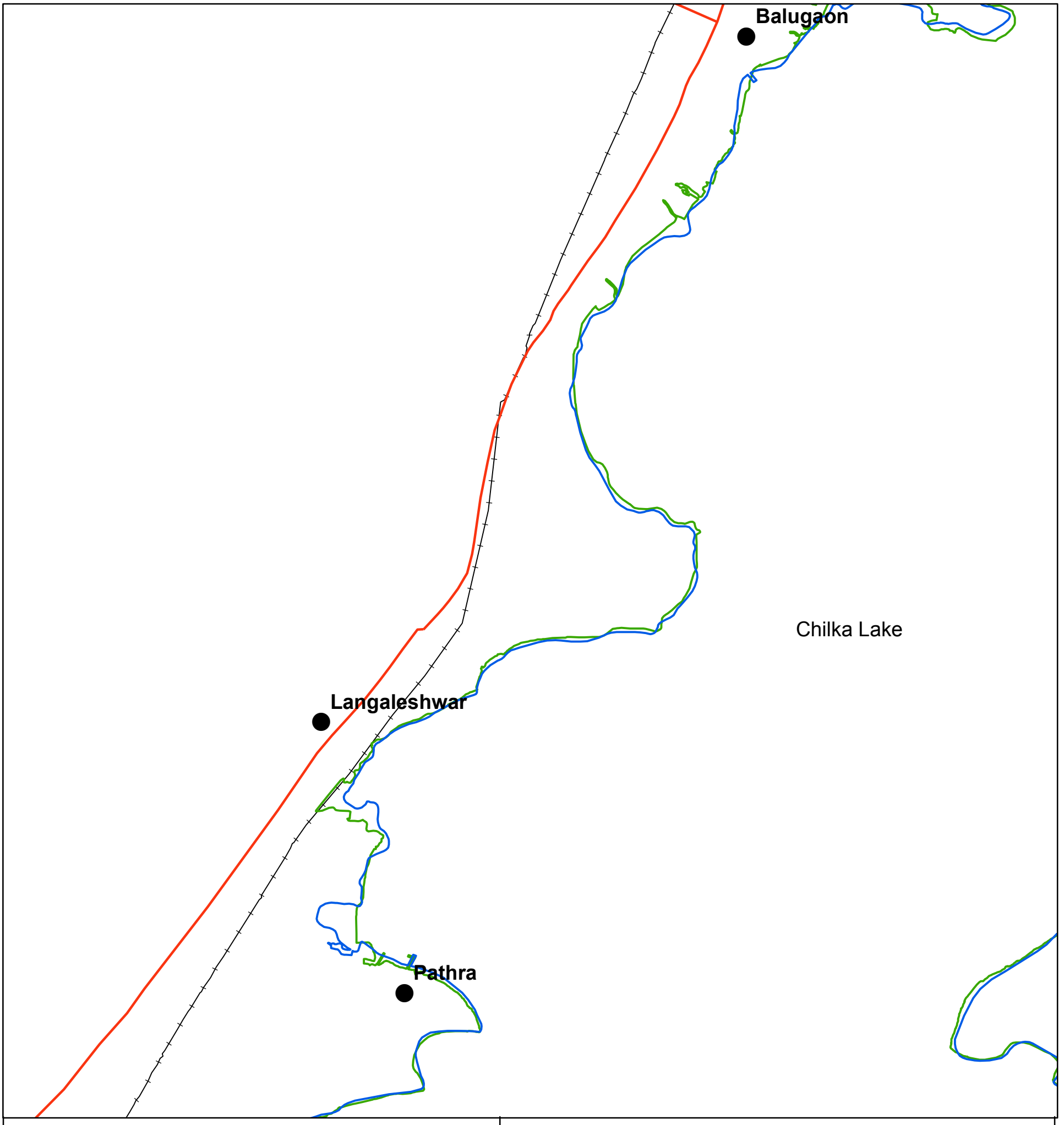
PURI/GANJAM DISTRICTS

SHEET NO. 74E02NE



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

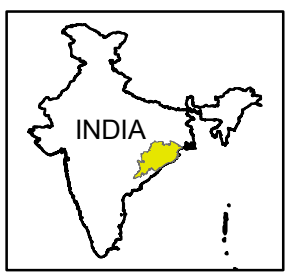
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

74E01SW	74E01SE	74E05SW
74E02NW		74E06NW
74E02SW	74E02SE	74E06SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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PURI DISTRICT

SHEET NO. 74E06NW

Chilka Lake

Garh Krishnaprasad

Legend

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

HABITATION

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

74E01SE	74E05SW	74E05SE
74E02NE		74E06NE
74E02SE	74E06SW	74E06SE

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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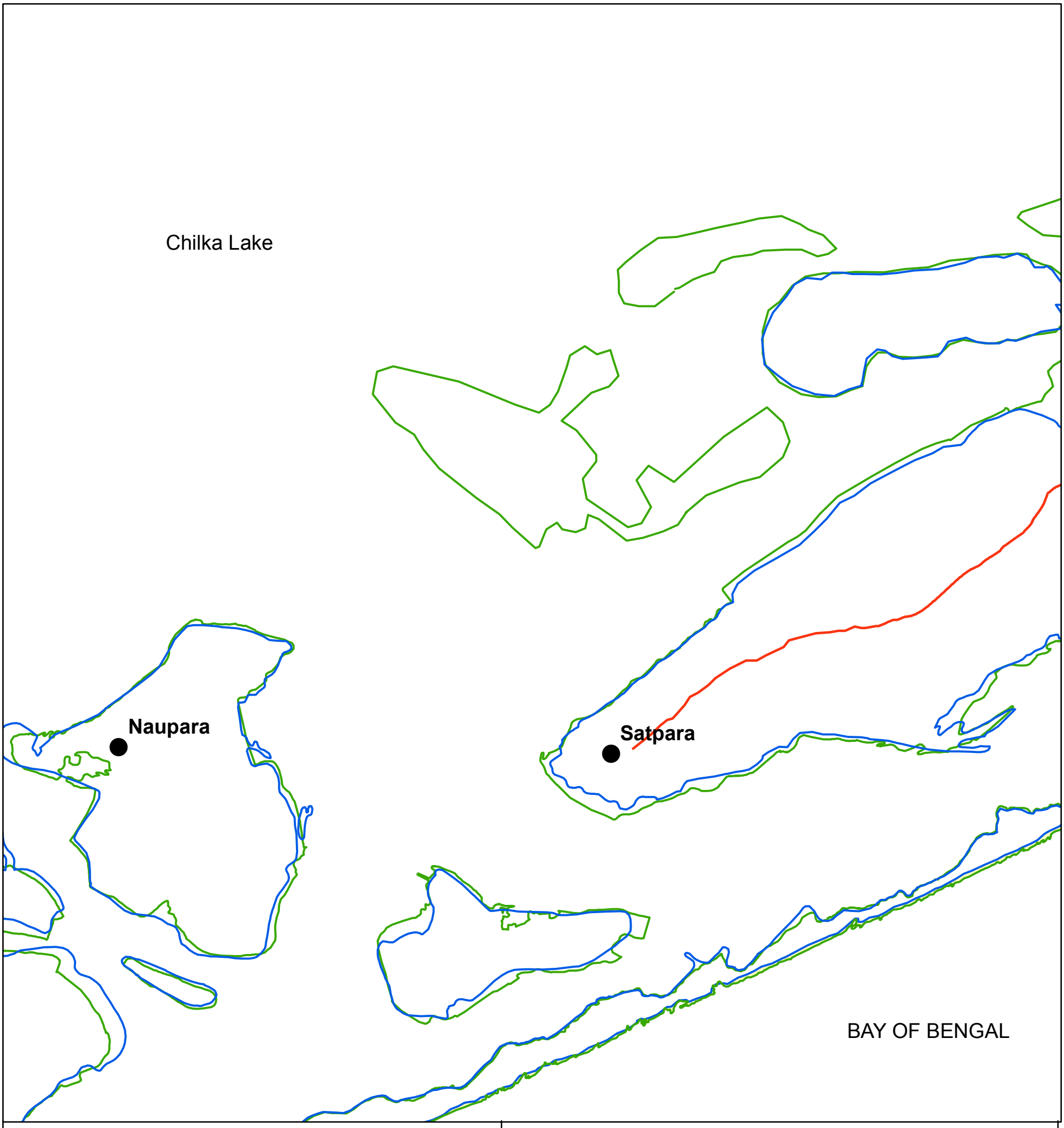
PURI DISTRICT

SHEET NO. 74E06NE



Legend

- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

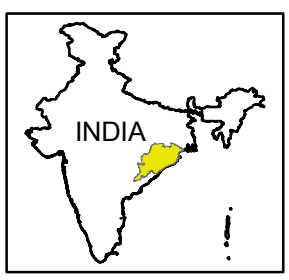
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

74E05SW	74E05SE	74E09SW
74E06NW		74E10NW
74E06SW	74E06SE	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

PURI DISTRICT

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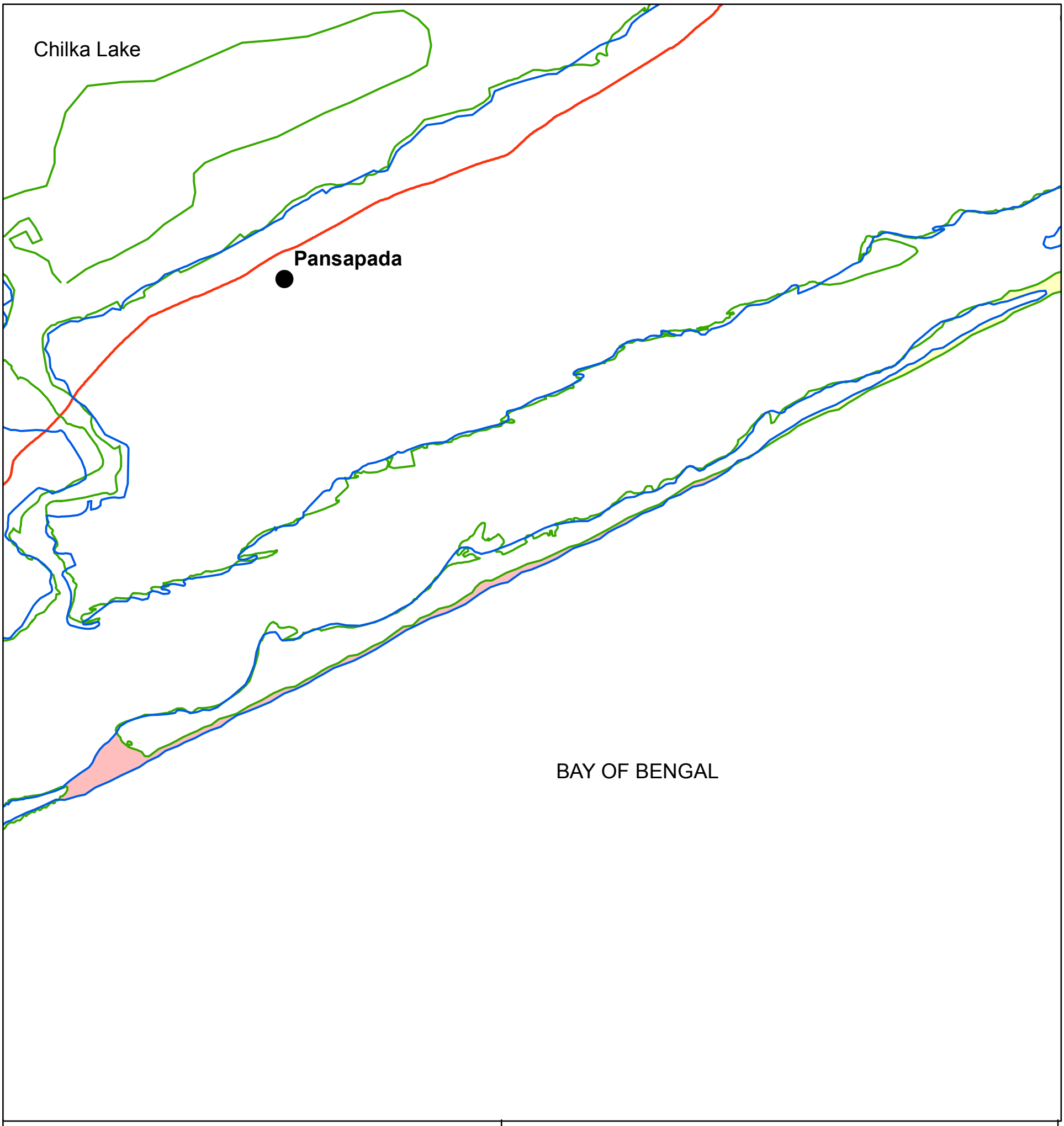
SHEET NO. 74E10NW



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E05SE	74E09SW	74E09SE
74E06NE		74E10NE
74E06SE	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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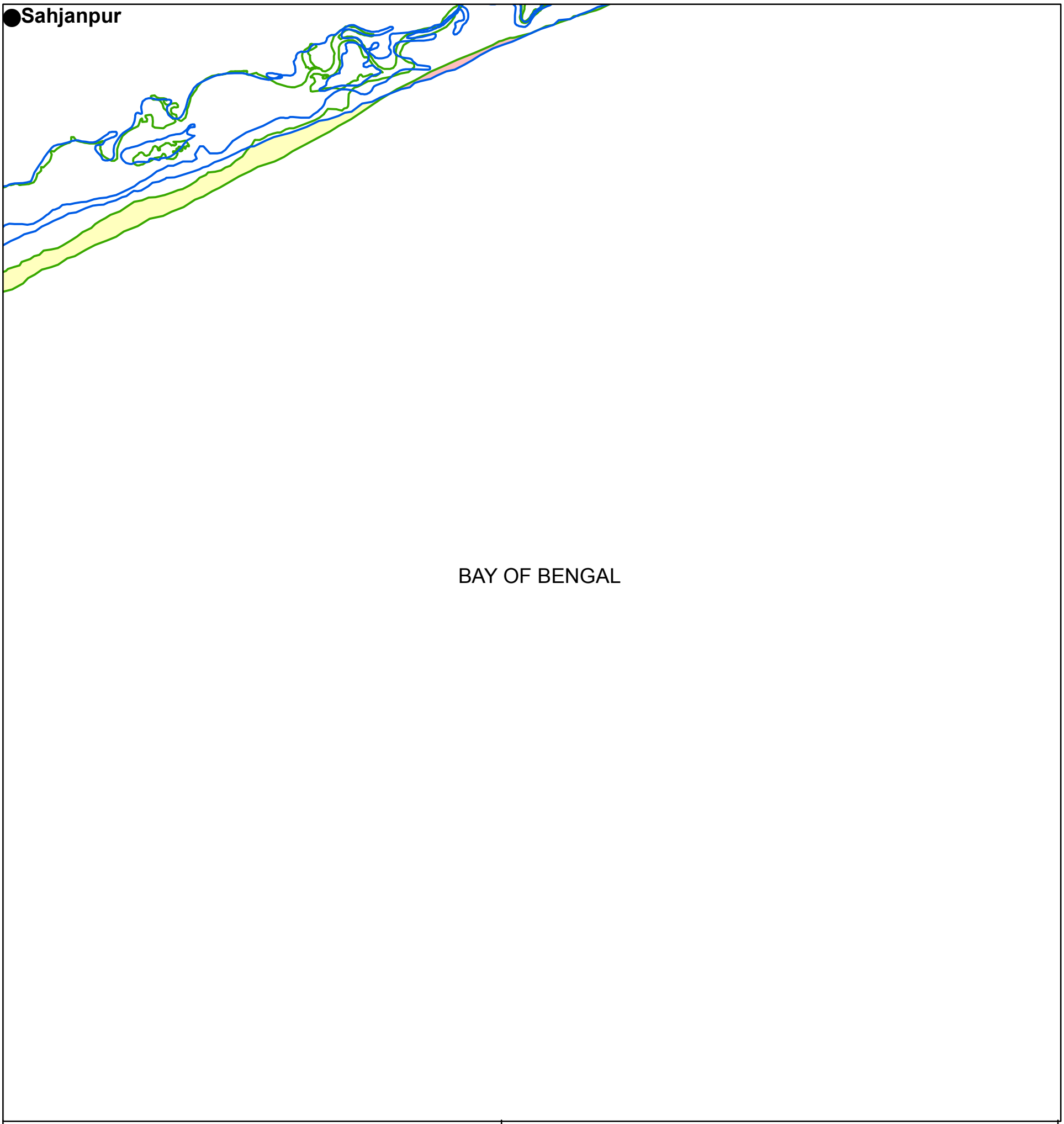
PURI DISTRICT

SHEET NO. 74E10NE



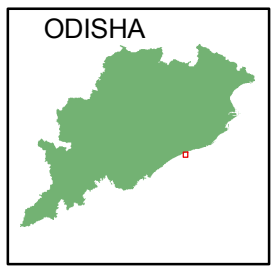
Legend

- ACCRETION
- EROSION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E09SW	74E09SE	74E13SW
74E10NW		SEA
SEA	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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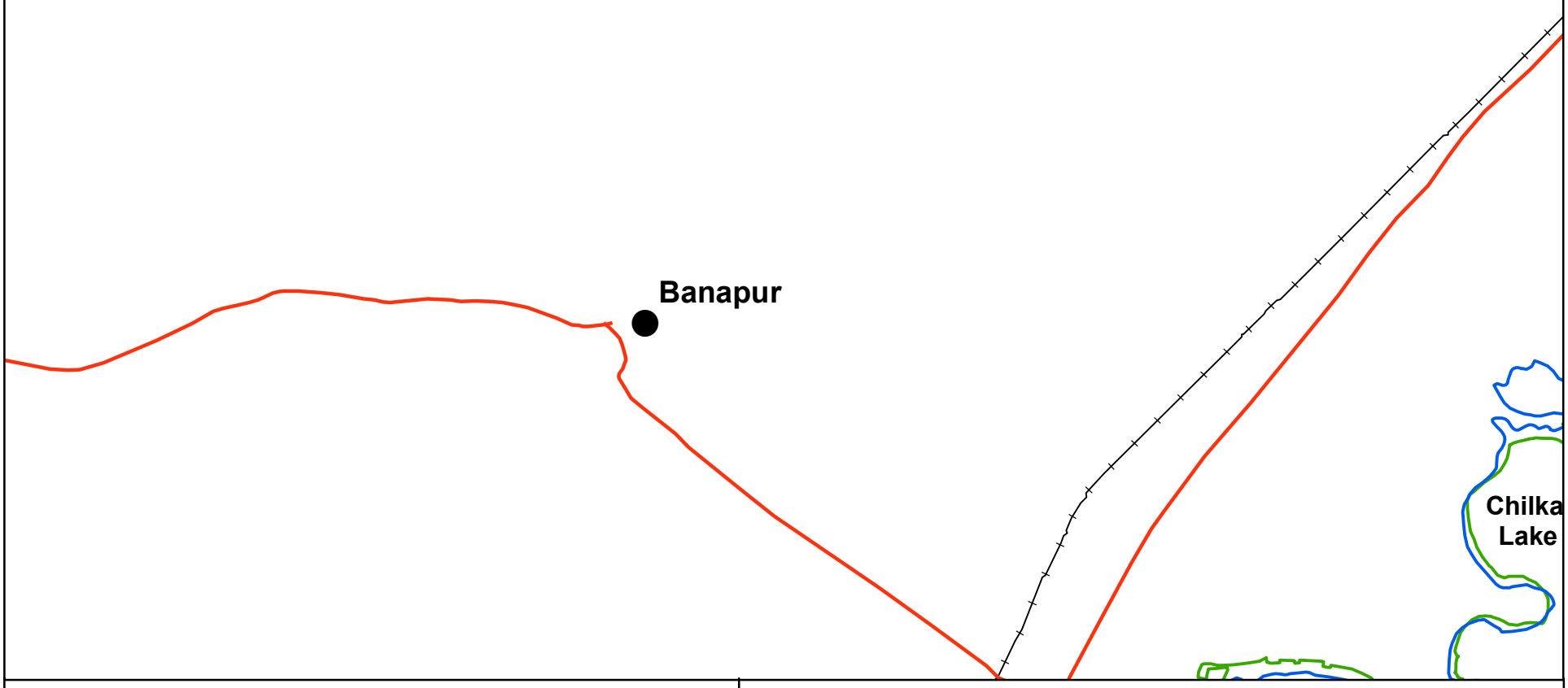
PURI DISTRICT

SHEET NO. 74E01SE



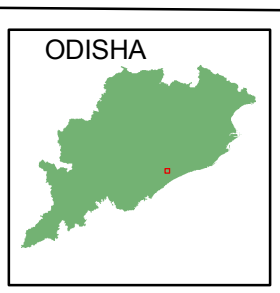
Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E01NW	74E01NE	74E05NW
74E01SW		74E05SW
74E02NW	74E02NE	74E06NW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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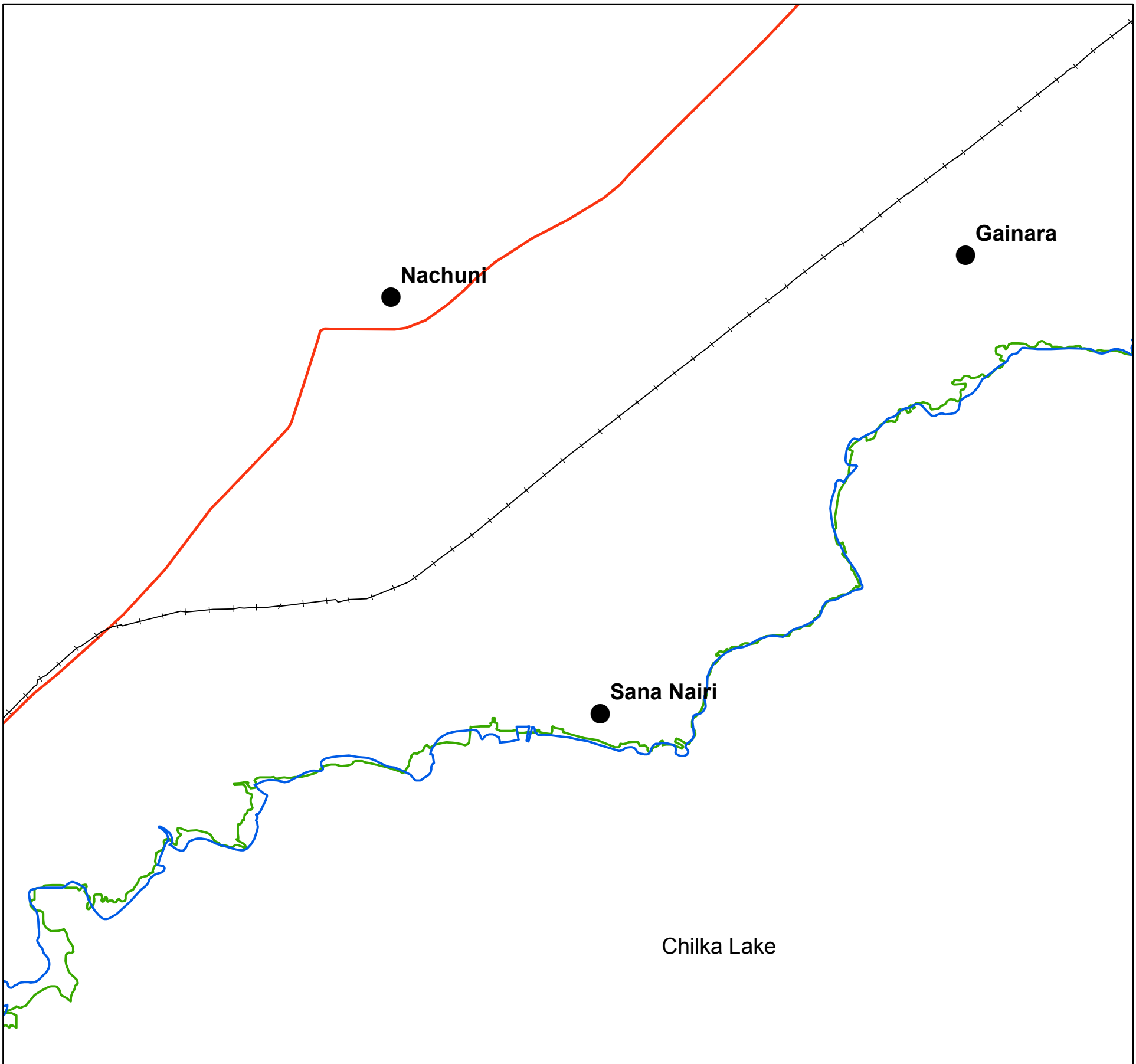
PURI DISTRICT

SHEET NO. 74E05SW



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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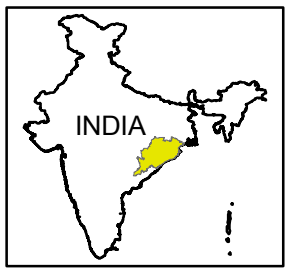
Scale in Km

INDEX TO SHEETS

74E01NE	74E05NW	74E05NE
74E01SE		74E05SE
74E02NE	74E06NW	74E06NE



DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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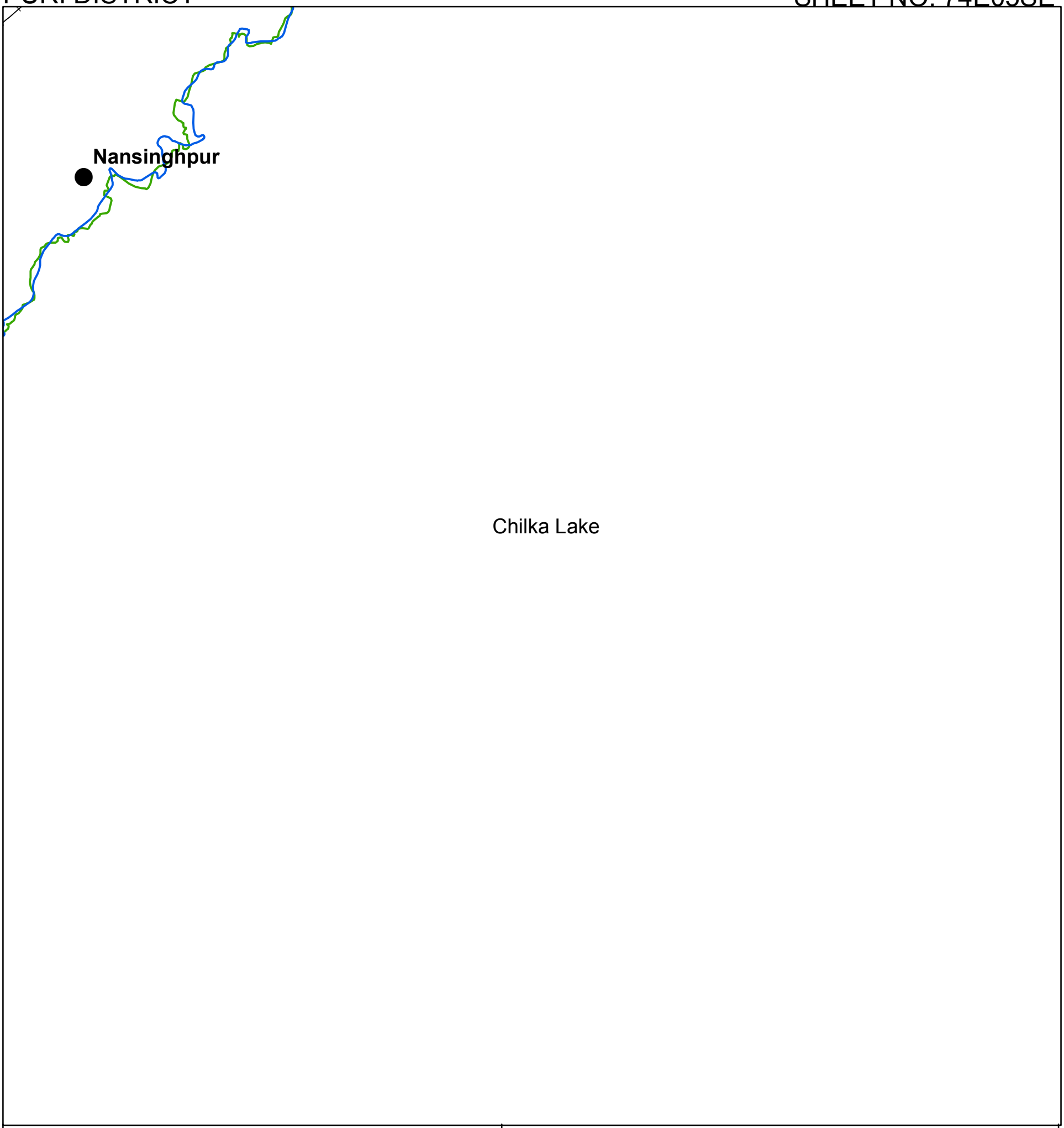
PURI DISTRICT

SHEET NO. 74E05SE



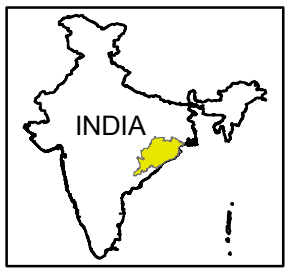
Legend

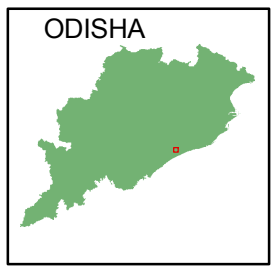
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E05NW	74E05NE	74E09NW
74E05SW		74E09SW
74E06NW	74E06NE	74E10NW





DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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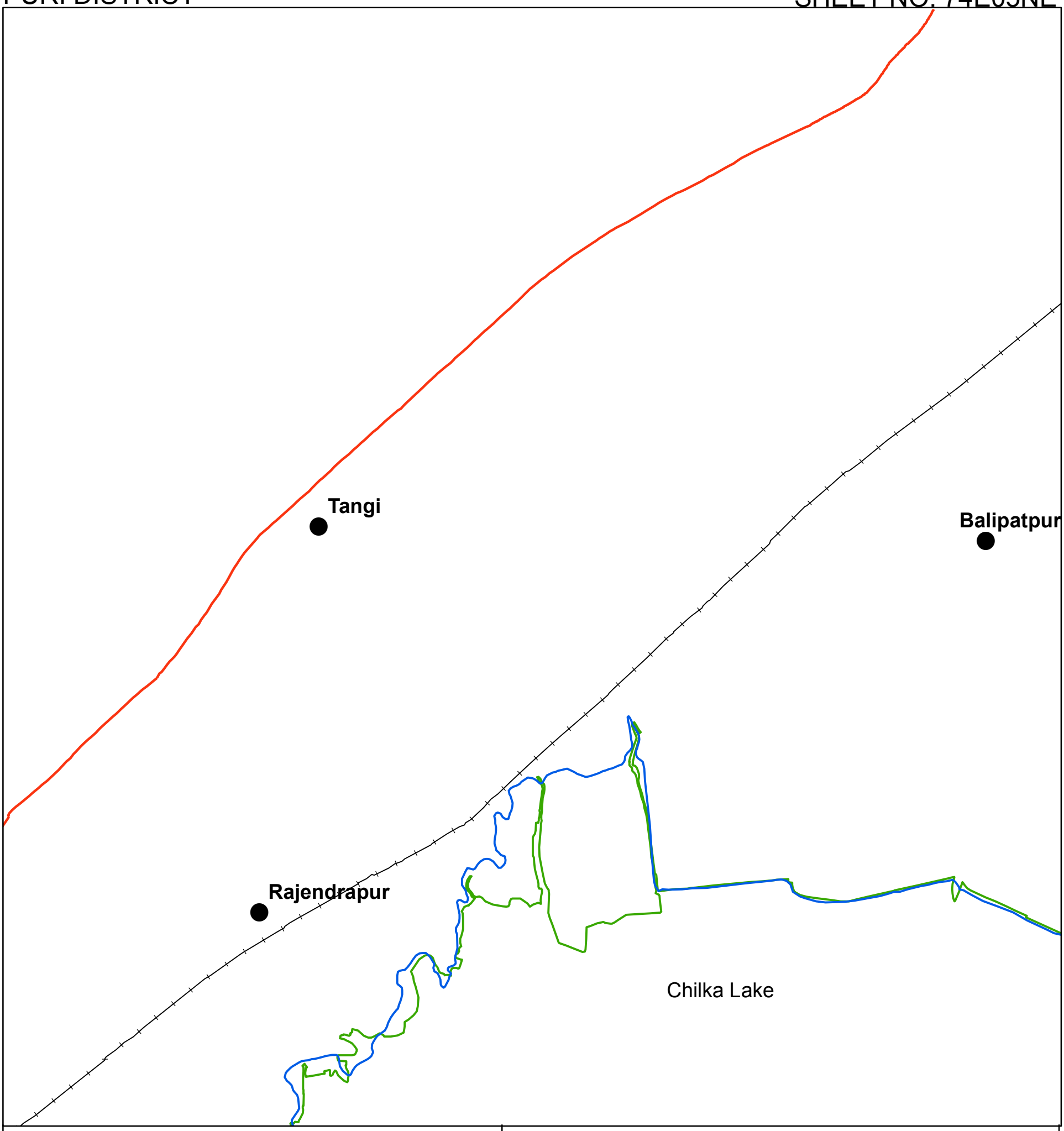
PURI DISTRICT

SHEET NO. 74E05NE



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73H08SW	73H08SE	73H12SW
74E05NW		74E09NW
74E05SW	74E05SE	74E09SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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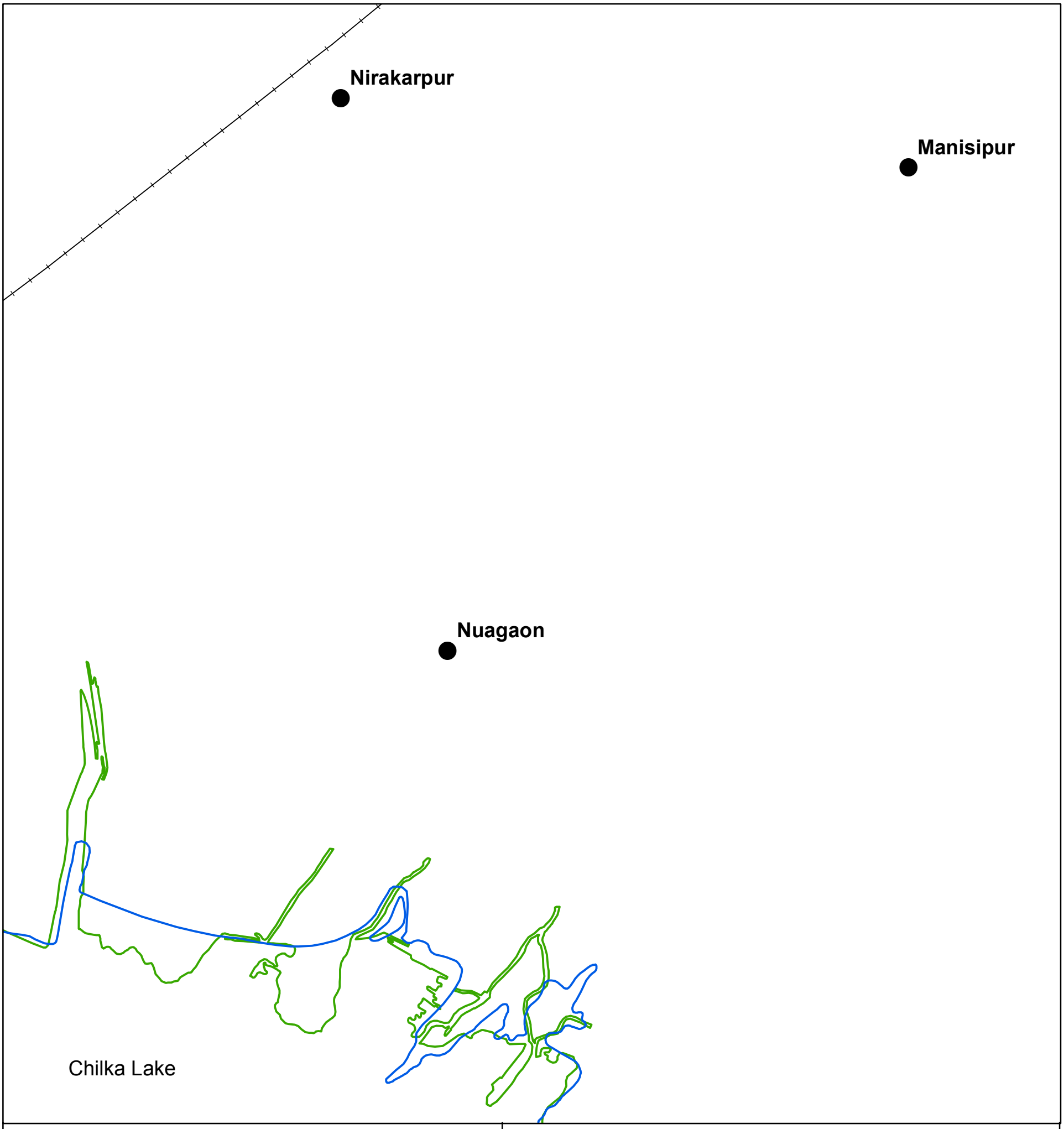
PURI DISTRICT

SHEET NO. 74E09NW



Legend

- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

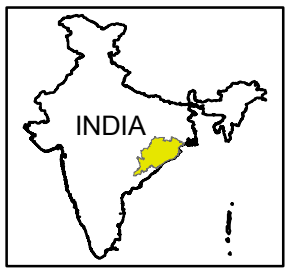
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73H08SE	73H12SW	73H12SE
74E05NE		74E09NE
74E05SE	74E09SW	74E09SE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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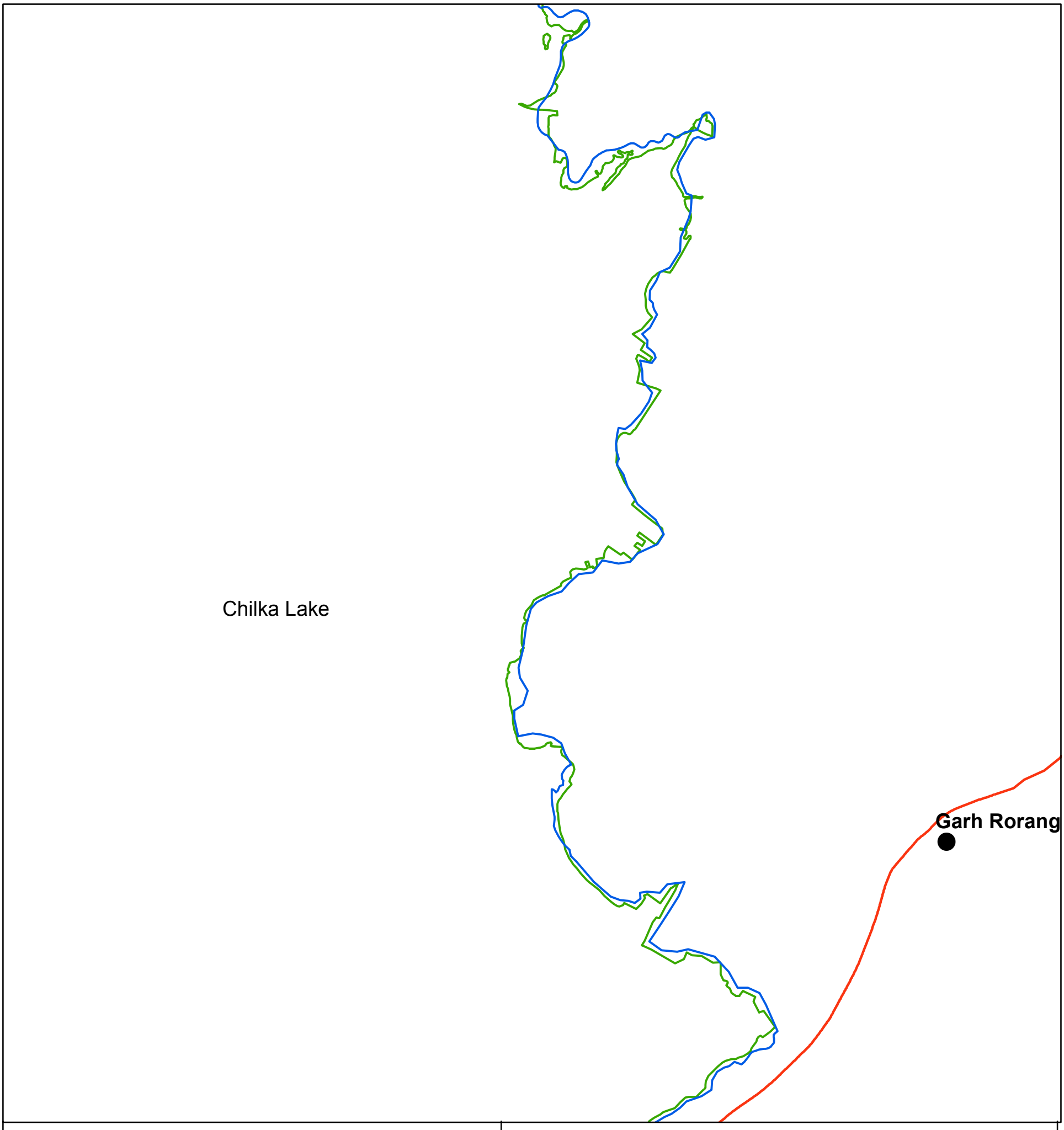
PURI DISTRICT

SHEET NO. 74E09SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

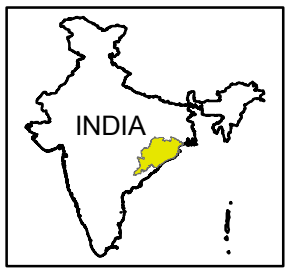
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

74E05NE	74E09NW	74E09NE
74E05SE		74E09SE
74E06NE	74E10NW	74E10NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

PURI DISTRICT

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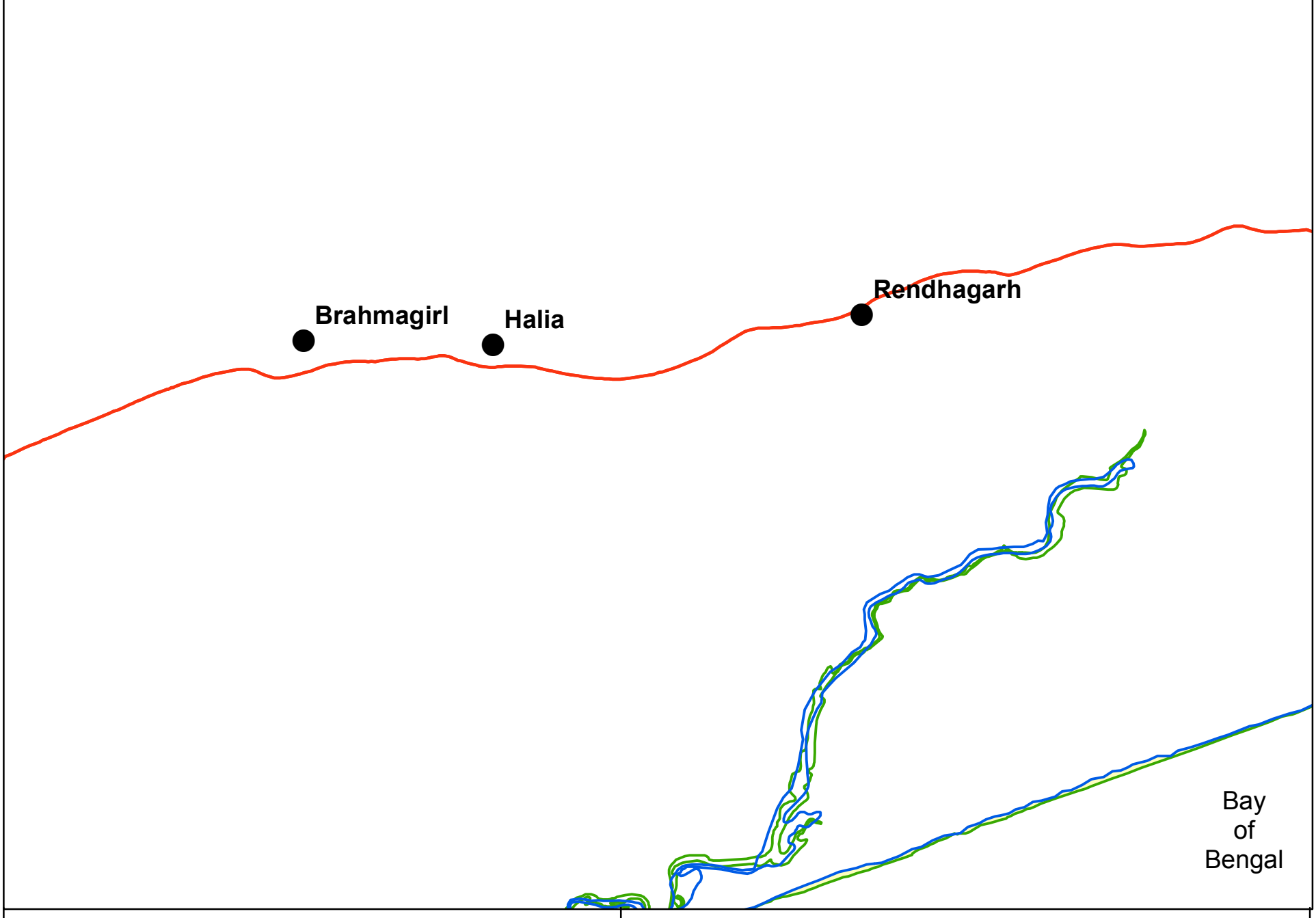
SHEET NO. 74E09SE



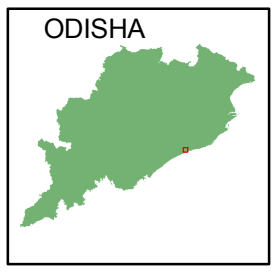
Legend

- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E09NW	74E09NE	74E13NW
74E09SW		74E13SW
74E10NW	74E10NE	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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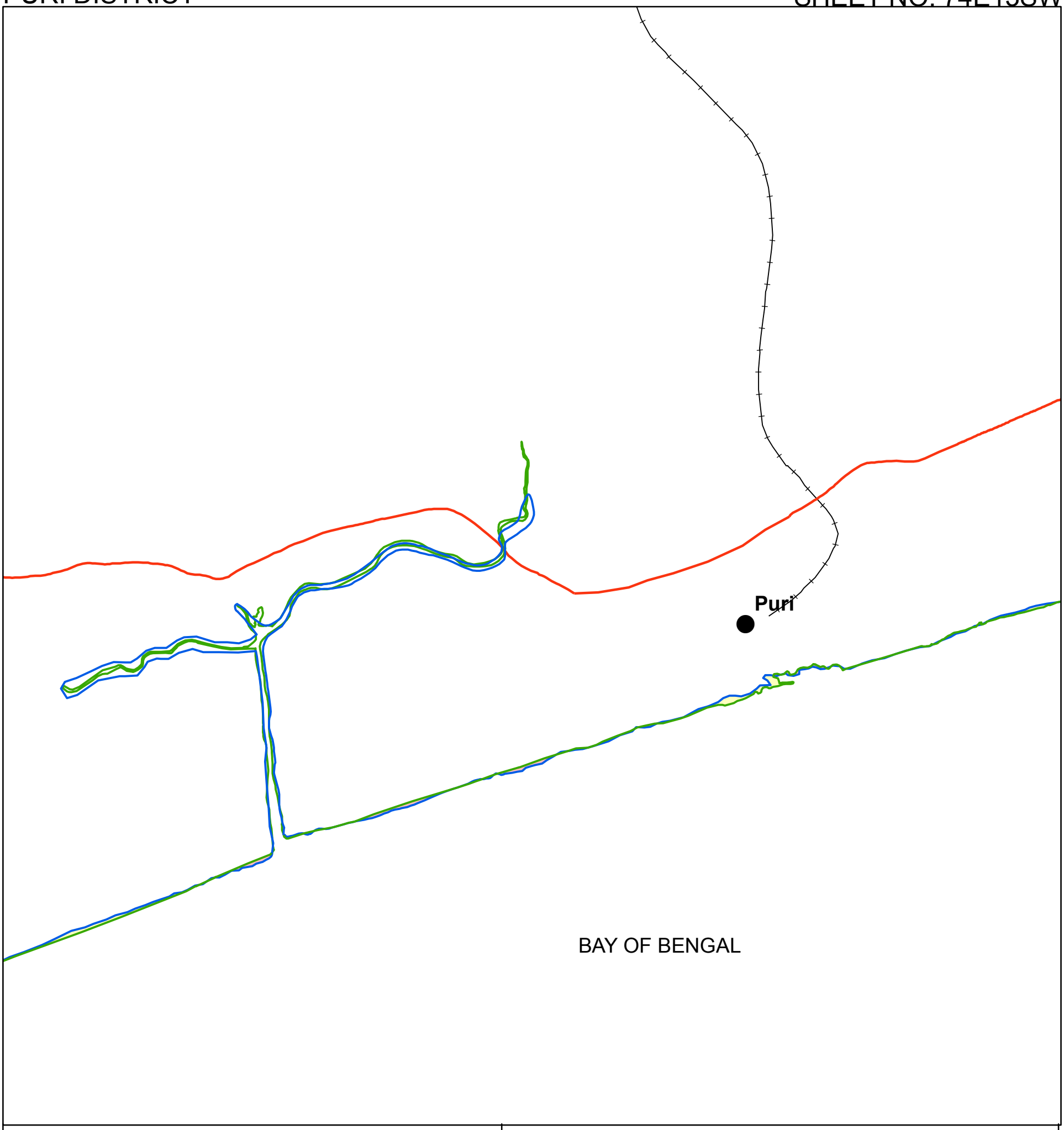
PURI DISTRICT

SHEET NO. 74E13SW



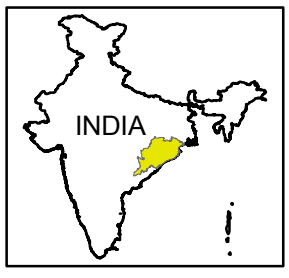
Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E09NE	74E13NW	74E13NE
74E09SE		74E13SE
74E10NE	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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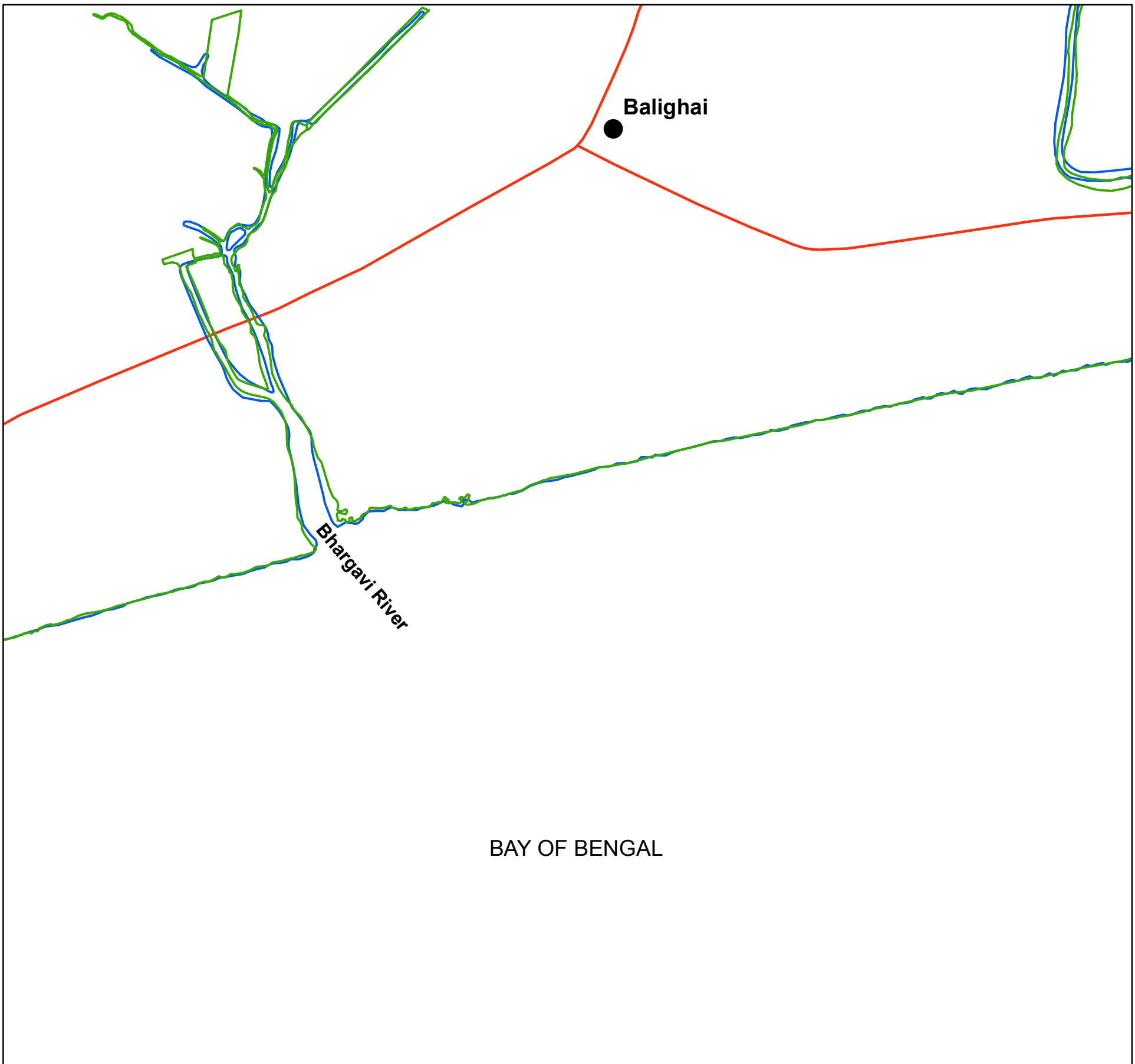
PURI DISTRICT

SHEET NO. 74E13SE



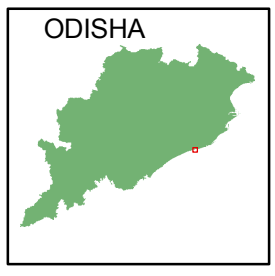
Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E13NW	74E13NE	74I01NW
74E13SW		74I01SW
SEA	SEA	SEA



DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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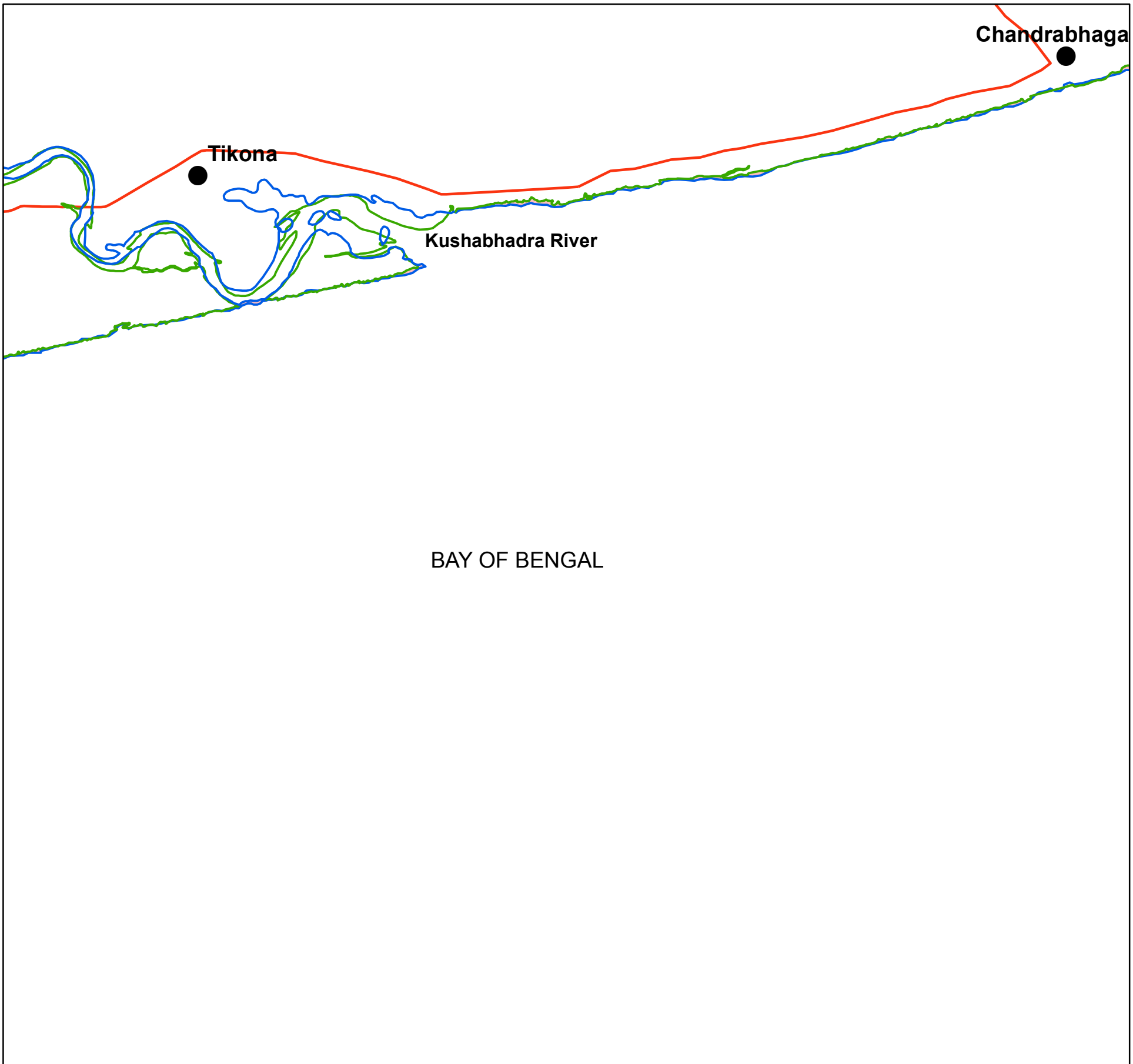
PURI DISTRICT

SHEET NO. 74I01SW



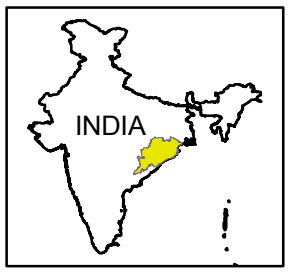
Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

74E13NE	74I01NW	74I01NE
74E13SE		74I01SE
SEA	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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PURI DISTRICT

SHEET NO. 74I01SE

BAY OF BENGAL

Legend

EROSION

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

74I01NW	74I01NE	74I05NW
74I01SW		SEA
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

PURI DISTRICT

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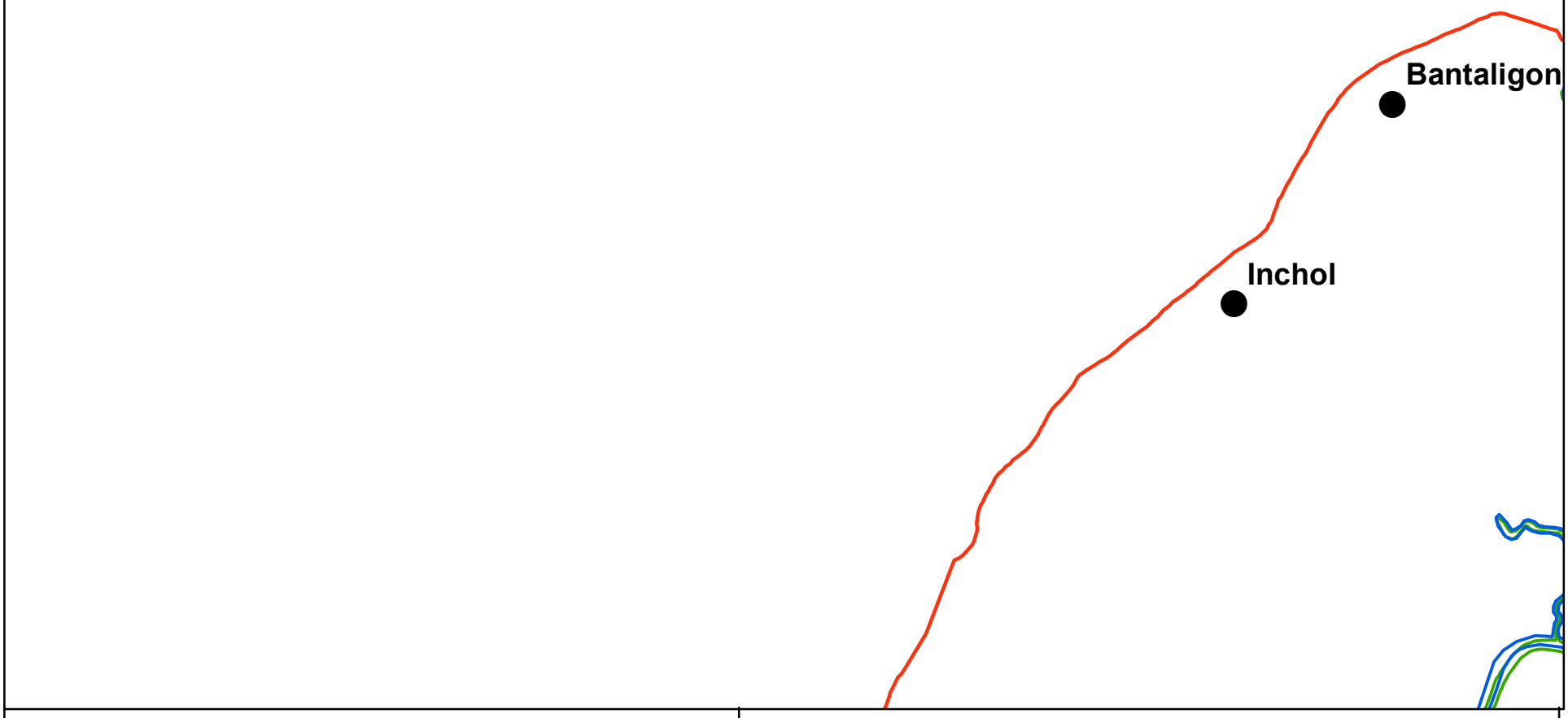
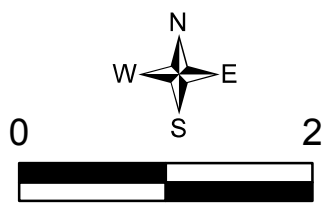
SHEET NO. 74E13NE



Legend

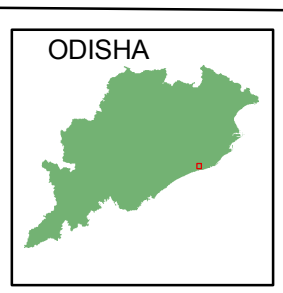
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION



Scale in Km

INDEX TO SHEETS

73H16SW	73H16SE	73L04SW
74E13NW		74I01NW
74E13SW	74E13SE	74I01SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

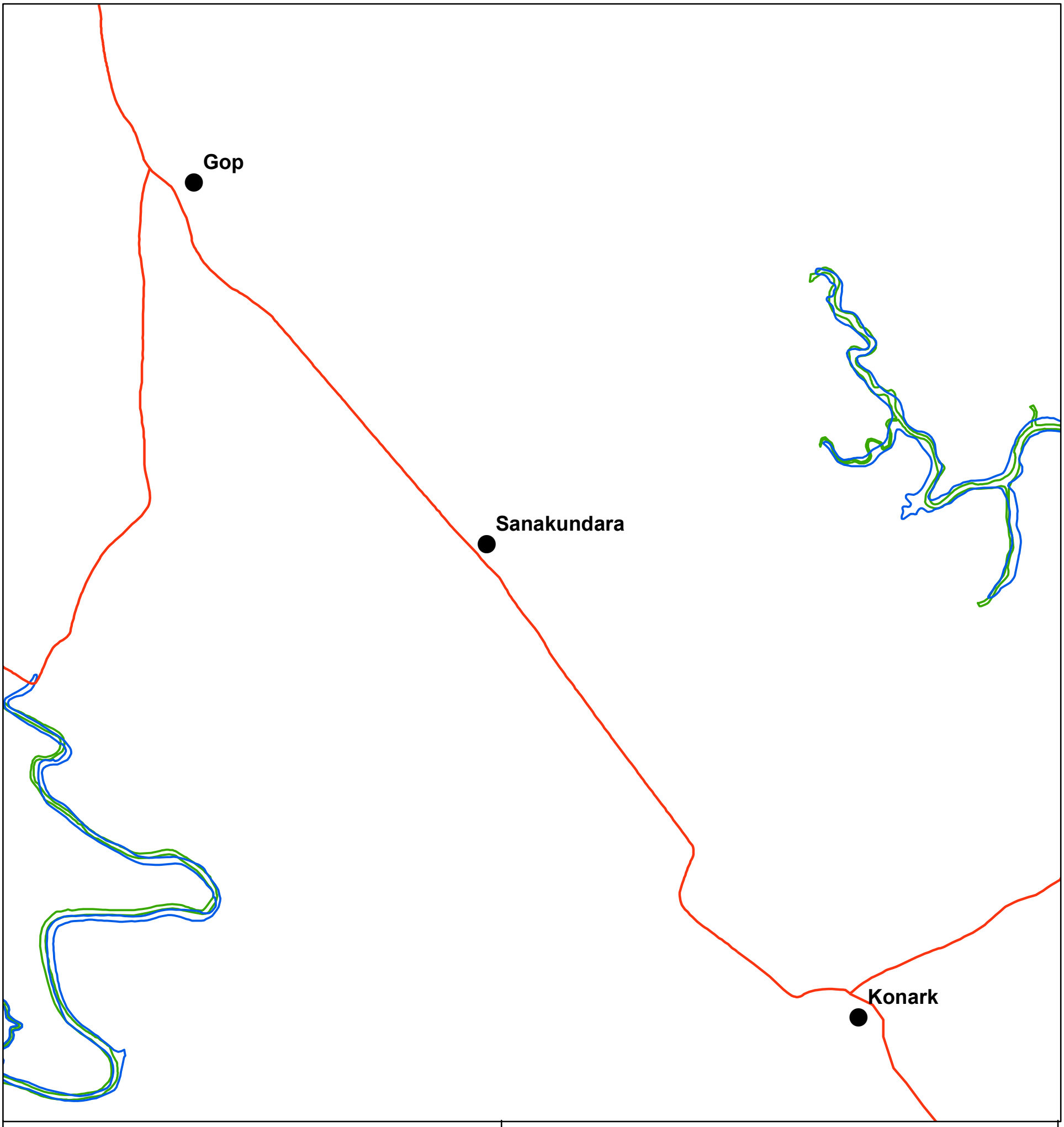
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

PURI DISTRICT

SHEET NO. 74I01NW



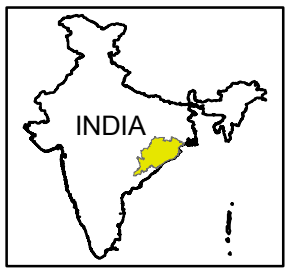
Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73H16SE	73L04SW	73L04SE
74E13NE		74I01NE
74E13SE	74I01SW	74I01SE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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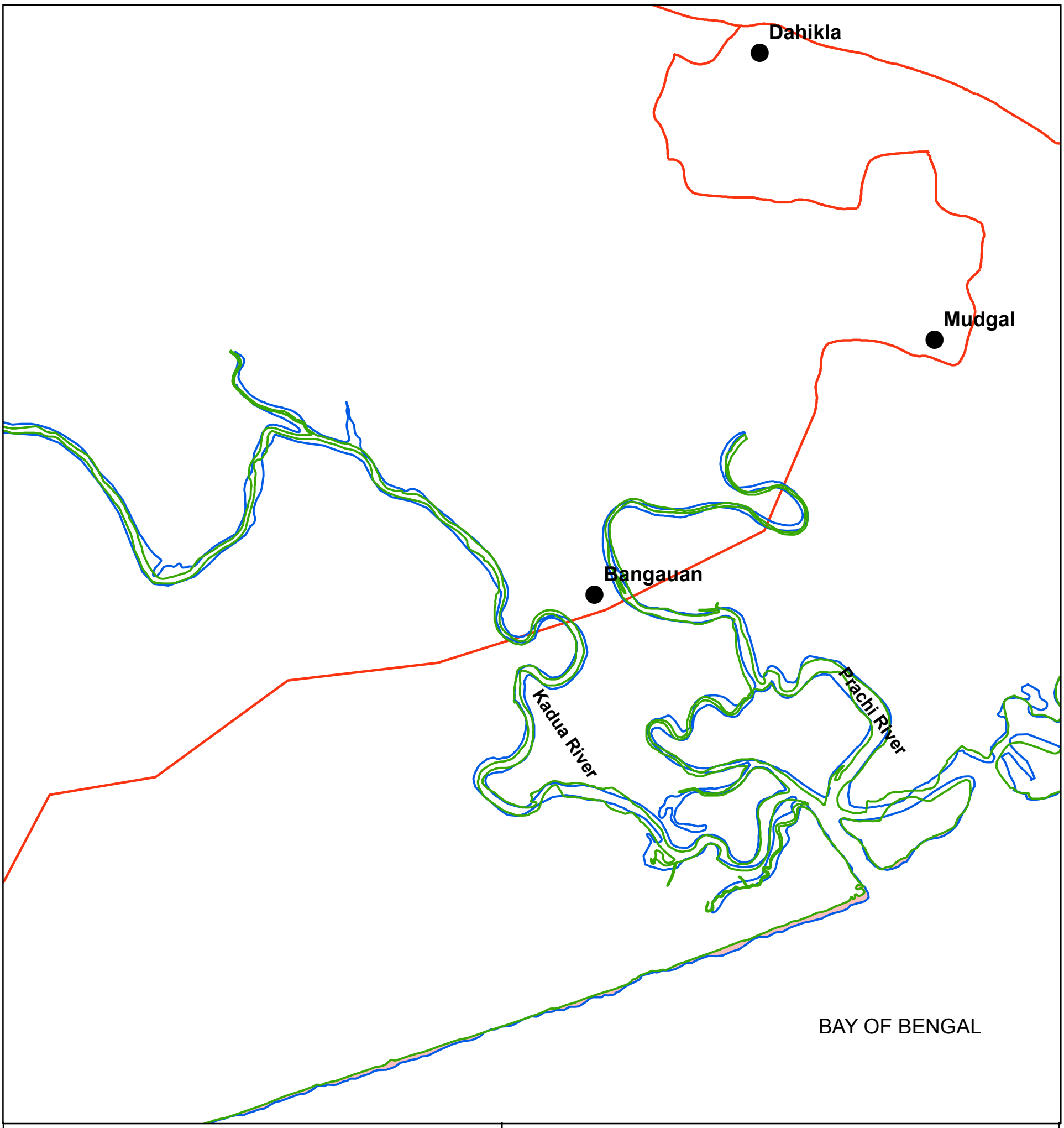
PURI DISTRICT

SHEET NO. 74I01NE



Legend

- EROSION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

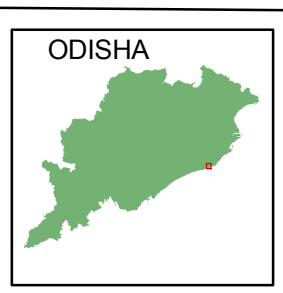
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L04SW	73L04SE	73L08SW
74I01NW		74I05NW
74I01SW	74I01SE	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

ODISHA

PURI/CUTTACK DISTRICTS

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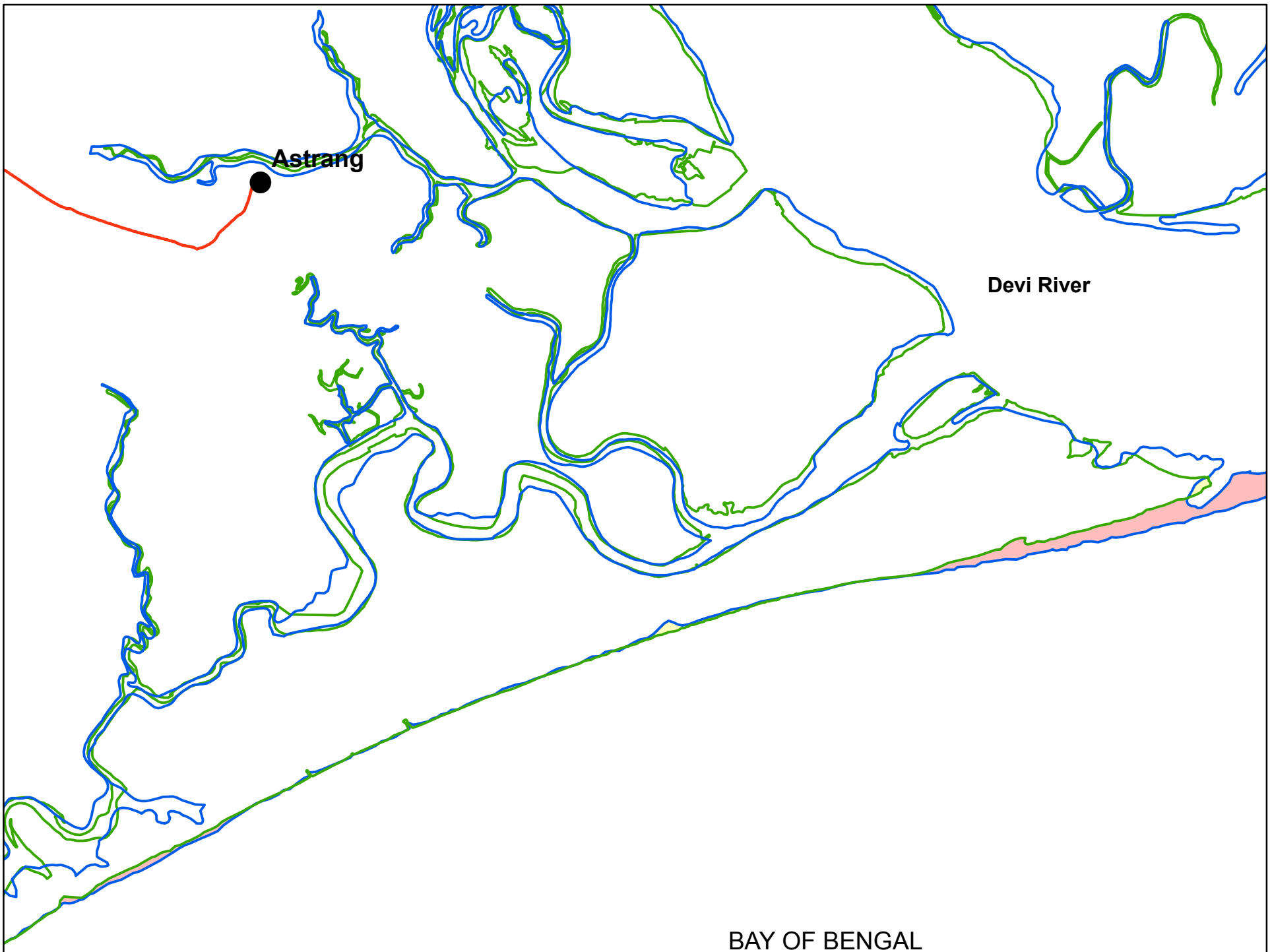
SHEET NO. 74I05NW



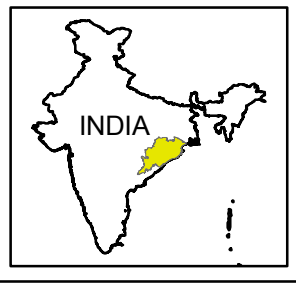
Legend

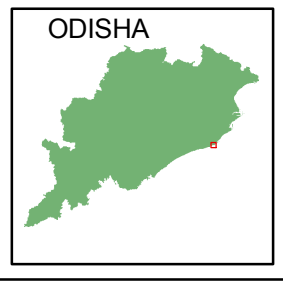
- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L04SE	73L08SW	73L08SE
74I01NE		74I05NE
74I01SE	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

PURI/CUTTACK DISTRICTS

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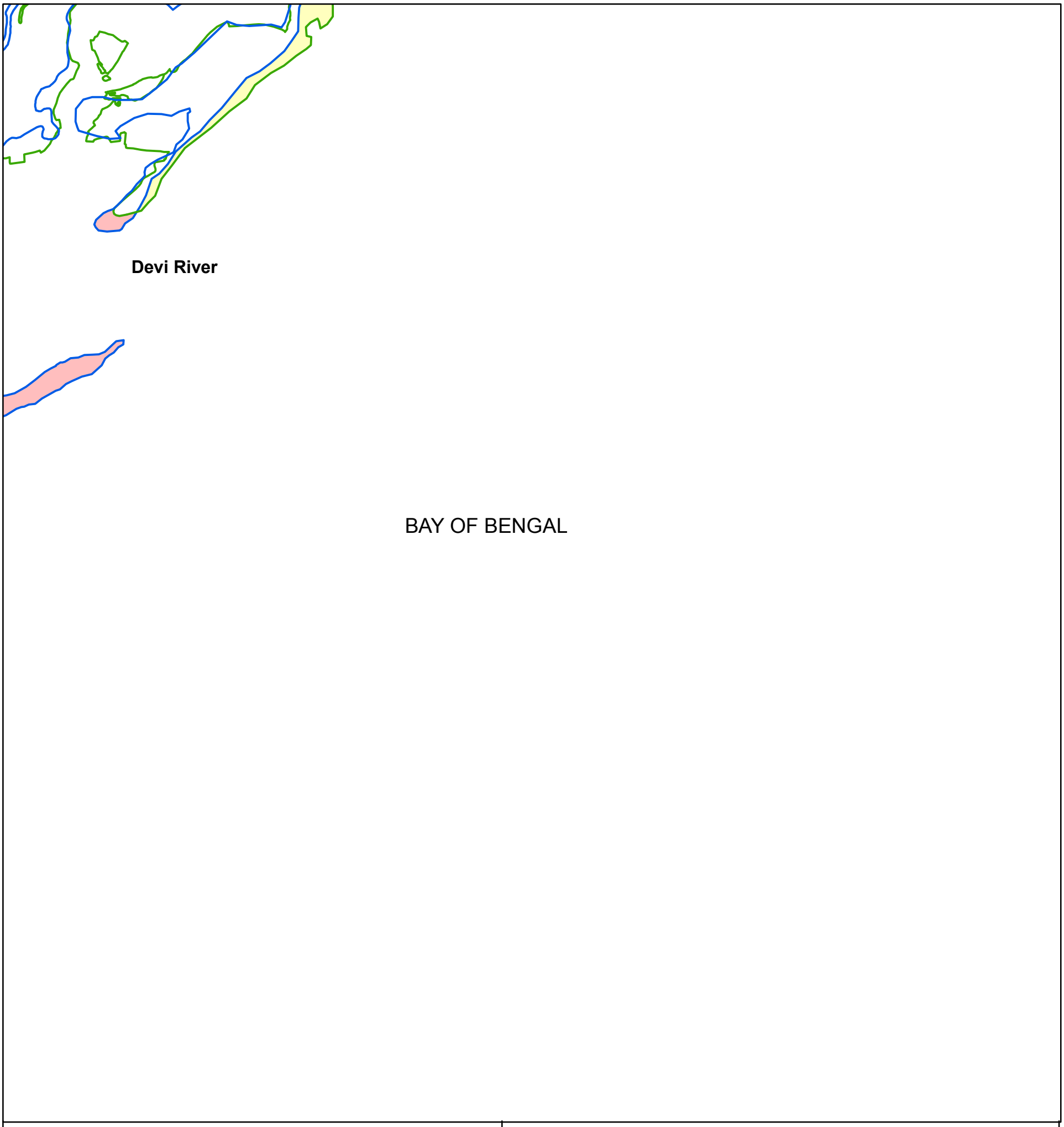
SHEET NO. 74I05NE



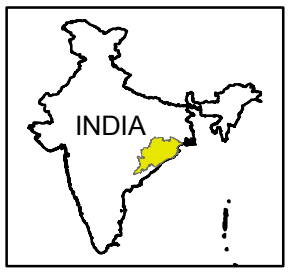
Legend

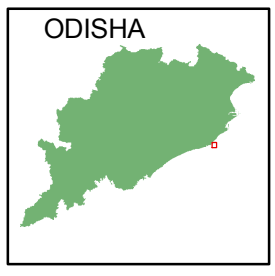
- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L08SW	73L08SE	SEA
74I05NW		SEA
SEA	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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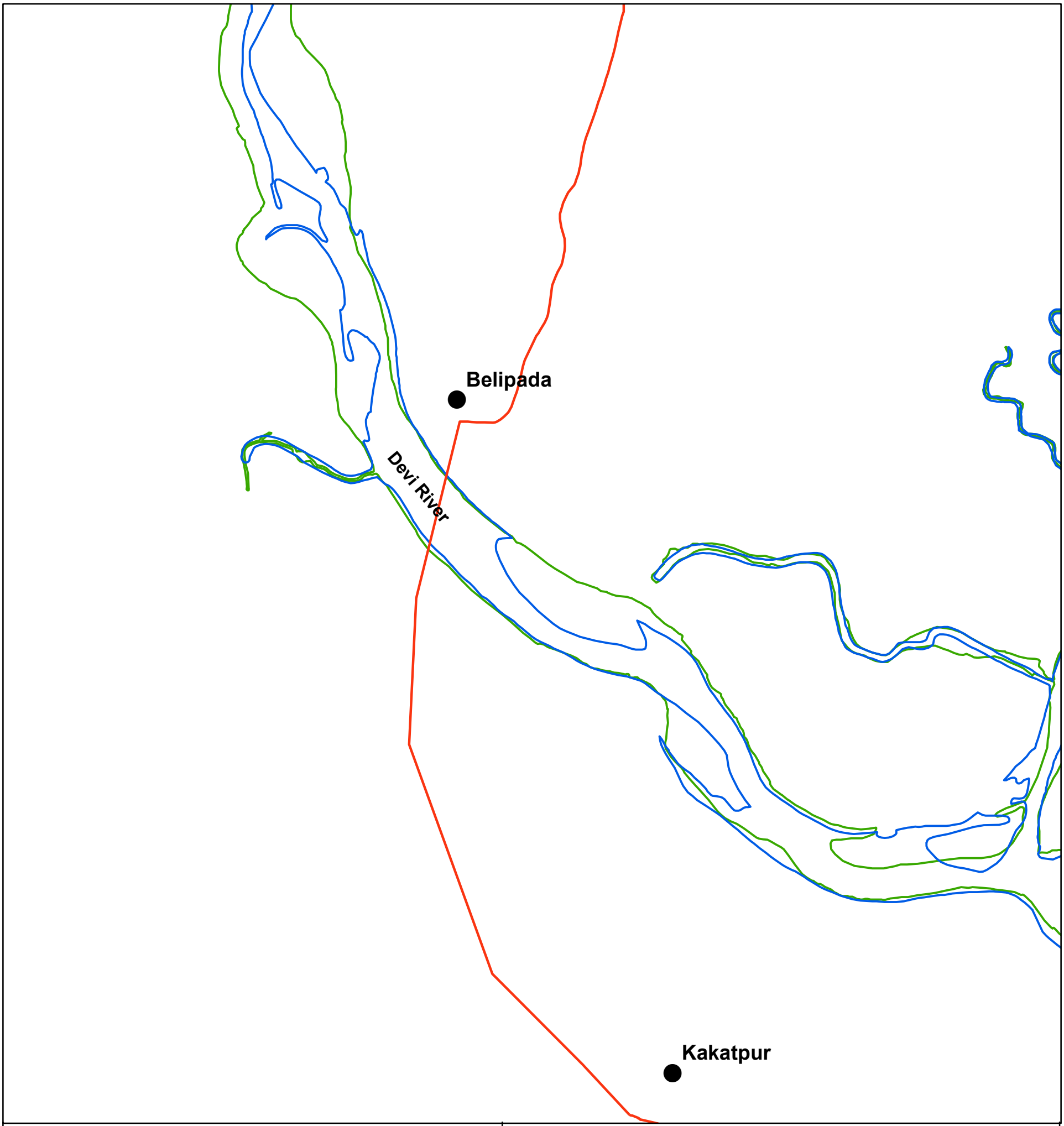
CUTTACK/PURI DISTRICTS

SHEET NO. 73L04SE



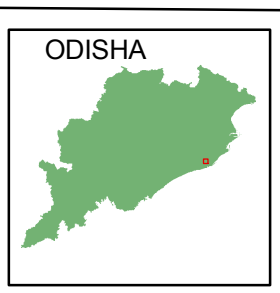
Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L04NW	73L04NE	73L08NW
73L04SW		73L08SW
74I01NW	74I01NE	74I05NW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

ODISHA

CUTTACK/PURI DISTRICTS

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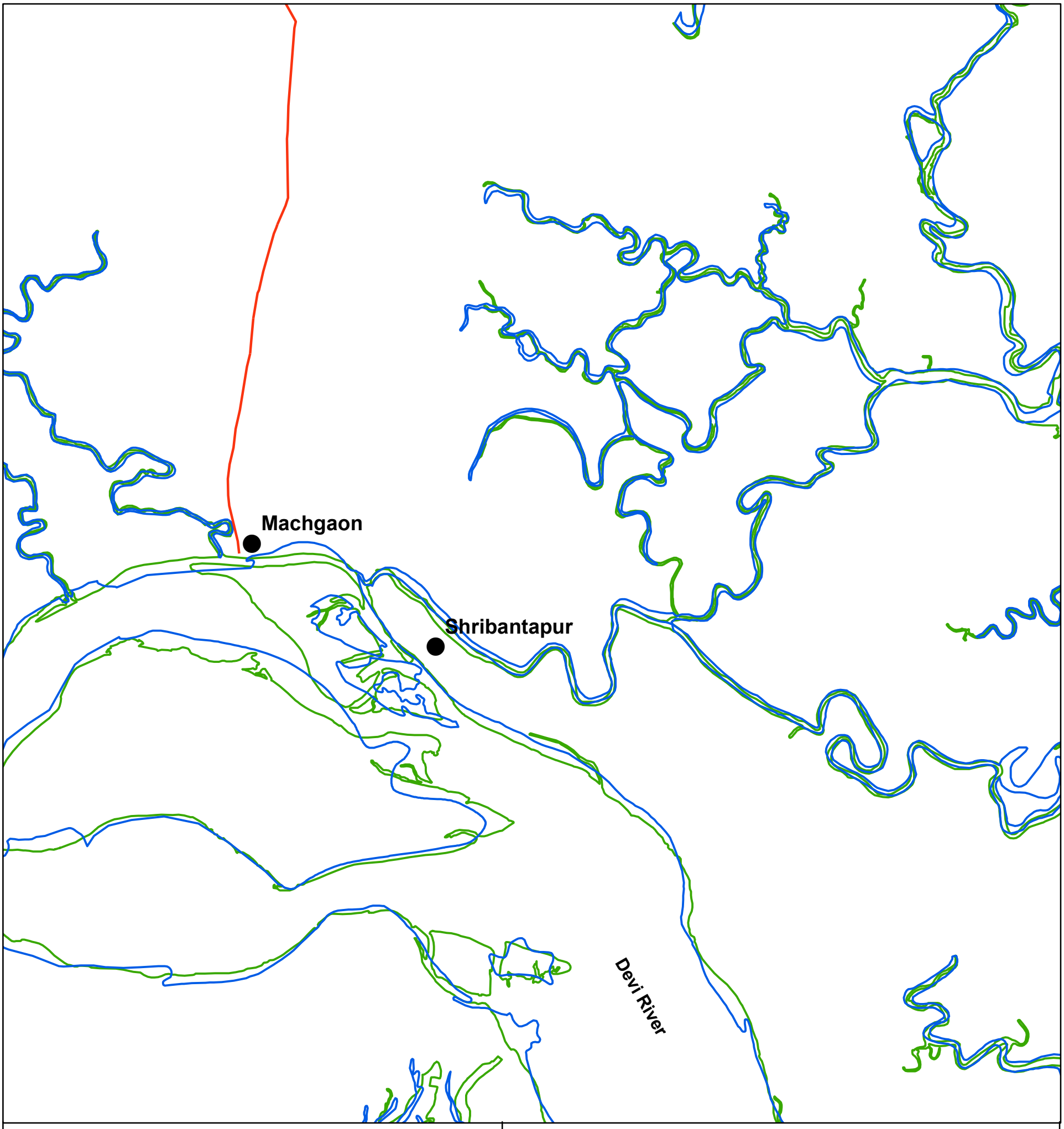
SHEET NO. 73L08SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

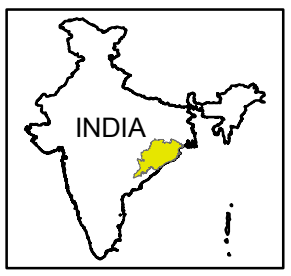
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L04NE	73L08NW	73L08NE
73L04SE		73L08SE
74I01NE	74I05NW	74I05NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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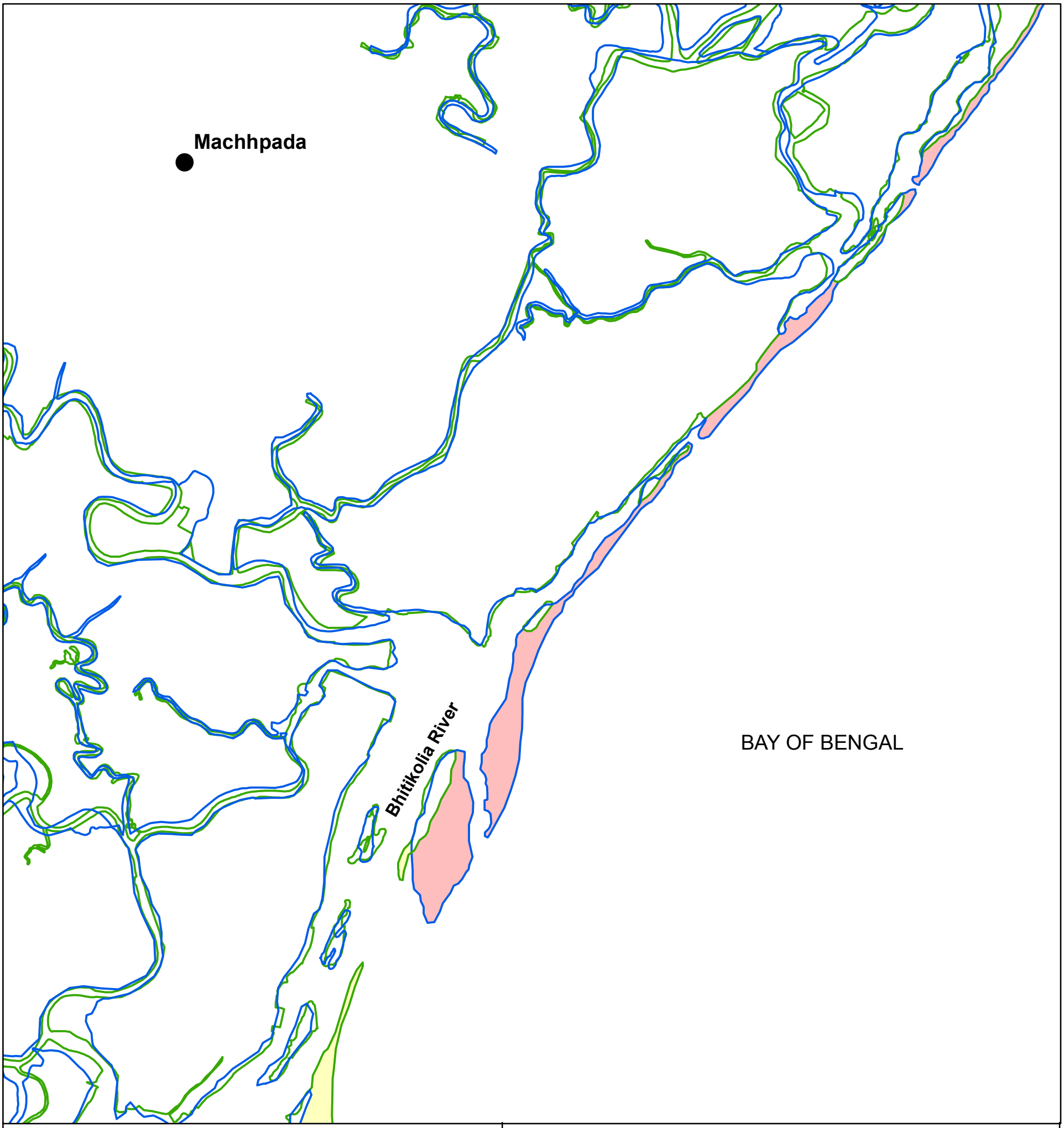
CUTTACK DISTRICT

SHEET NO. 73L08SE



Legend

- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

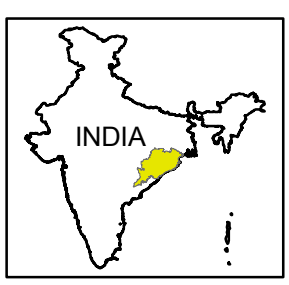
N
W E
S

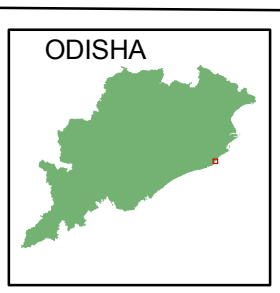
0 2

Scale in Km

INDEX TO SHEETS

73L08NW	73L08NE	73L12NW
73L08SW		SEA
74I05NW	74I05NE	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

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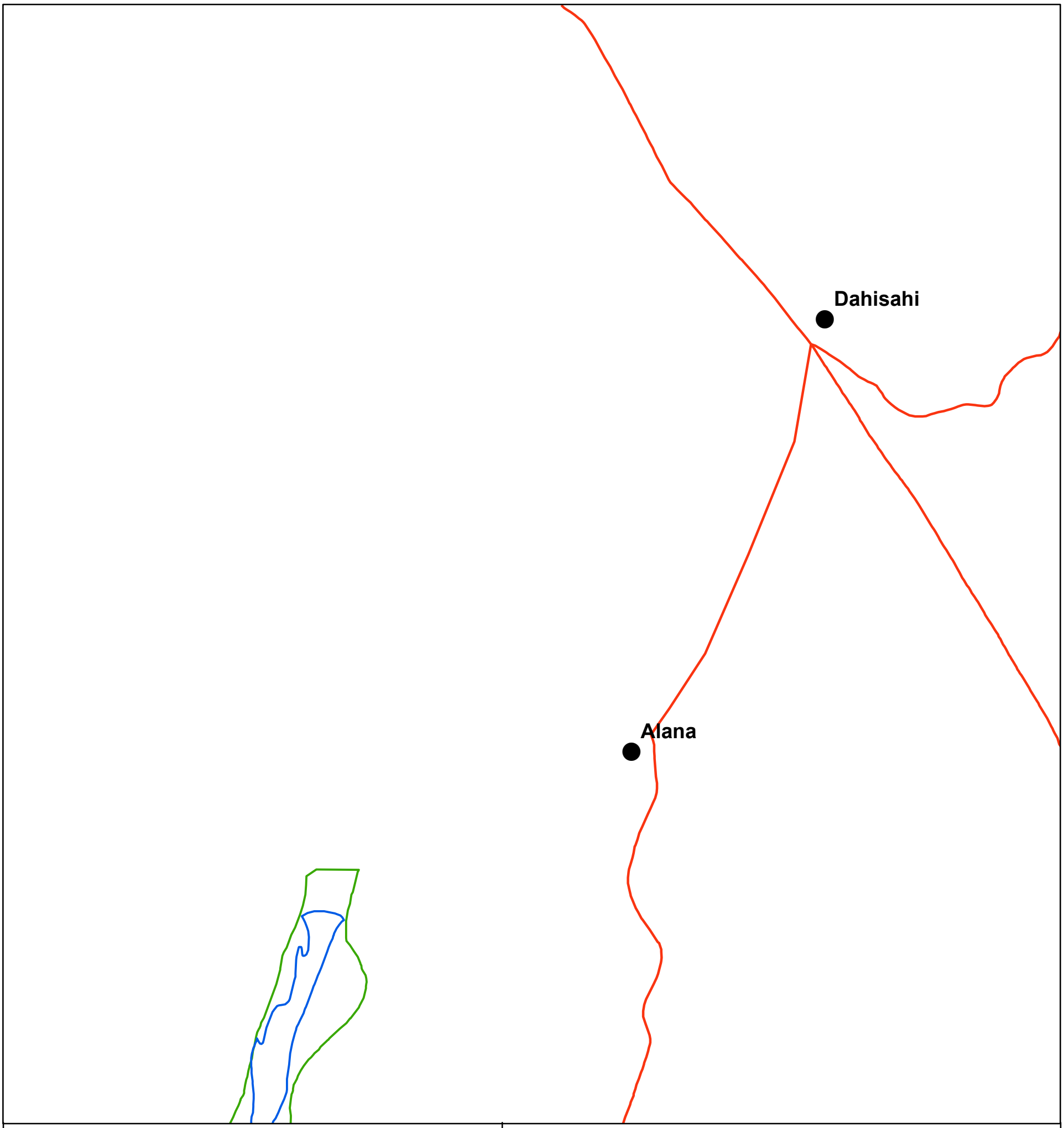
SHEET NO. 73L04NE



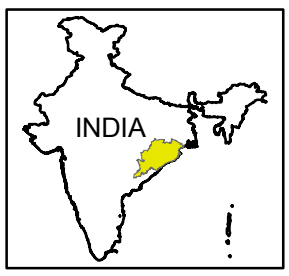
Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L03SW	73L03SE	73L07SW
73L04NW		73L08NW
73L04SW	73L04SE	73L08SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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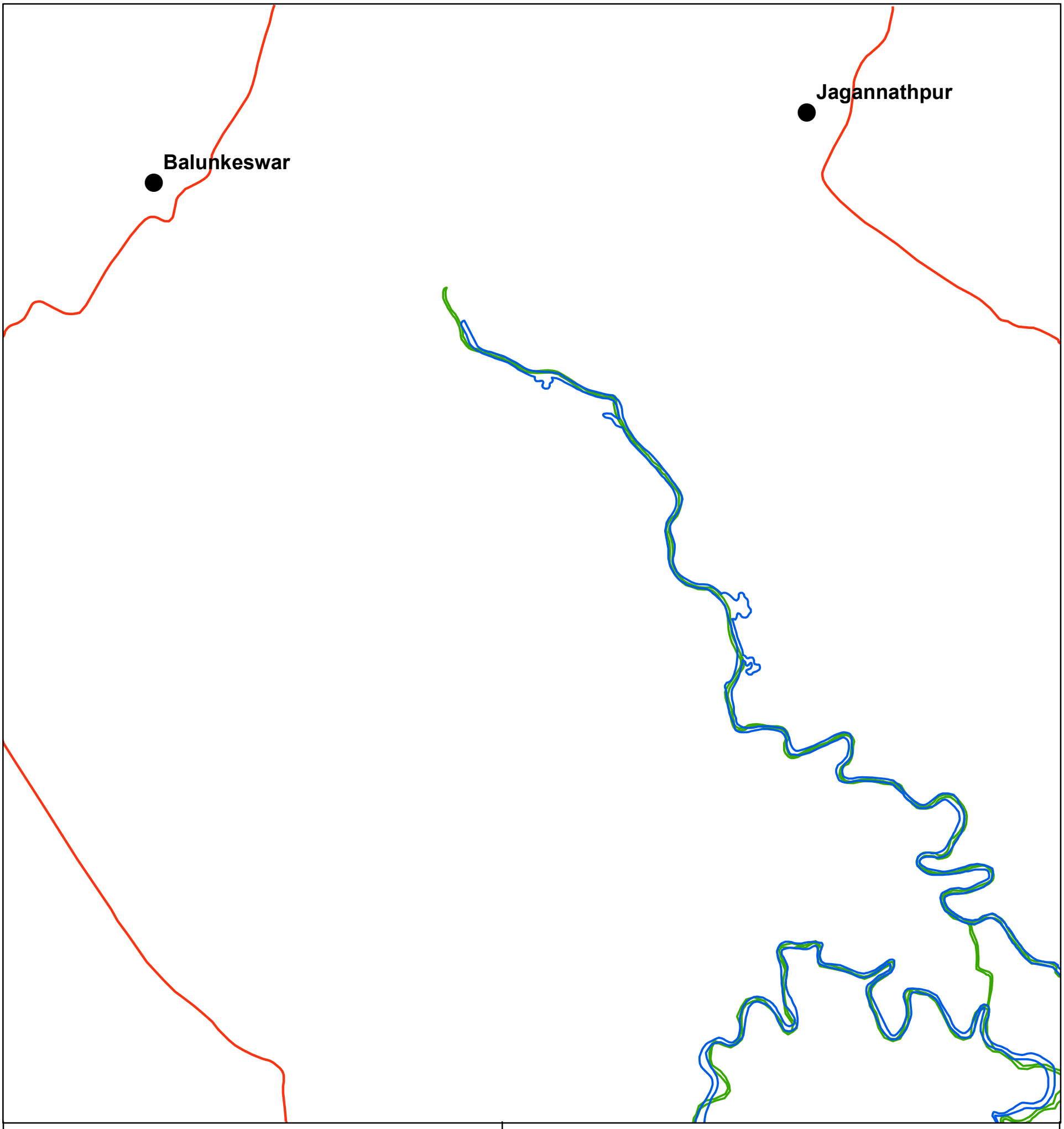
CUTTACK DISTRICT

SHEET NO. 73L08NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

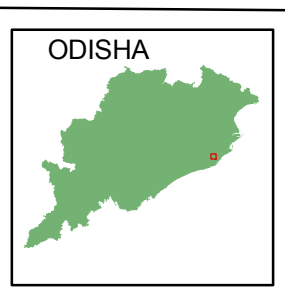
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L03SE	73L07SW	73L07SE
73L04NE		73L08NE
73L04SE	73L08SW	73L08SE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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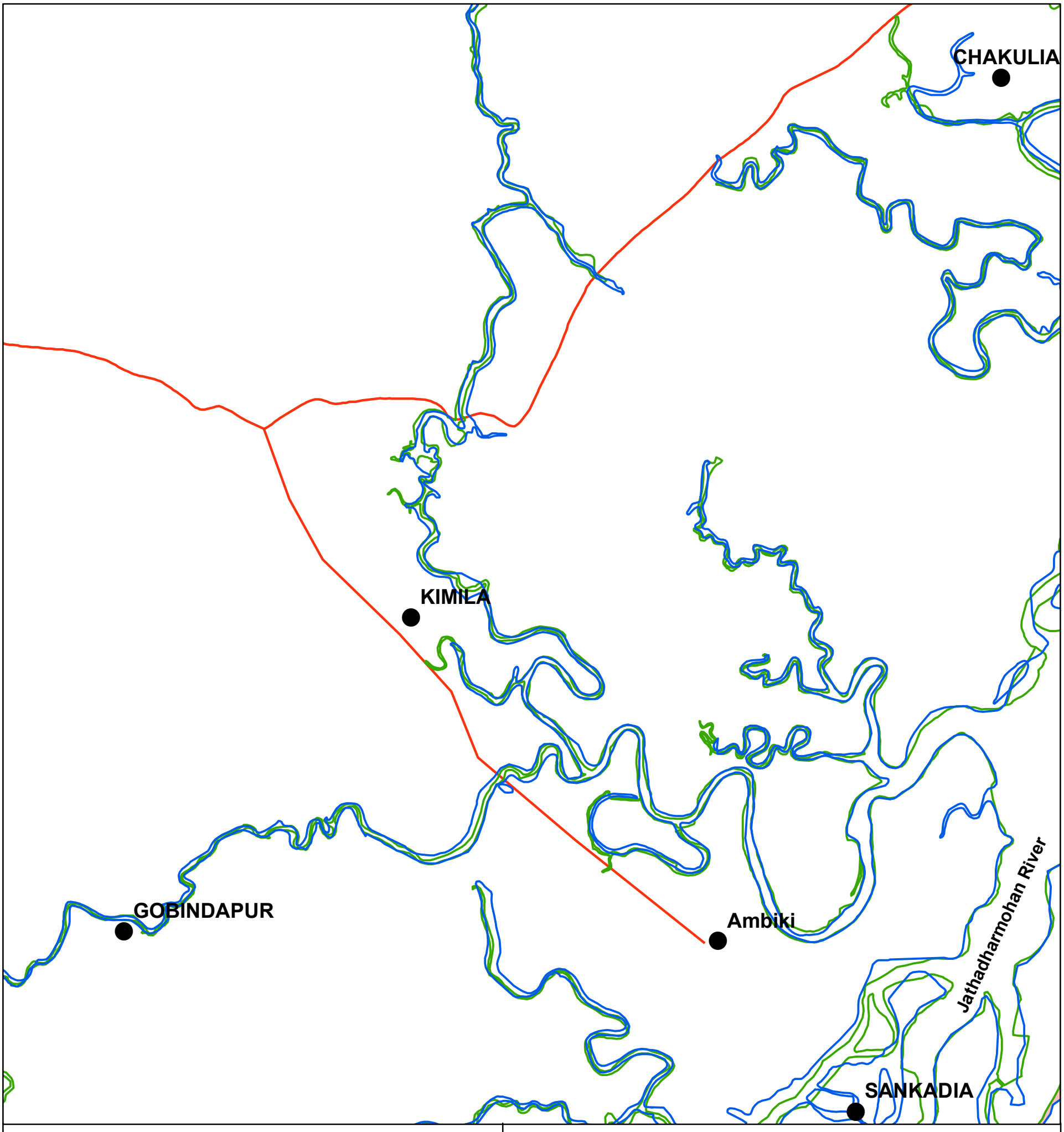
CUTTACK DISTRICT

SHEET NO. 73L08NE



Legend

- EROSION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

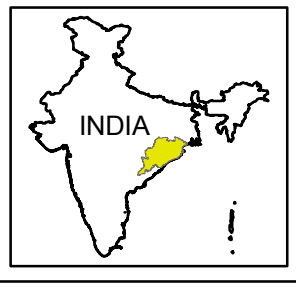
N
W E
S

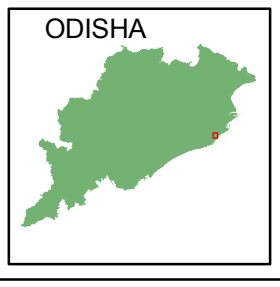
0 2

Scale in Km

INDEX TO SHEETS

73L07SW	73L07SE	73L11SW
73L08NW		73L12NW
73L08SW	73L08SE	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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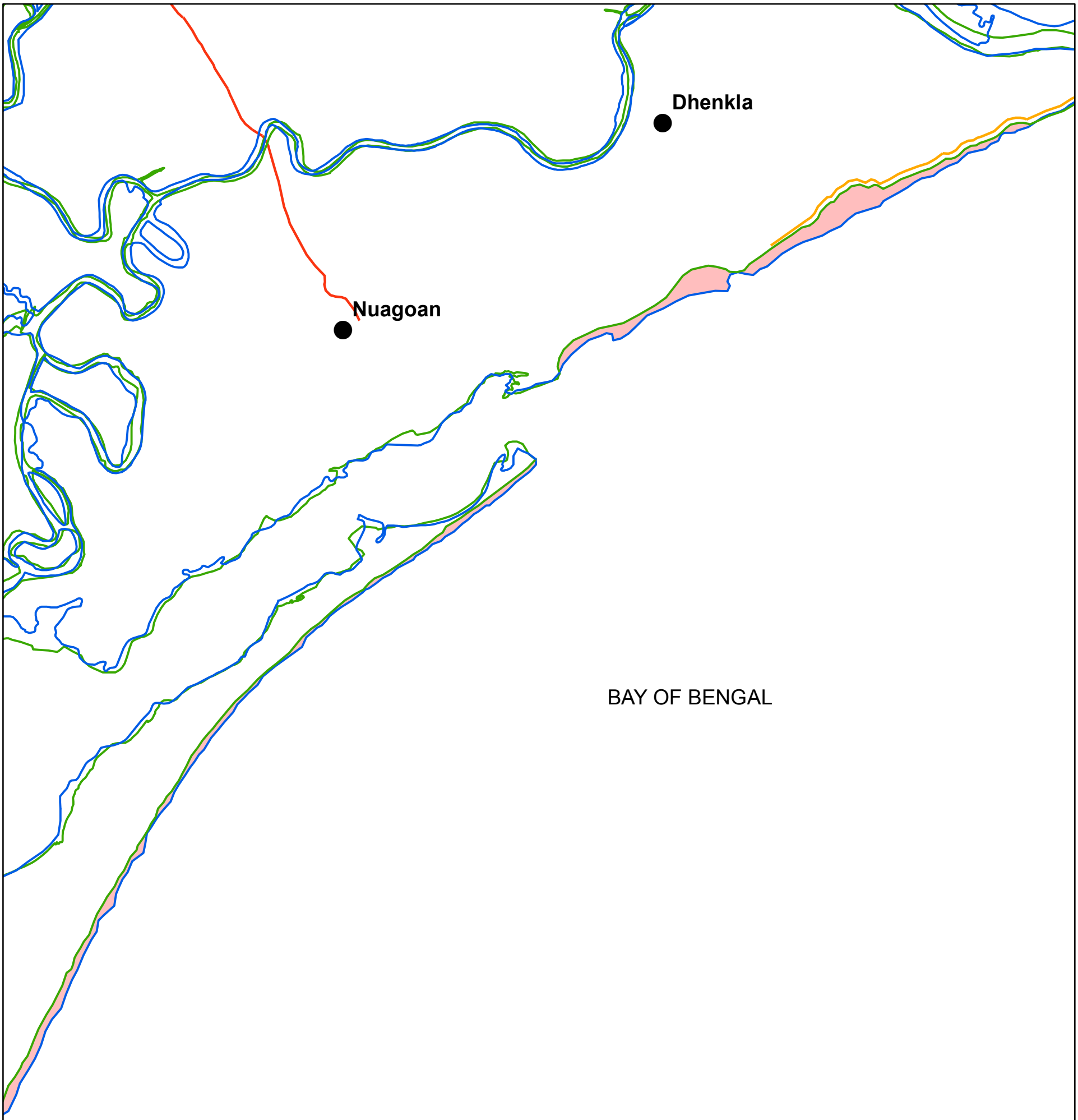
CUTTACK DISTRICT

SHEET NO. 73L12NW



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- SEA WALL
- HABITATION

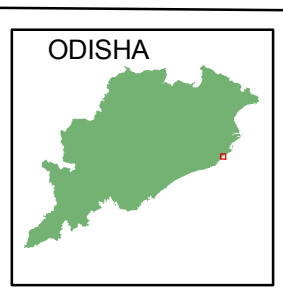
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L07SE	73L11SW	73L11SE
73L08NE		73L12NE
73L08SE	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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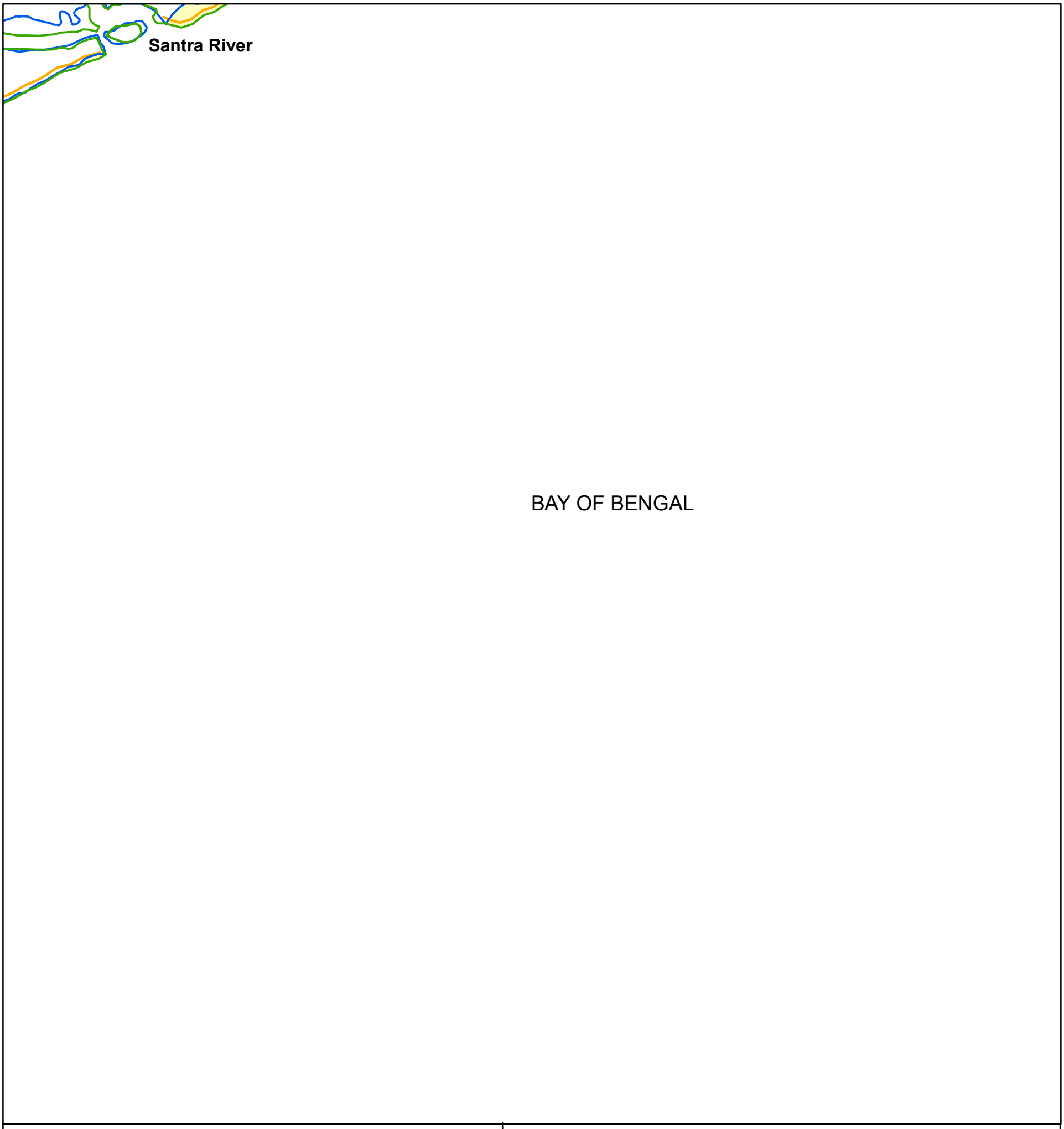
CUTTACK DISTRICT

SHEET NO. 73L12NE



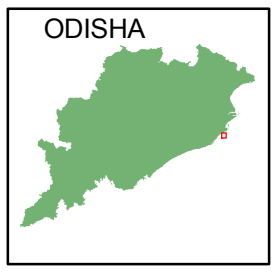
Legend

- ACCRETION
- SEA WALL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L11SW	73L11SE	73L15SW
73L12NW		SEA
SEA	SEA	SEA



DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

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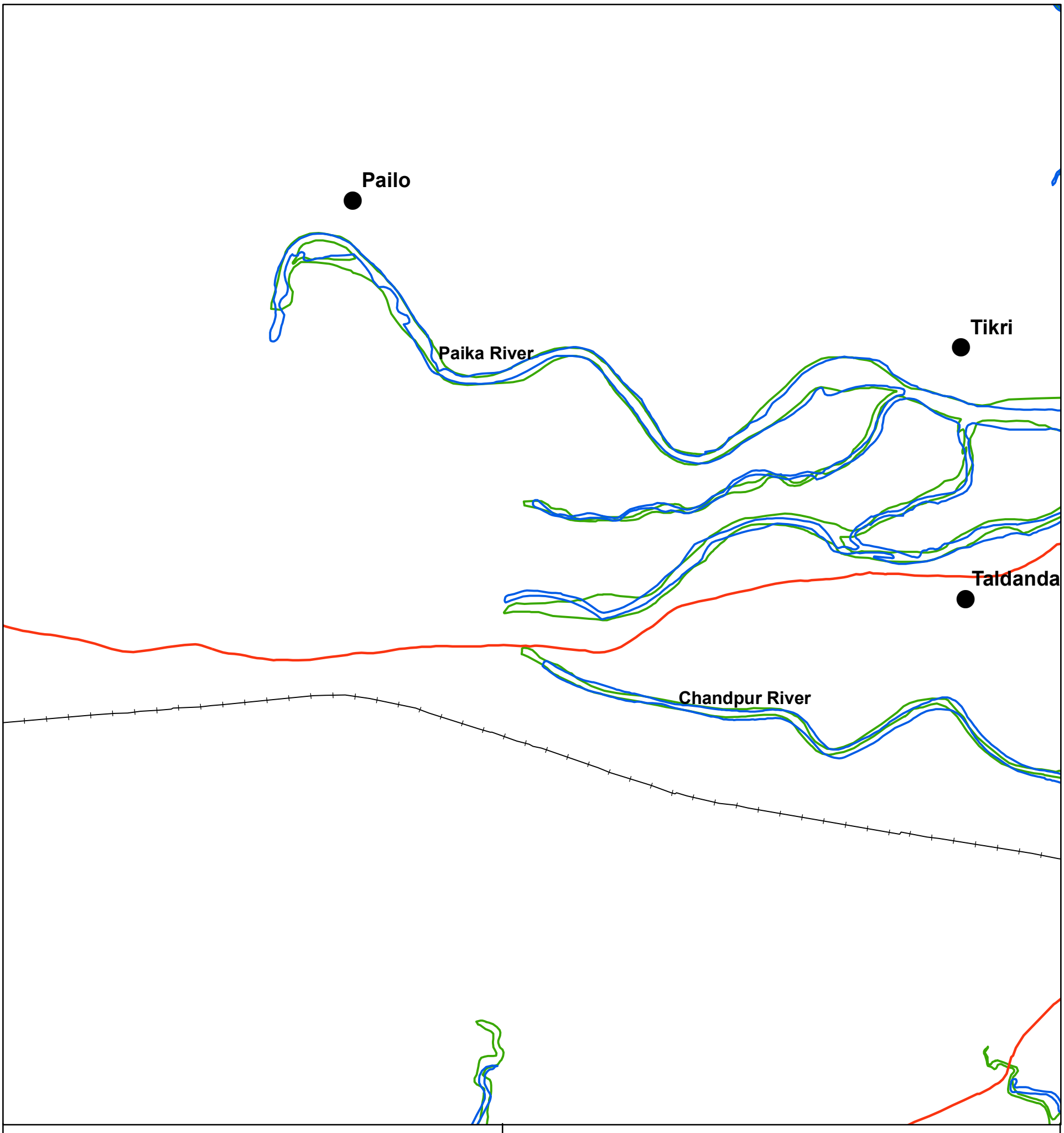
SHEET NO. 73L07SE



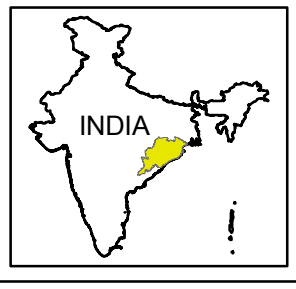
Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L07NW	73L07NE	73L11NW
73L07SW		73L11SW
73L08NW	73L08NE	73L12NW



DATA SOURCE:
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SHORELINE CHANGE MAP

ODISHA

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CUTTACK DISTRICT

SHEET NO. 73L11SW

Raypur

Anantpur

Patpur

Rangiagarh

Mahanadi River

Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

73L07NE	73L11NW	73L11NE
73L07SE		73L11SE
73L08NE	73L12NW	73L12NE

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

FOR OFFICIAL USE ONLY

SHEET NO. 73L11SE

Bahukud

Agnashi

Paradip

Mahanadi River

BAY OF BENGAL

Legend

- EROSION
- ACCRETION
- SEA WALL
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

73L11NW	73L11NE	73L15NW
73L11SW		73L15SW
73L12NW	73L12NE	SEA

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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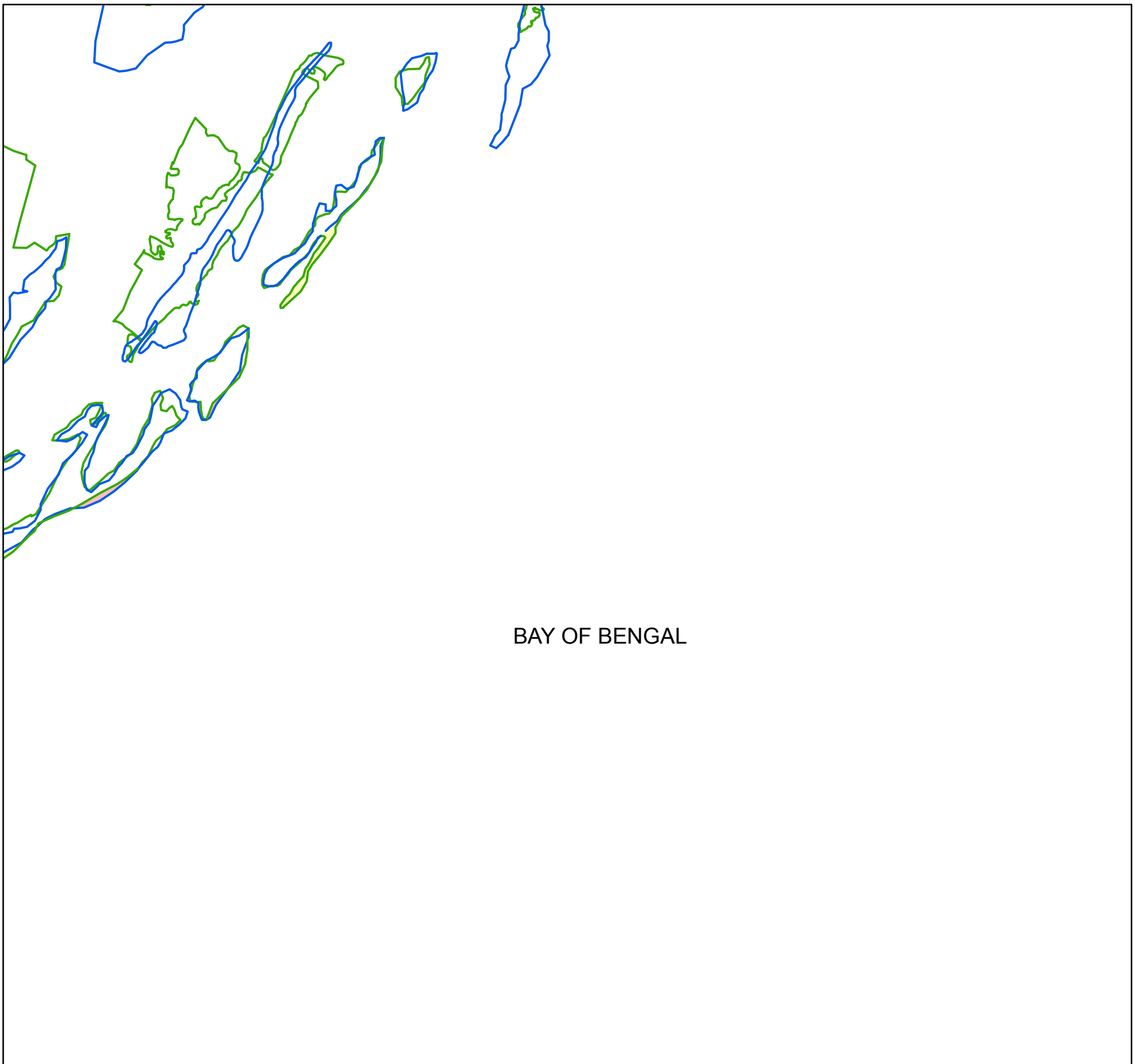
CUTTACK DISTRICT

SHEET NO. 73L15SW



Legend

- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L11NE	73L15NW	SEA
73L11SE		SEA
73L12NE	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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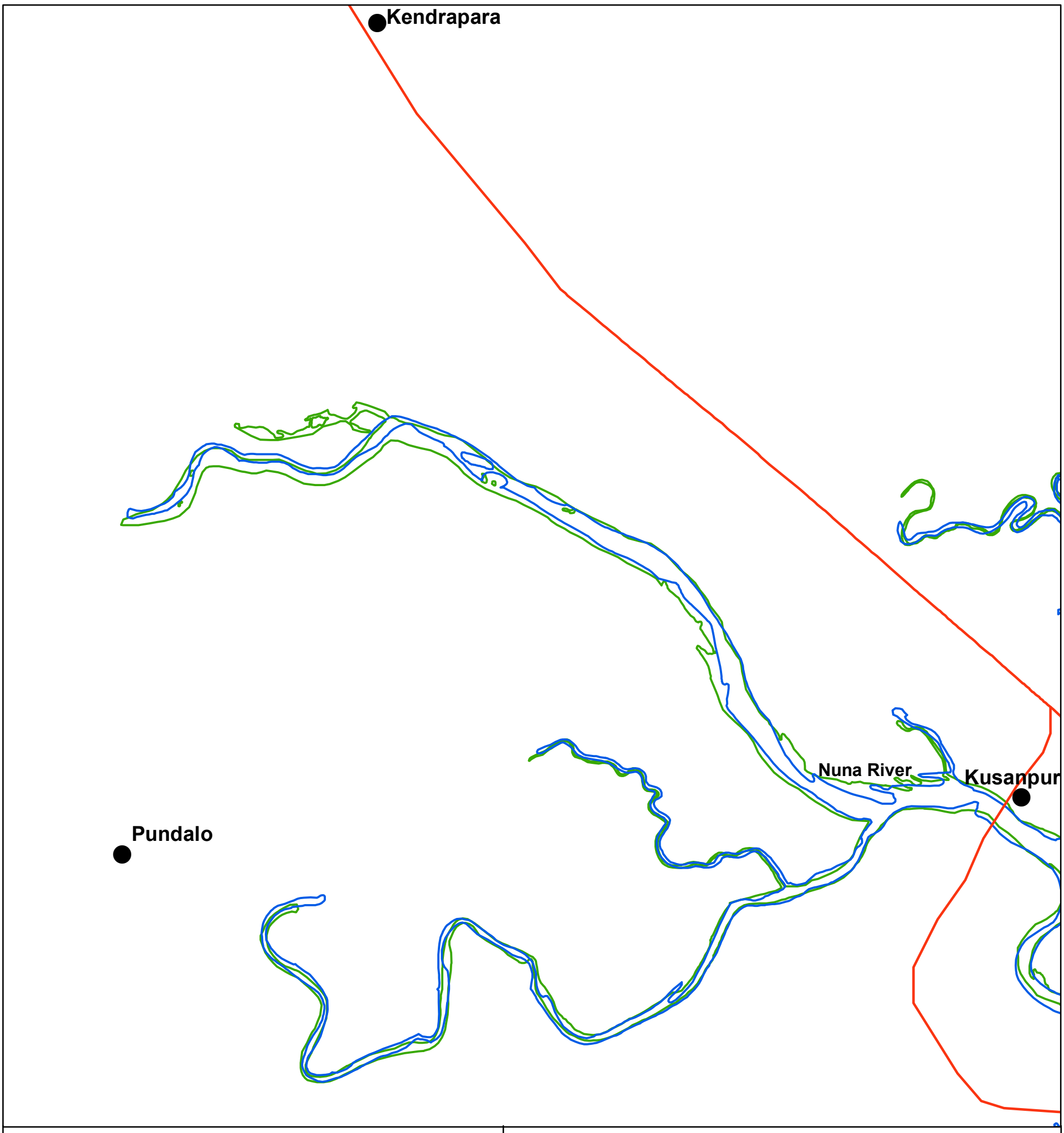
CUTTACK DISTRICT

SHEET NO. 73L07NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

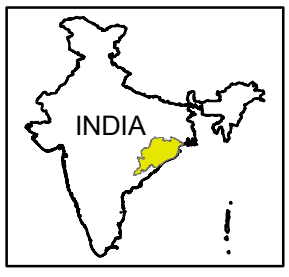
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L06SW	73L06SE	73L10SW
73L07NW		73L11NW
73L07SW	73L07SE	73L11SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

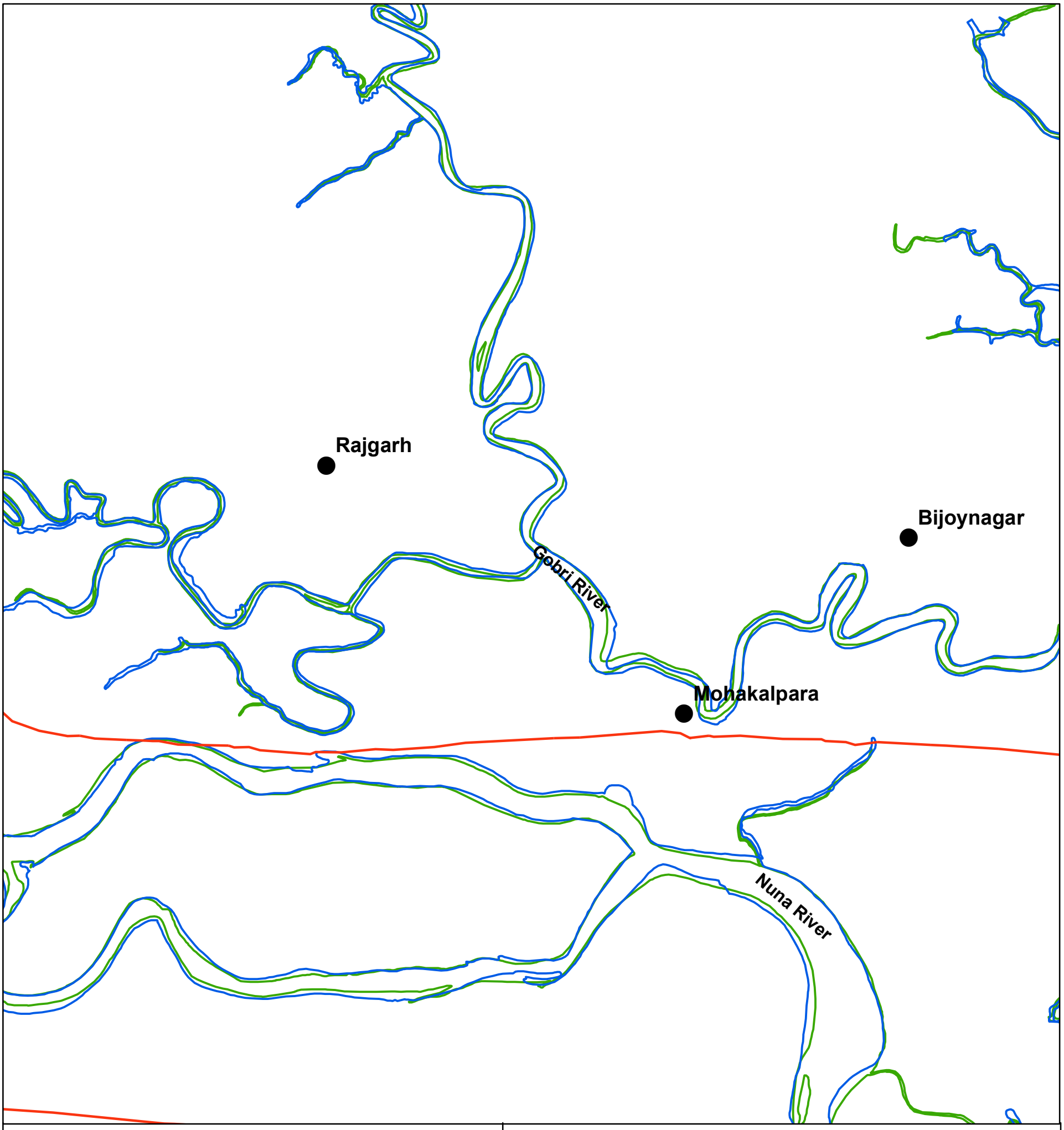
SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

FOR OFFICIAL USE ONLY

SHEET NO. 73L11NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

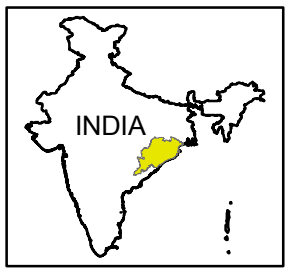
N
W E
S

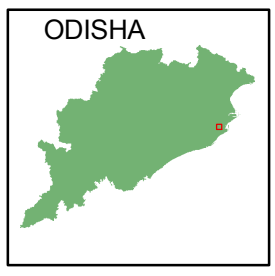
0 2

Scale in Km

INDEX TO SHEETS

73L06SE	73L10SW	73L10SE
73L07NE		73L11NE
73L07SE	73L11SW	73L11SE





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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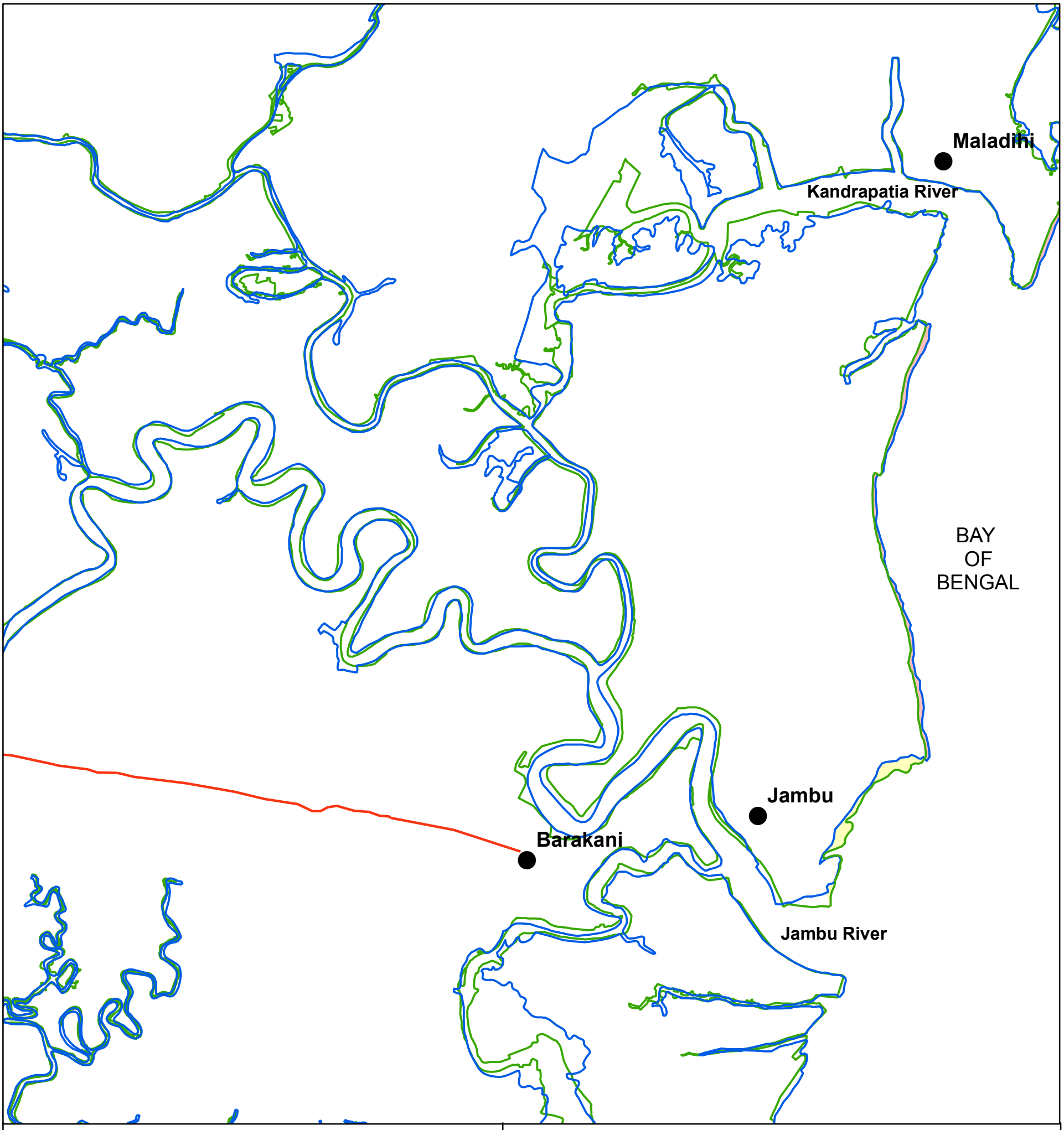
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

CUTTACK DISTRICT

SHEET NO. 73L11NE



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

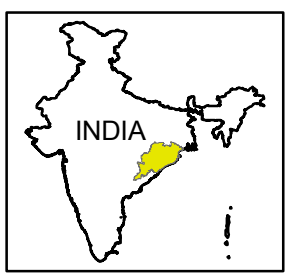
N
W E
S

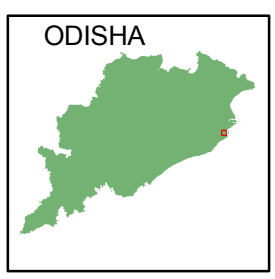
0 2

Scale in Km

INDEX TO SHEETS

73L10SW	73L10SE	73L14SW
73L11NW		73L15NW
73L11SW	73L11SE	73L15SW





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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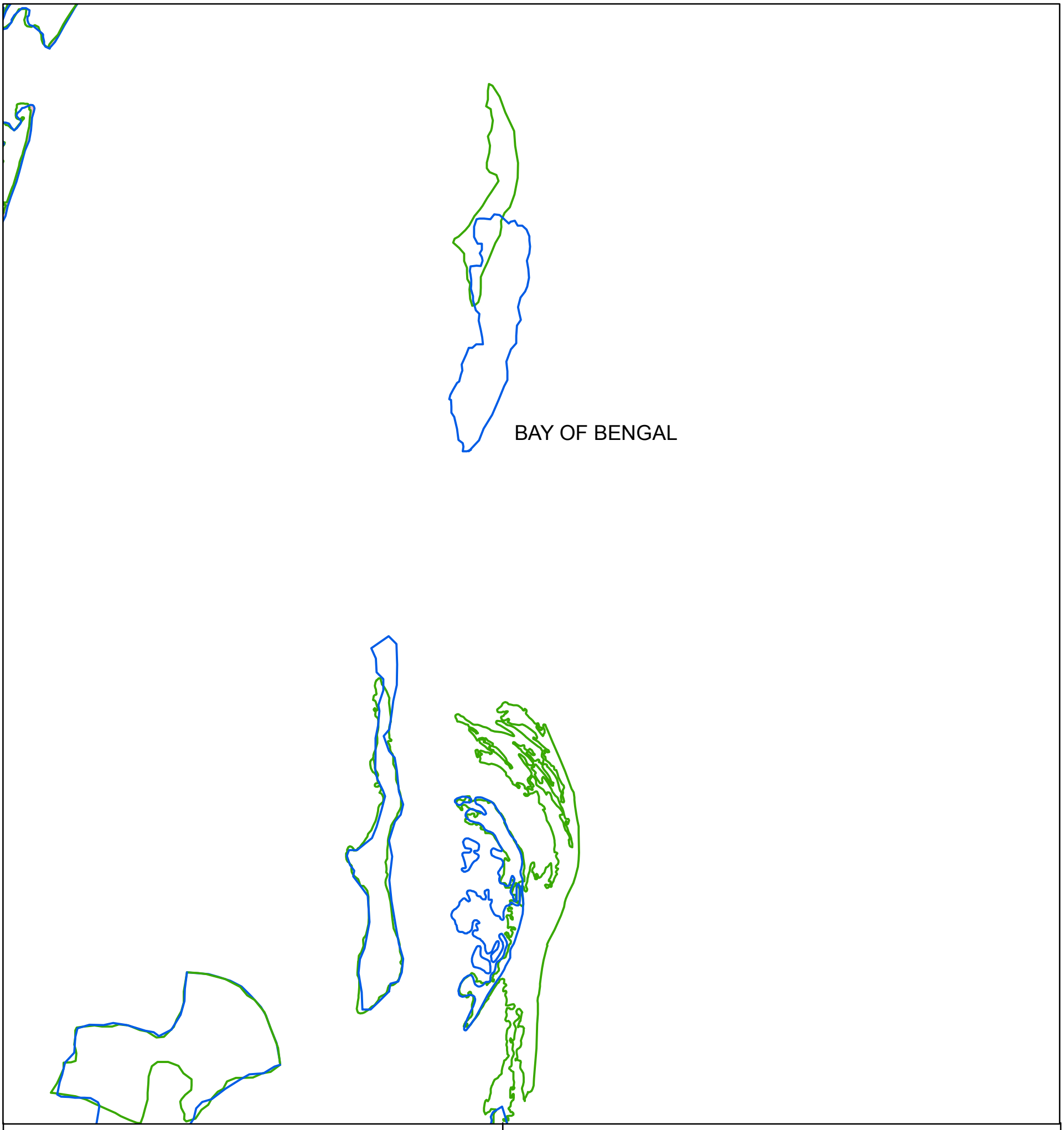
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

CUTTACK DISTRICT

SHEET NO. 73L15NW



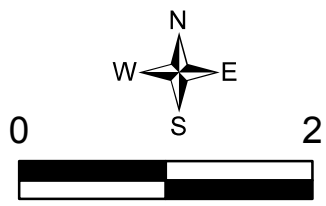
Legend

EROSION

ACCRETION

HIGH-TIDE LINE 2004-06

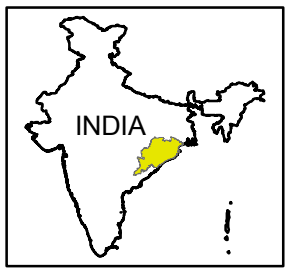
HIGH-TIDE LINE 1989-91



Scale in Km

INDEX TO SHEETS

73L10SE	73L14SW	73L14SE
73L11NE		SEA
73L11SE	73L15SW	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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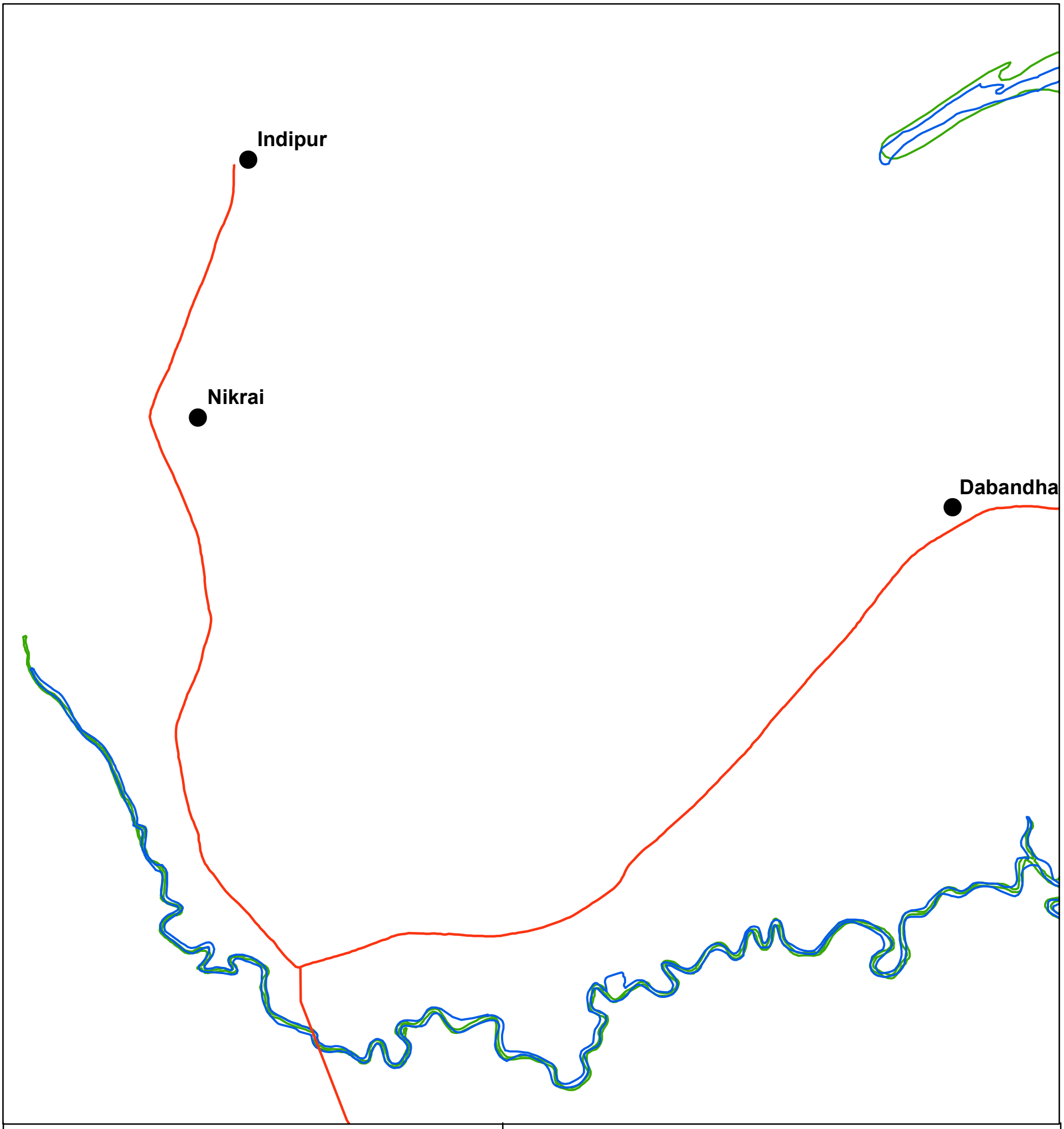
CUTTACK DISTRICT

SHEET NO. 73L06SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L06NW	73L06NE	73L10NW
73L06SW		73L10SW
73L07NW	73L07NE	73L11NW

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

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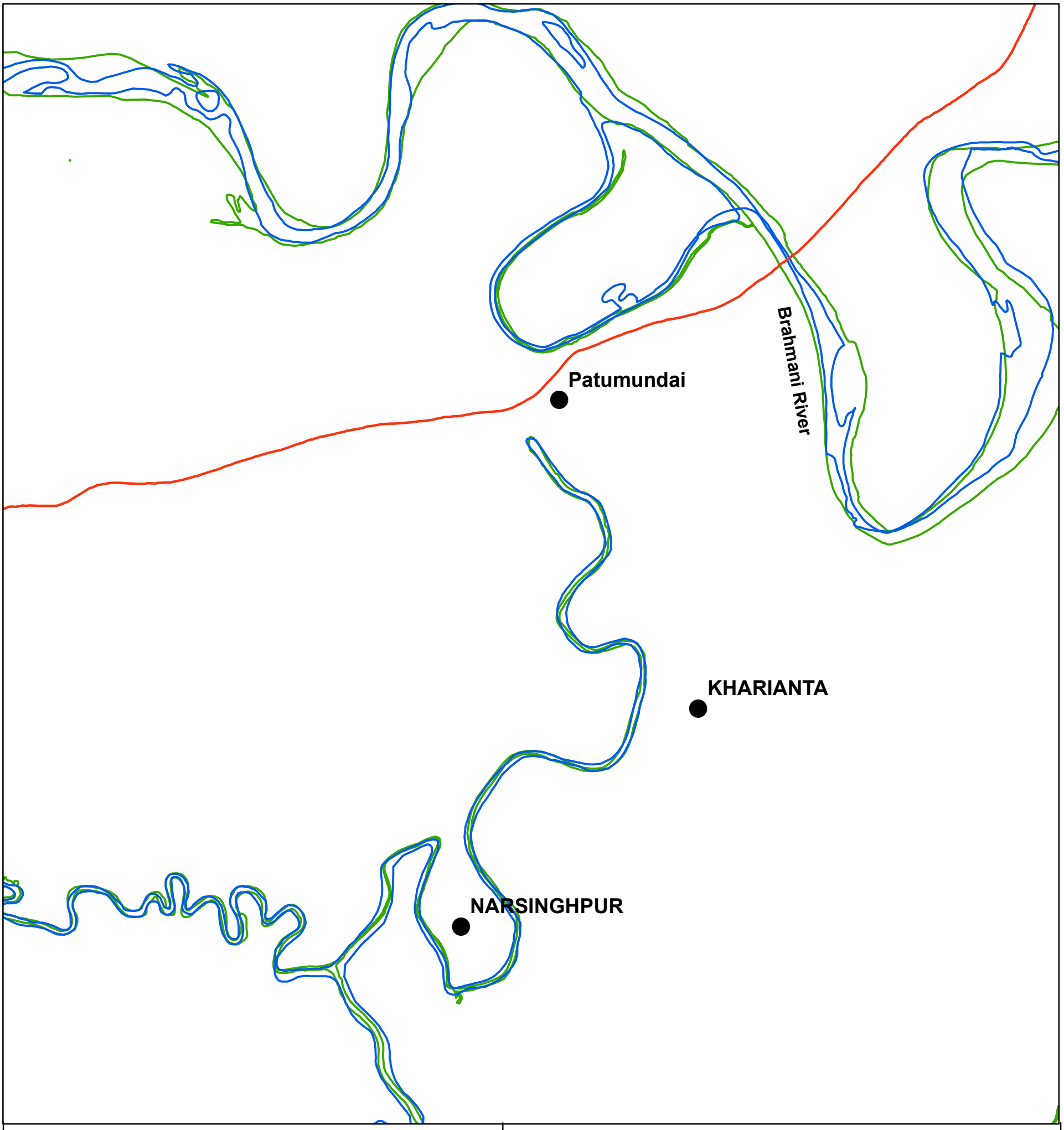
SHEET NO. 73L10SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

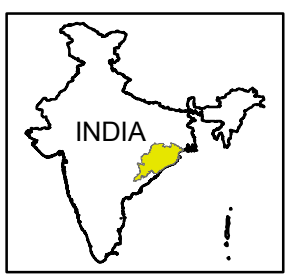
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L06NE	73L10NW	73L10NE
73L06SE		73L10SE
73L07NE	73L11NW	73L11NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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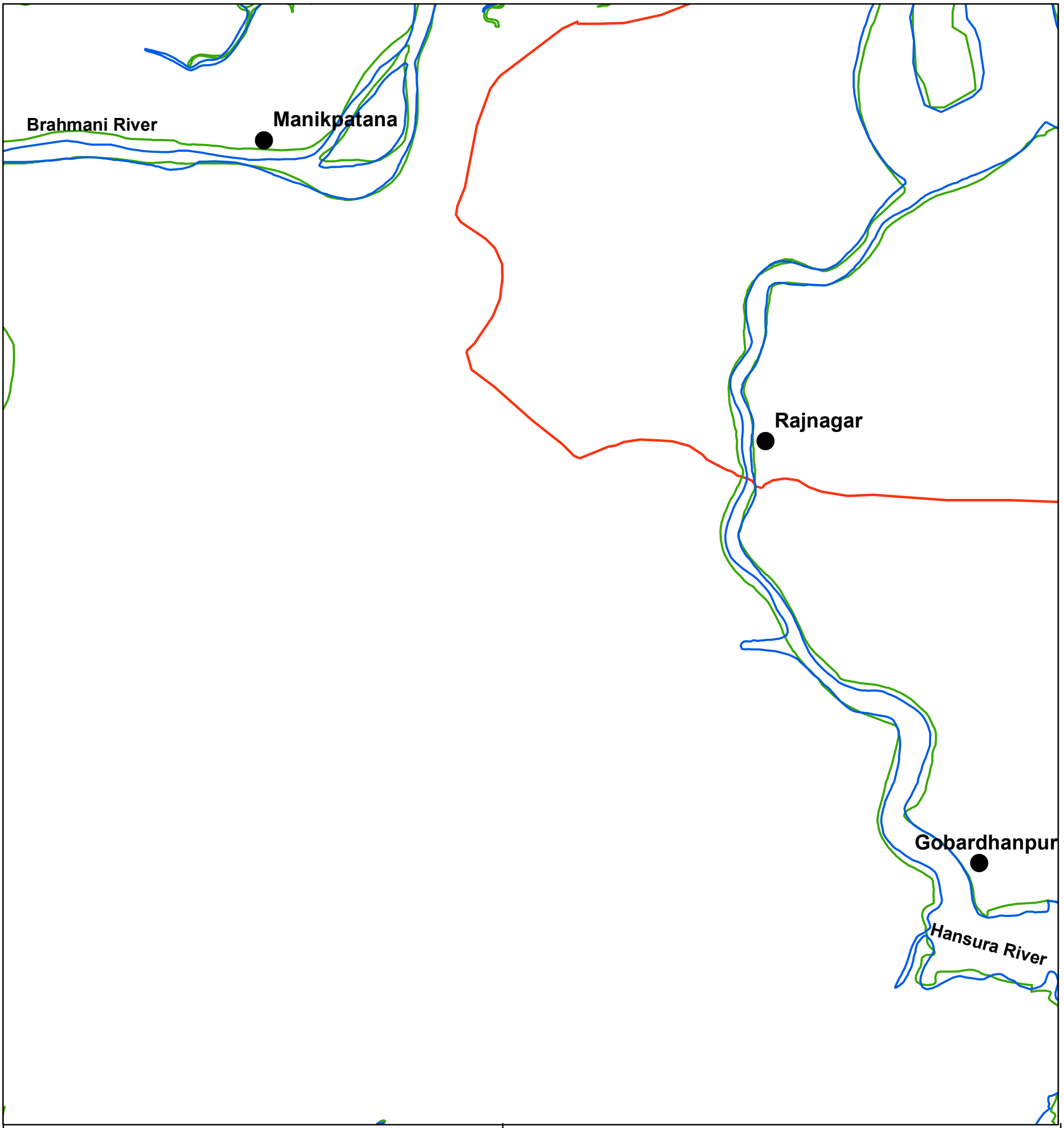
CUTTACK DISTRICT

SHEET NO. 73L10SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L10NW	73L10NE	73L14NW
73L10SW		73L14SW
73L11NW	73L11NE	73L15NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

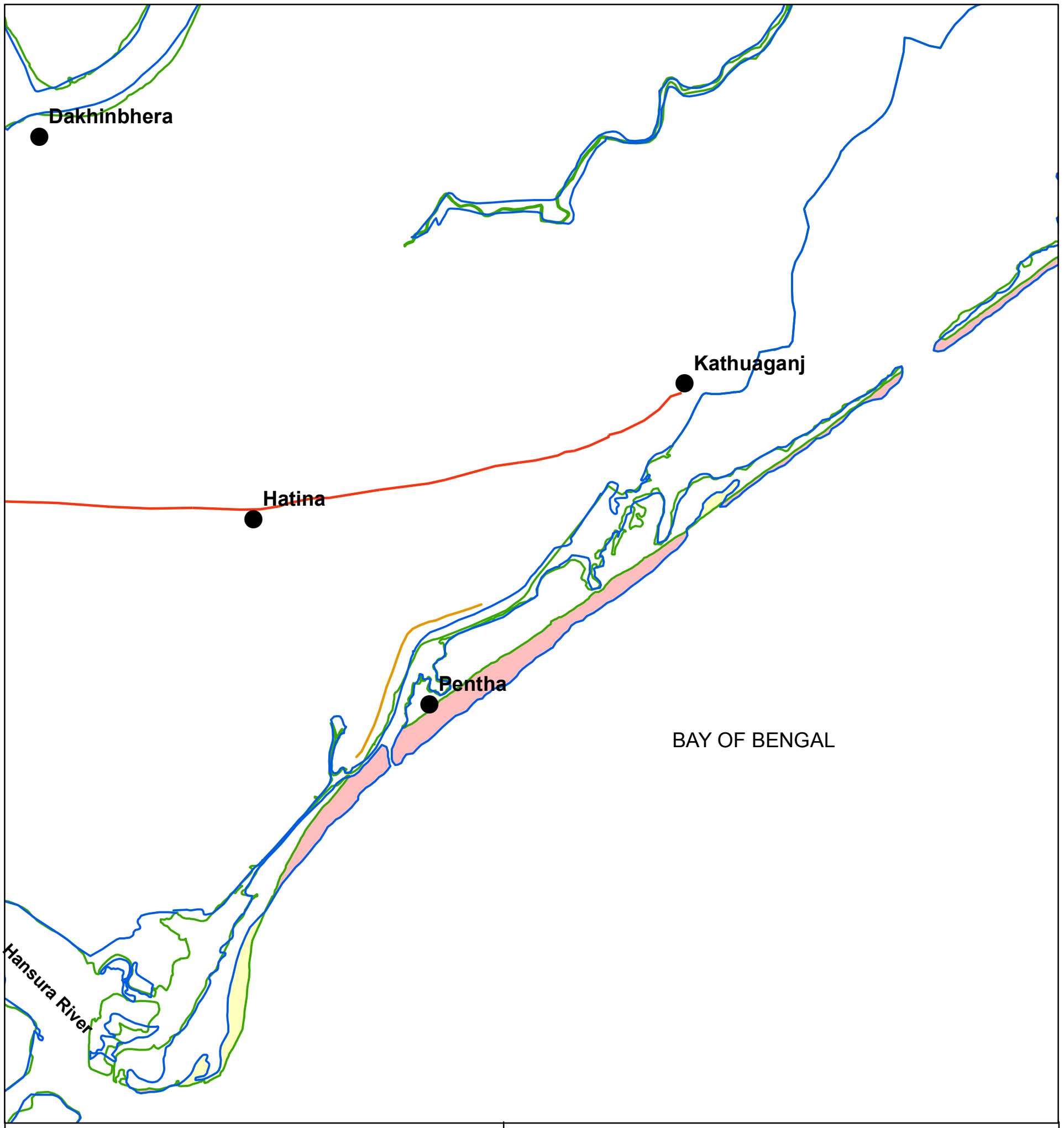
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

CUTTACK DISTRICT

SHEET NO. 73L14SW



Legend

- EROSION
- ACCRETION
- SEA WALL
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

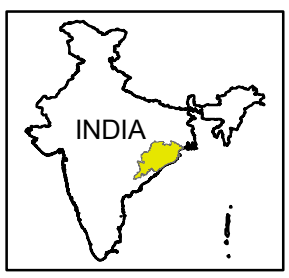
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L10NE	73L14NW	73L14NE
73L10SE		73L14SE
73L11NE	73L15NW	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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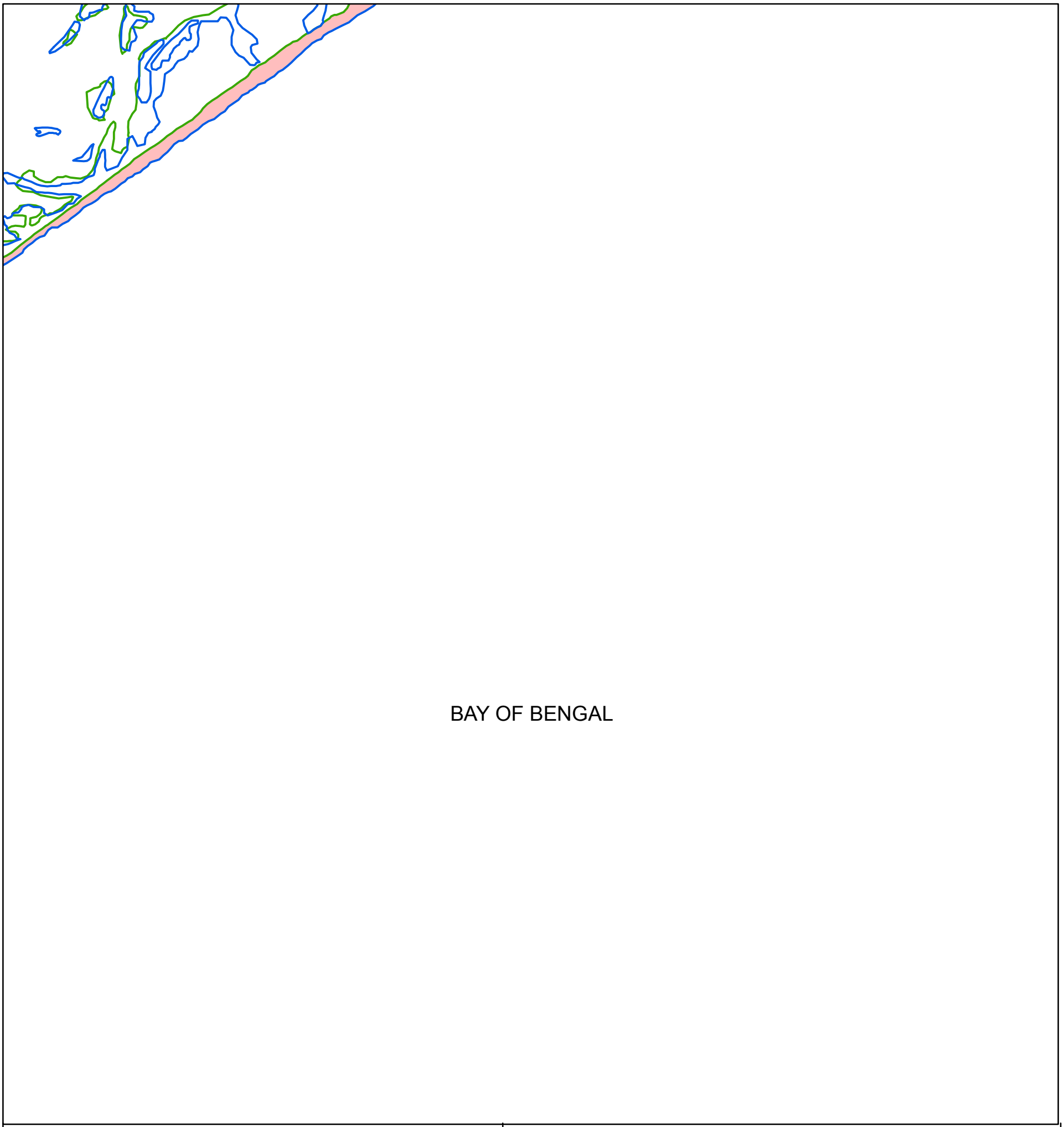
CUTTACK DISTRICT

SHEET NO. 73L14SE



Legend

EROSION

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

73L14NW	73L14NE	73P02NW
73L14SW		SEA
73L15NW	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

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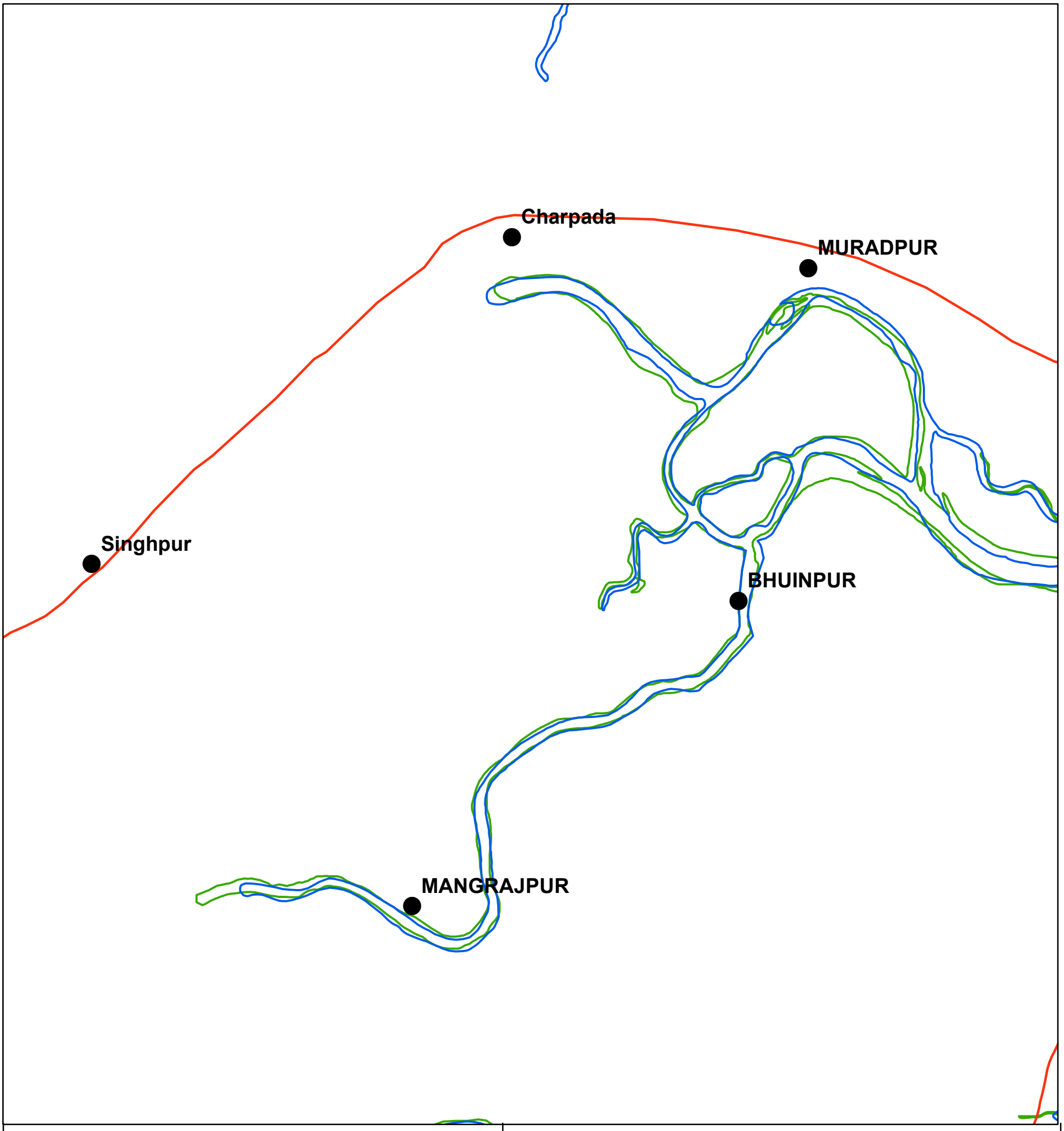
SHEET NO. 73L10NW



Legend

- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ROAD
- HABITATION

N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L05SE	73L09SW	73L09SE
73L06NE		73L10NE
73L06SE	73L10SW	73L10SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

CUTTACK DISTRICT

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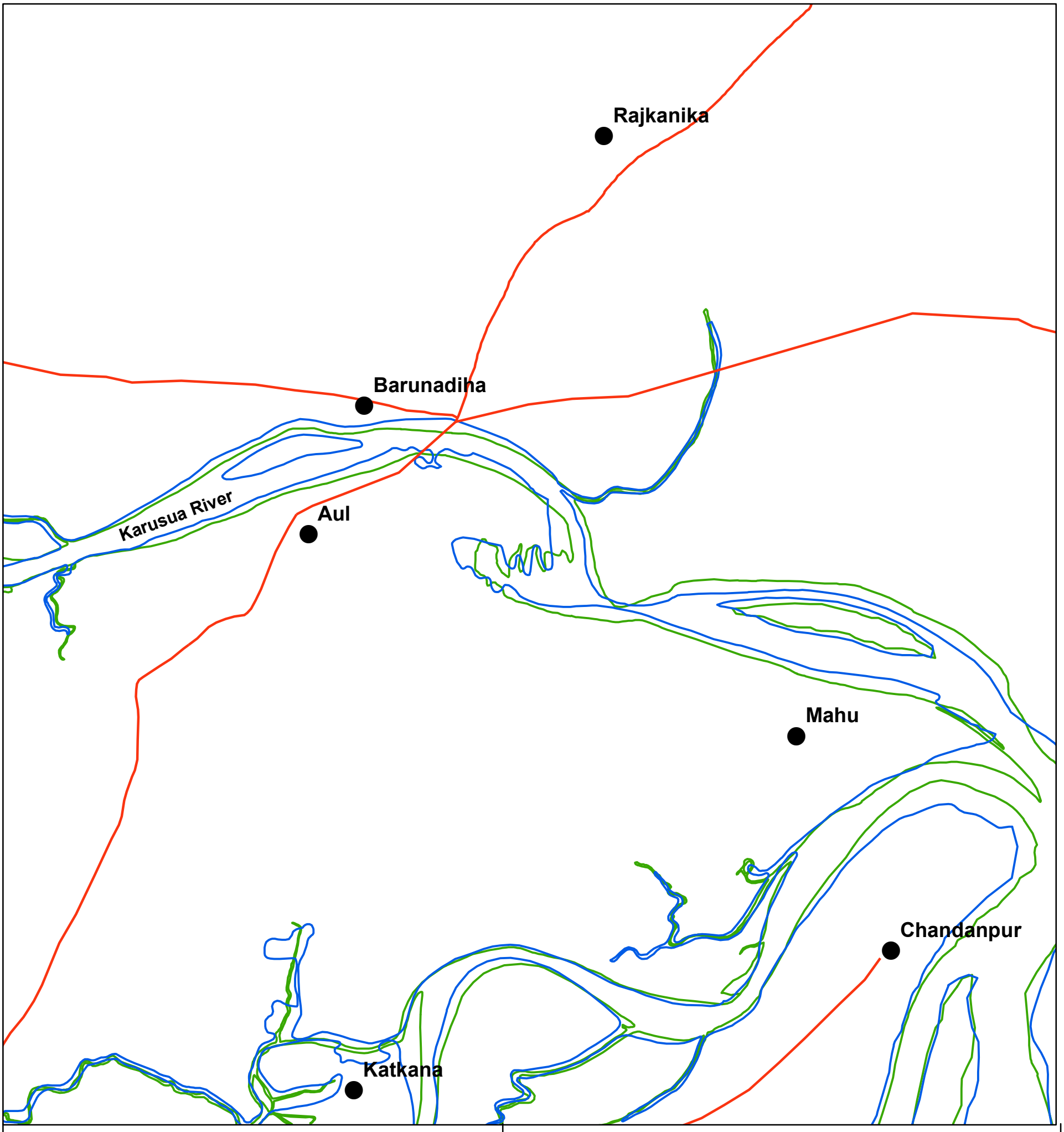
SHEET NO. 73L10NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

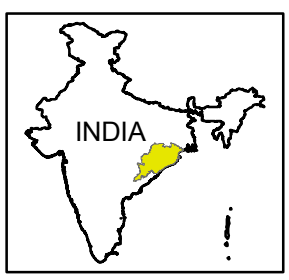
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L09SW	73L09SE	73L13SW
73L10NW		73L14NW
73L10SW	73L10SE	73L14SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

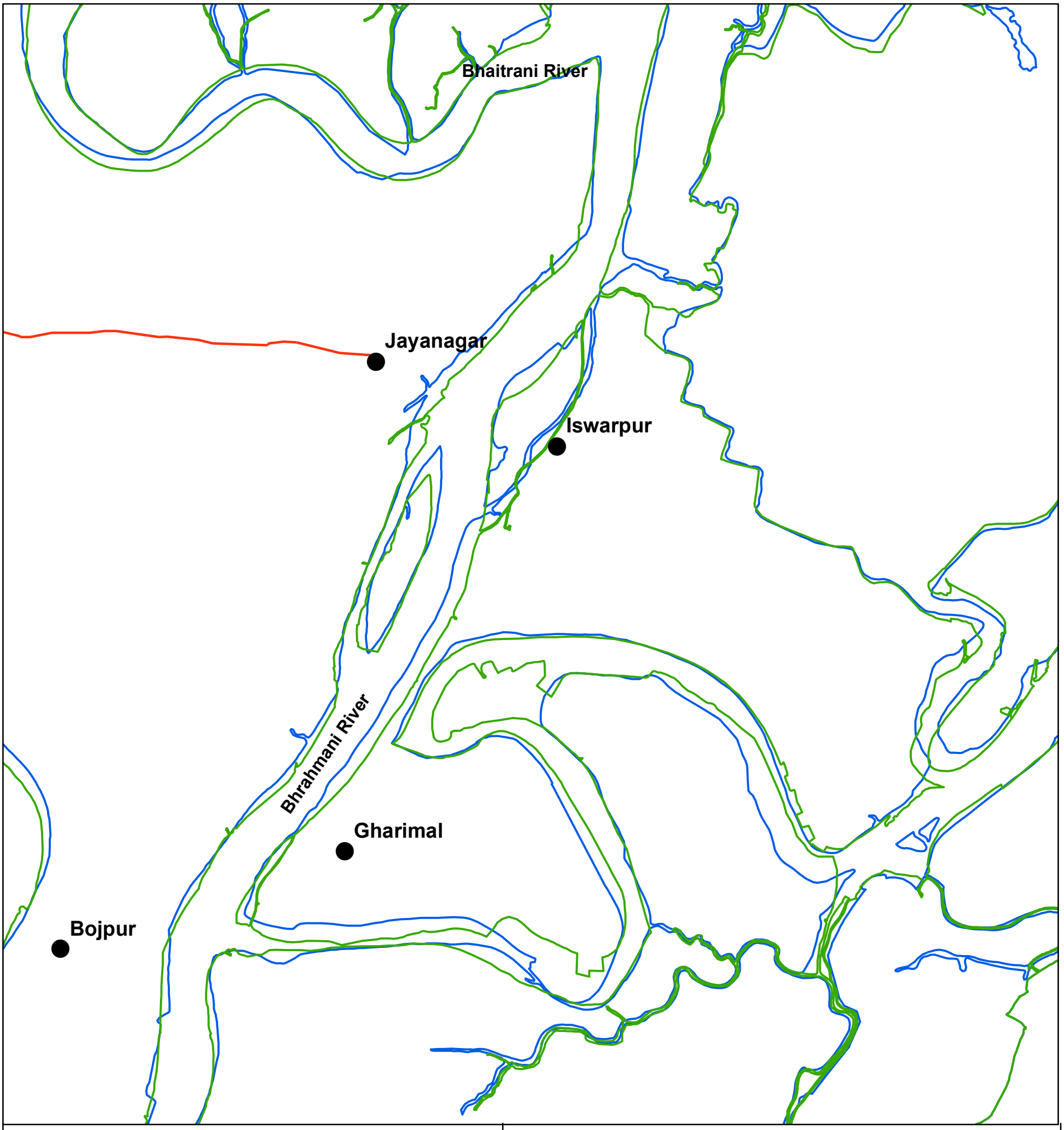
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

CUTTACK DISTRICT

SHEET NO. 73L14NW



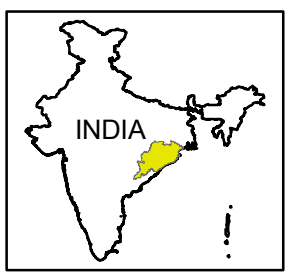
Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L09SE	73L13SW	73L13SE
73L10NE		73L14NE
73L10SE	73L14SW	73L14SE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

FOR OFFICIAL USE ONLY

ODISHA

CUTTACK DISTRICT

SHEET NO. 73L14NE

Kurma

Kerupal

Prabhati

Maipura River

BAY OF BENGAL

Legend

- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

73L13SW	73L13SE	73P01SW
73L14NW		73P02NW
73L14SW	73L14SE	SEA

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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CUTTACK DISTRICT

SHEET NO. 73P02NW

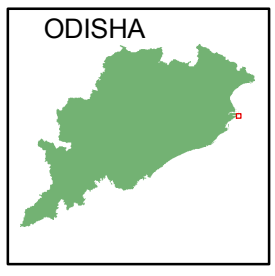
Legend

- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L13SE	73P01SW	SEA
73L14NE		SEA
73L14SE	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

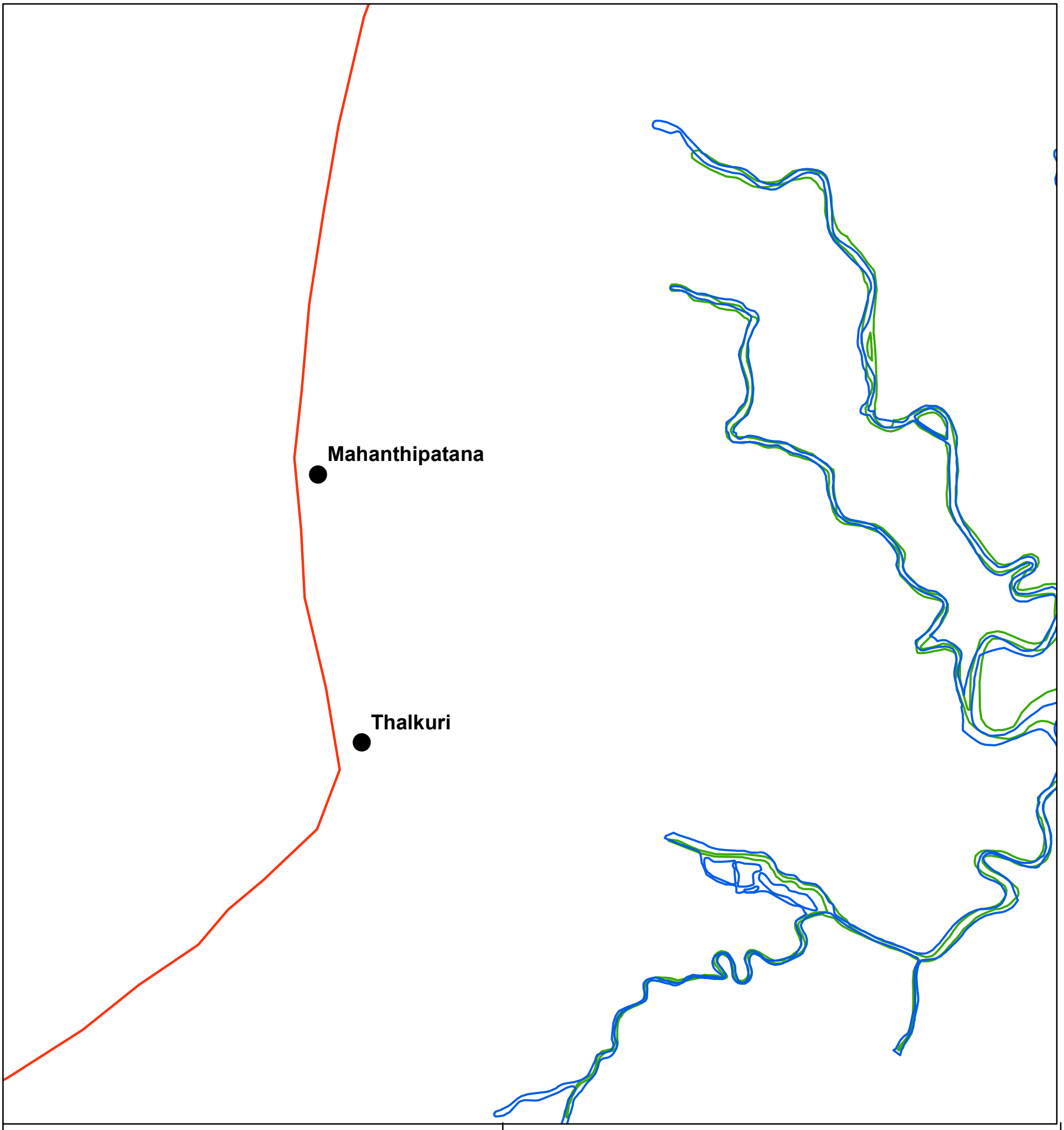
SHORELINE CHANGE MAP

FOR OFFICIAL USE ONLY

ODISHA

BALESHWAR/CUTTACK DISTRICTS

SHEET NO. 73L09SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L05NE	73L09NW	73L09NE
73L05SE		73L09SE
73L06NE	73L10NW	73L10NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

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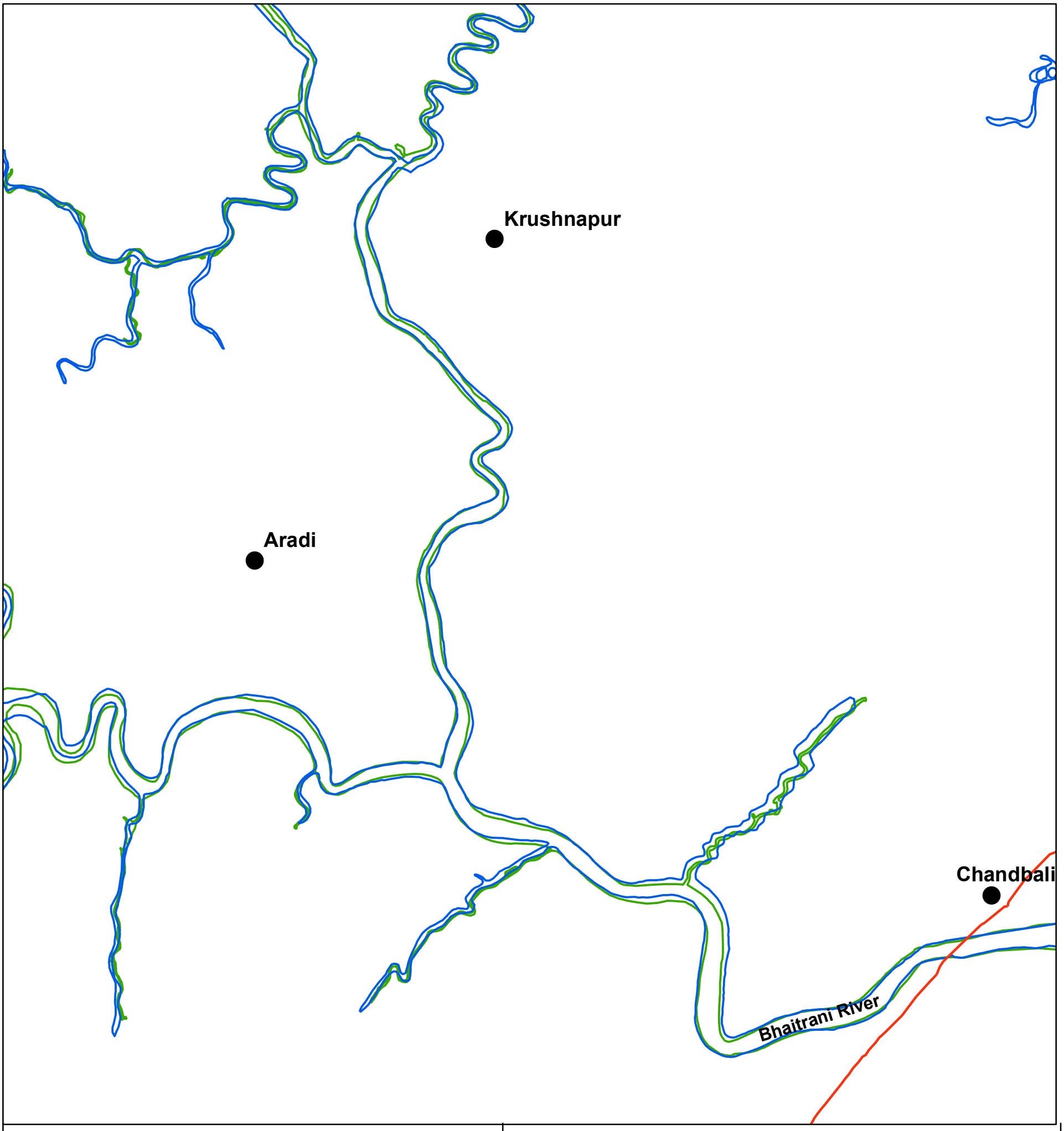
ODISHA

BALESHWAR/CUTTACK DISTRICTS

SHEET NO. 73L09SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73L09NW	73L09NE	73L13NW
73L09SW		73L13SW
73L10NW	73L10NE	73L14NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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BALESHWAR/CUTTACK DISTRICTS

SHEET NO. 73L13SW

Mato

Mrigayanayani

Chardia

Dhamra River

Bentalpur

Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

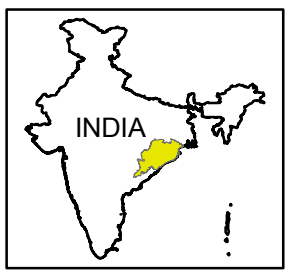
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L09NE	73L13NW	73L13NE
73L09SE		73L13SE
73L10NE	73L14NW	73L14NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

ODISHA

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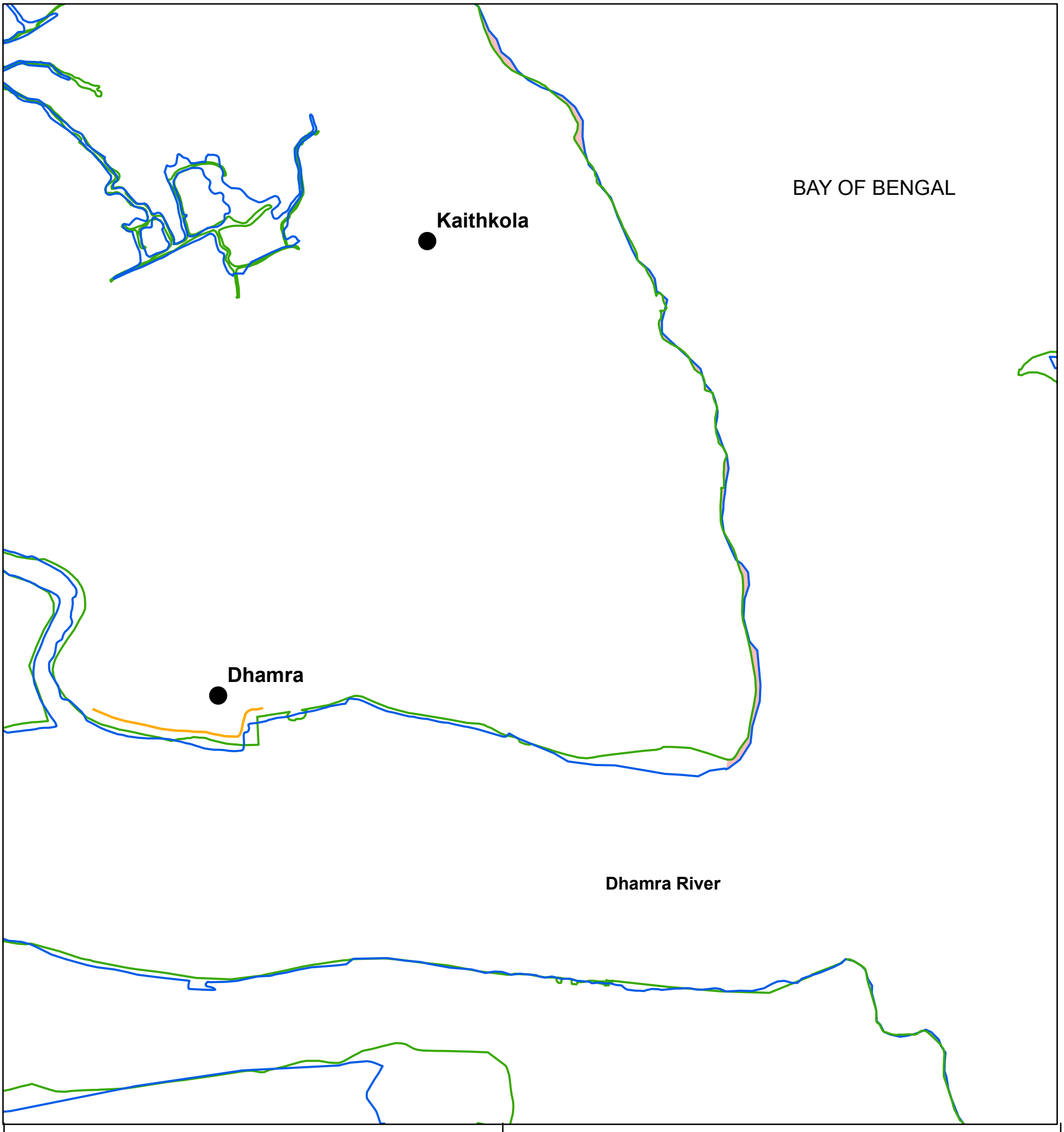
BALESHWAR/CUTTACK DISTRICTS

SHEET NO. 73L13SE



Legend

- EROSION
- ACCRETION
- SEA WALL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

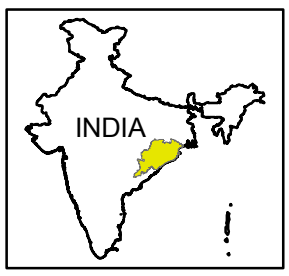
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73L13NW	73L13NE	SEA
73L13SW		73P01SW
73L14NW	73L14NE	73P02NW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ORISSA

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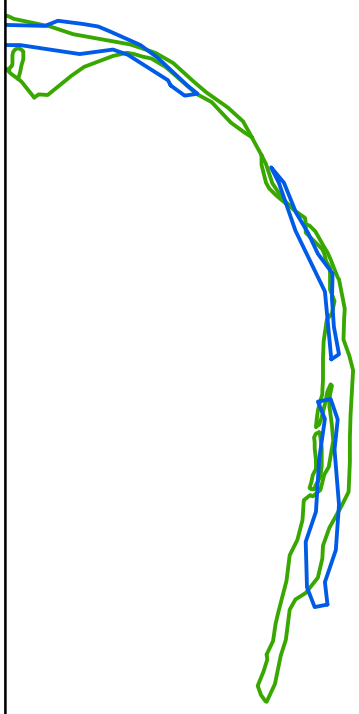
BALESHWAR/CUTTACK DISTRICTS

SHEET NO. 73P01SW

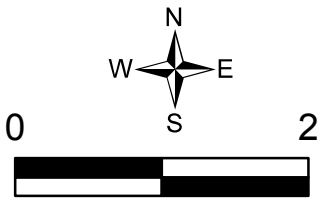


BAY OF BENGAL

Legend

HIGH-TIDE LINE 2004-06

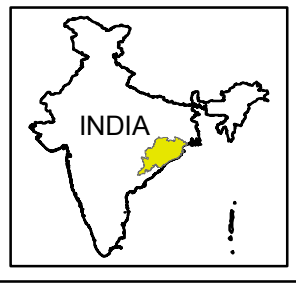
HIGH-TIDE LINE 1989-91



Scale in Km

INDEX TO SHEETS

73L13NE	SEA	SEA
73L13SE		SEA
73L14NE	73P02NW	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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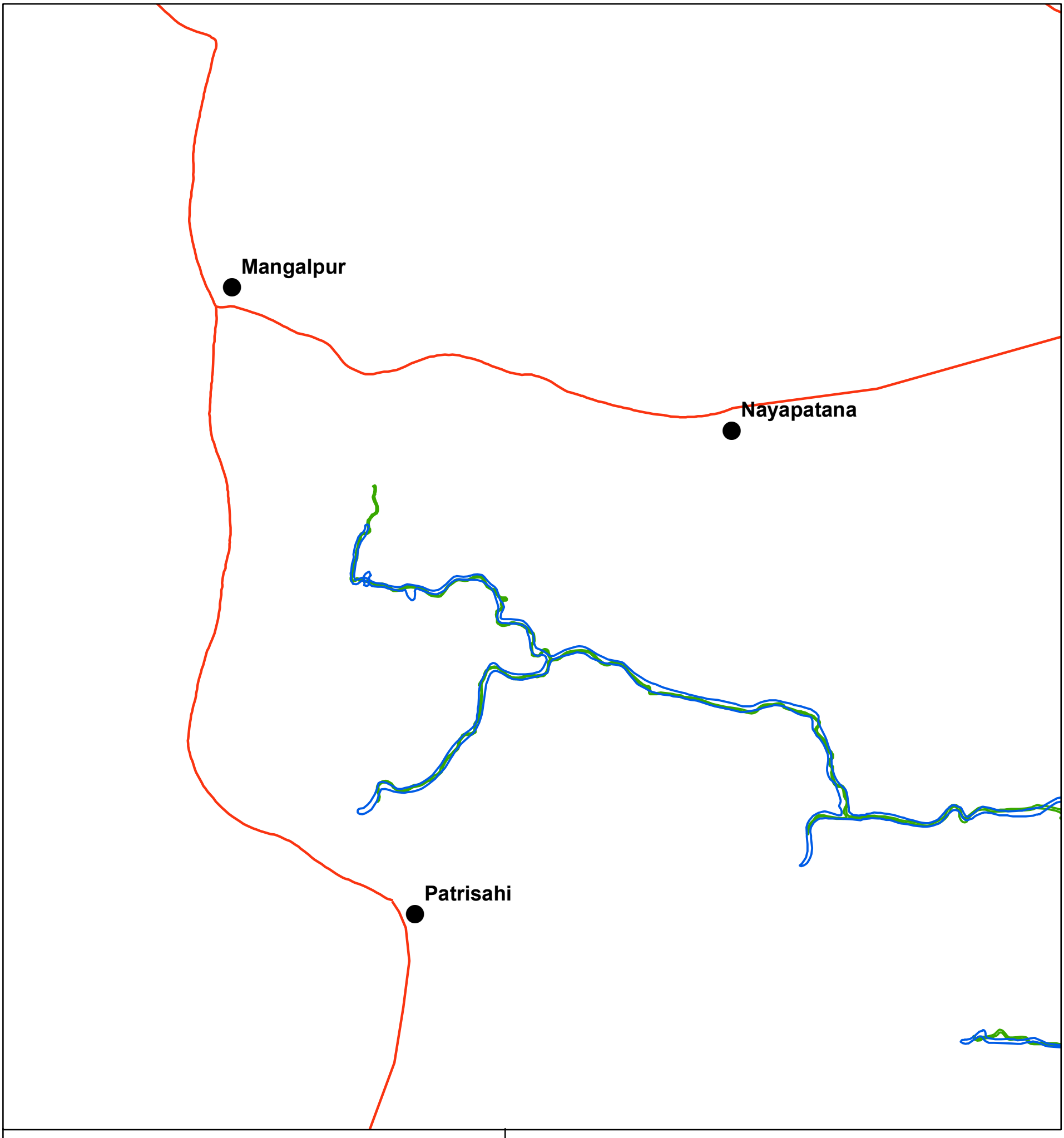
BALESHWAR DISTRICT

SHEET NO. 73L09NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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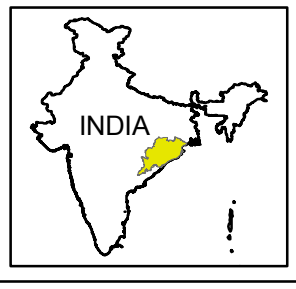
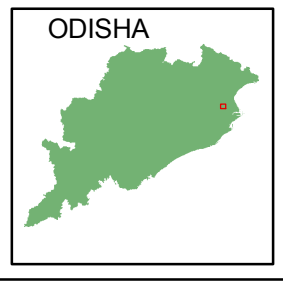
Scale in Km

INDEX TO SHEETS

73K08SE	73K12SW	73K12SE
73L05NE		73L09NE
73L05SE	73L09SW	73L09SE





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

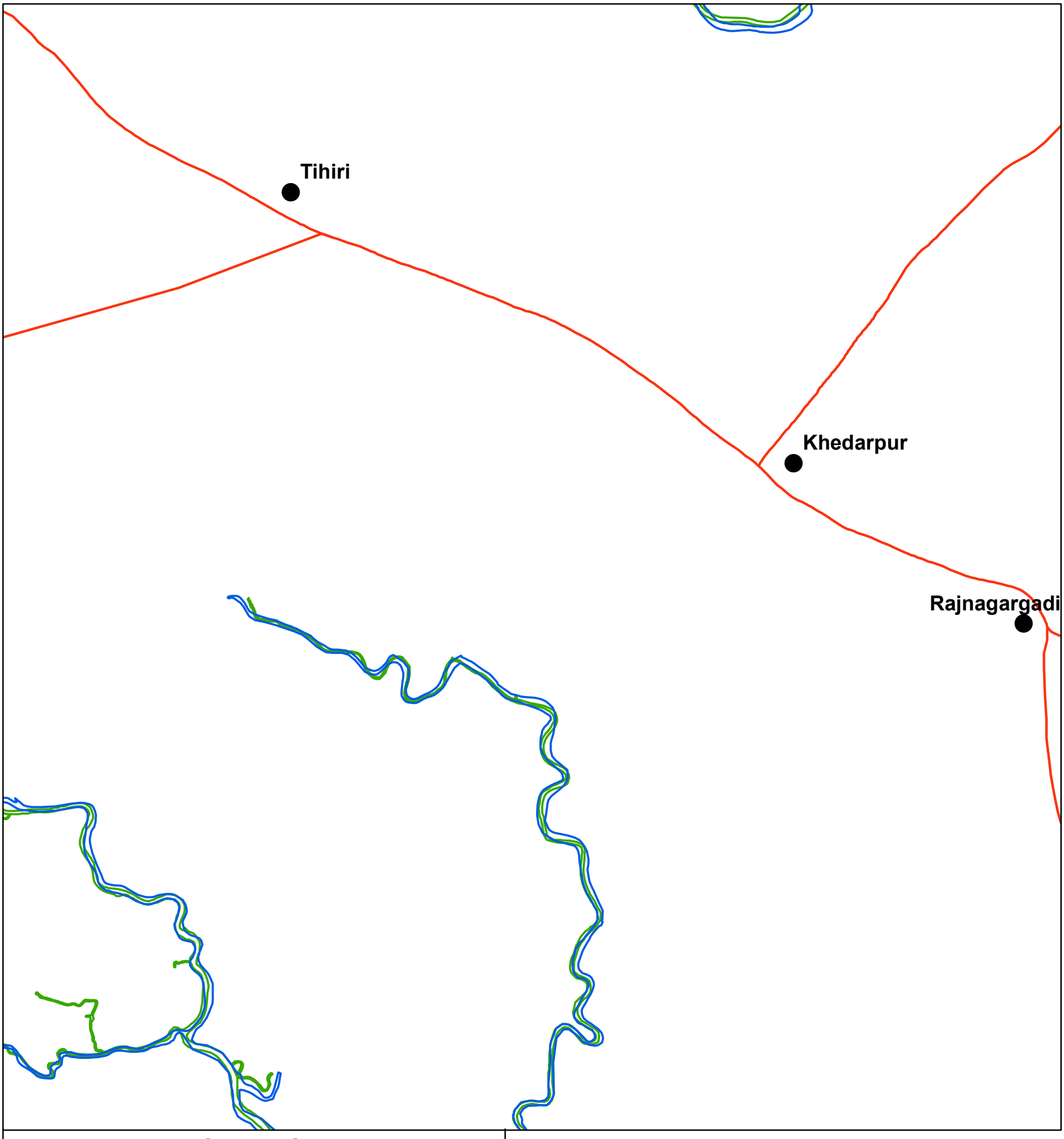
SHORELINE CHANGE MAP

ODISHA

BALESHWAR DISTRICT

FOR OFFICIAL USE ONLY

SHEET NO. 73L09NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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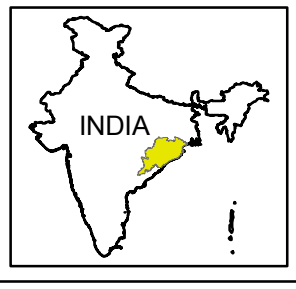
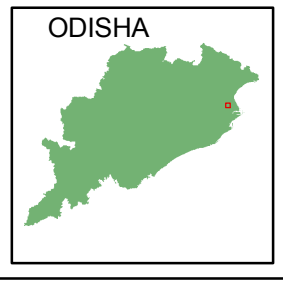
Scale in Km

INDEX TO SHEETS

73K12SW	73K12SE	73K16SW
73L09NW		73L13NW
73L09SW	73L09SE	73L13SW





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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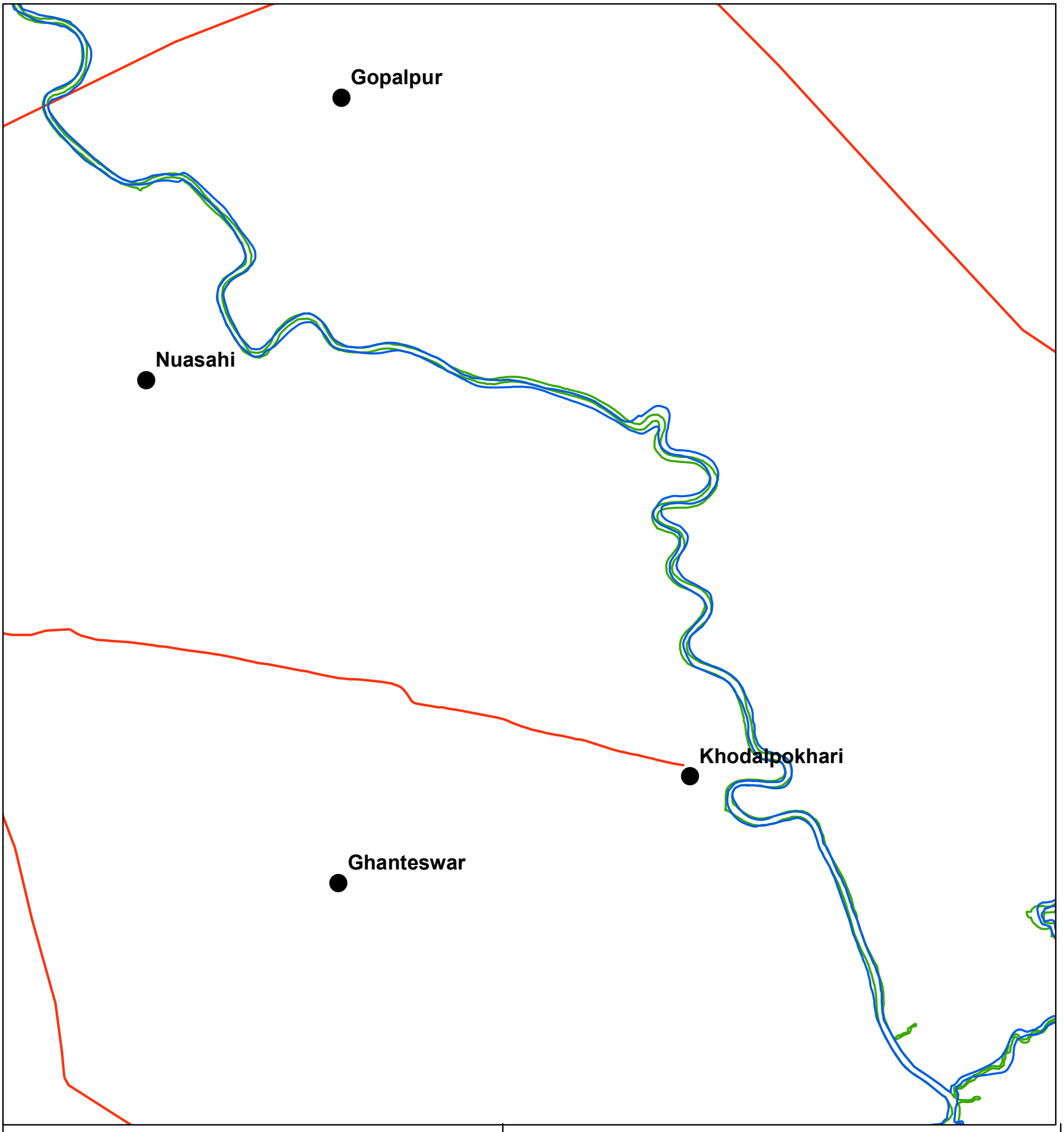
BALESHWAR DISTRICT

SHEET NO. 73L13NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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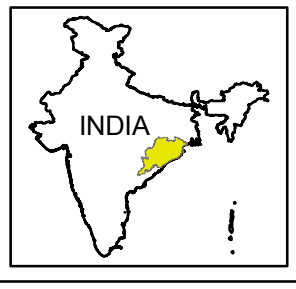
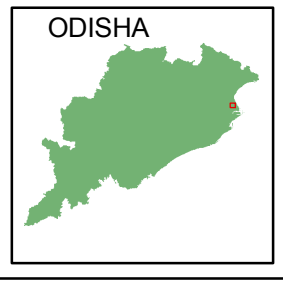
Scale in Km

INDEX TO SHEETS

73K12SE	73K16SW	73K16SE
73L09NE		73L13NE
73L09SE	73L13SW	73L13SE





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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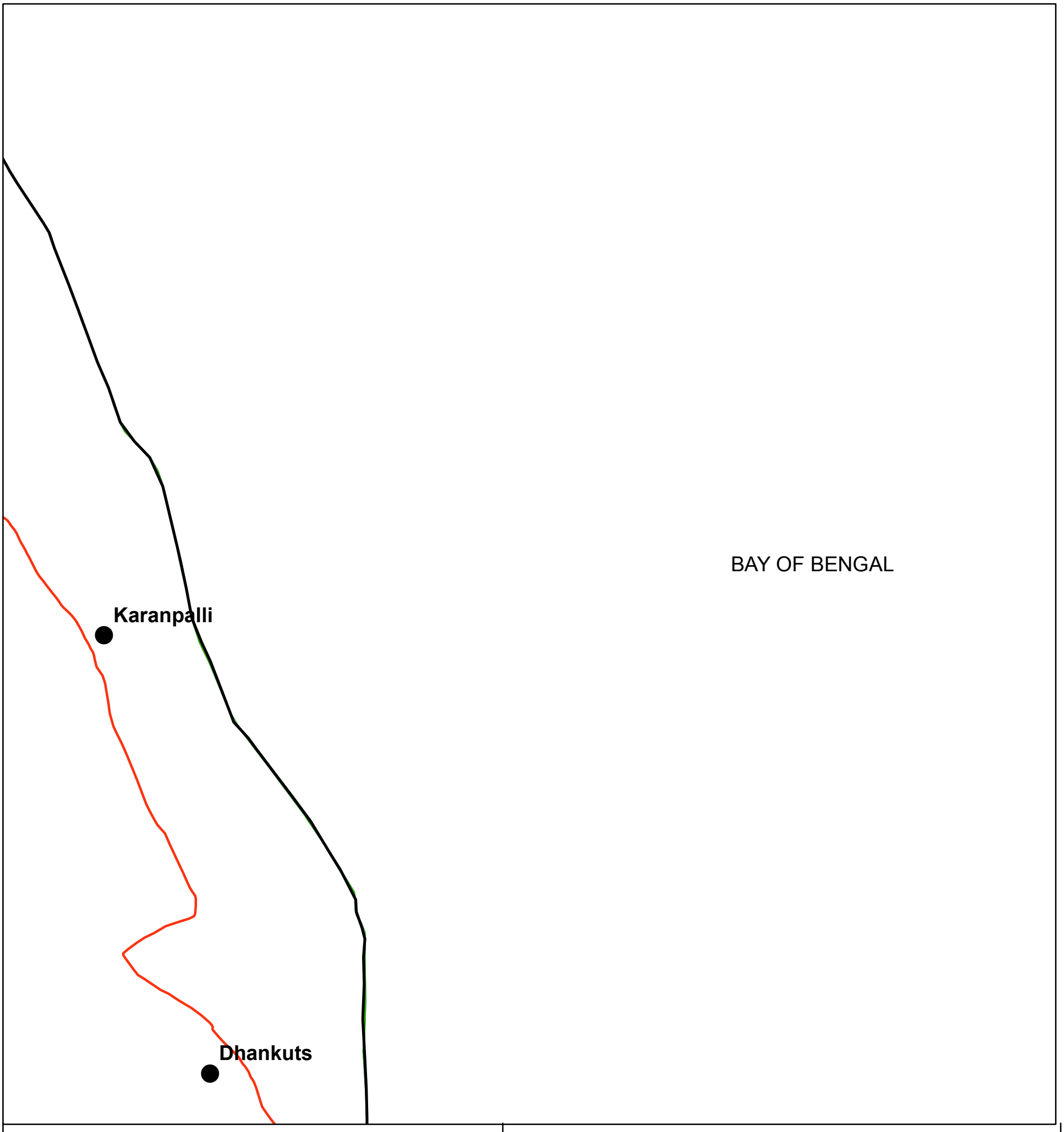
CUTTACK DISTRICT

SHEET NO. 73L13NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION
- STABLE

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W E
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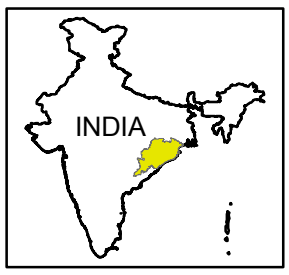
Scale in Km

INDEX TO SHEETS

73K16SW	73K16SE	SEA
73L13NW		SEA
73L13SW	73L13SE	73P01SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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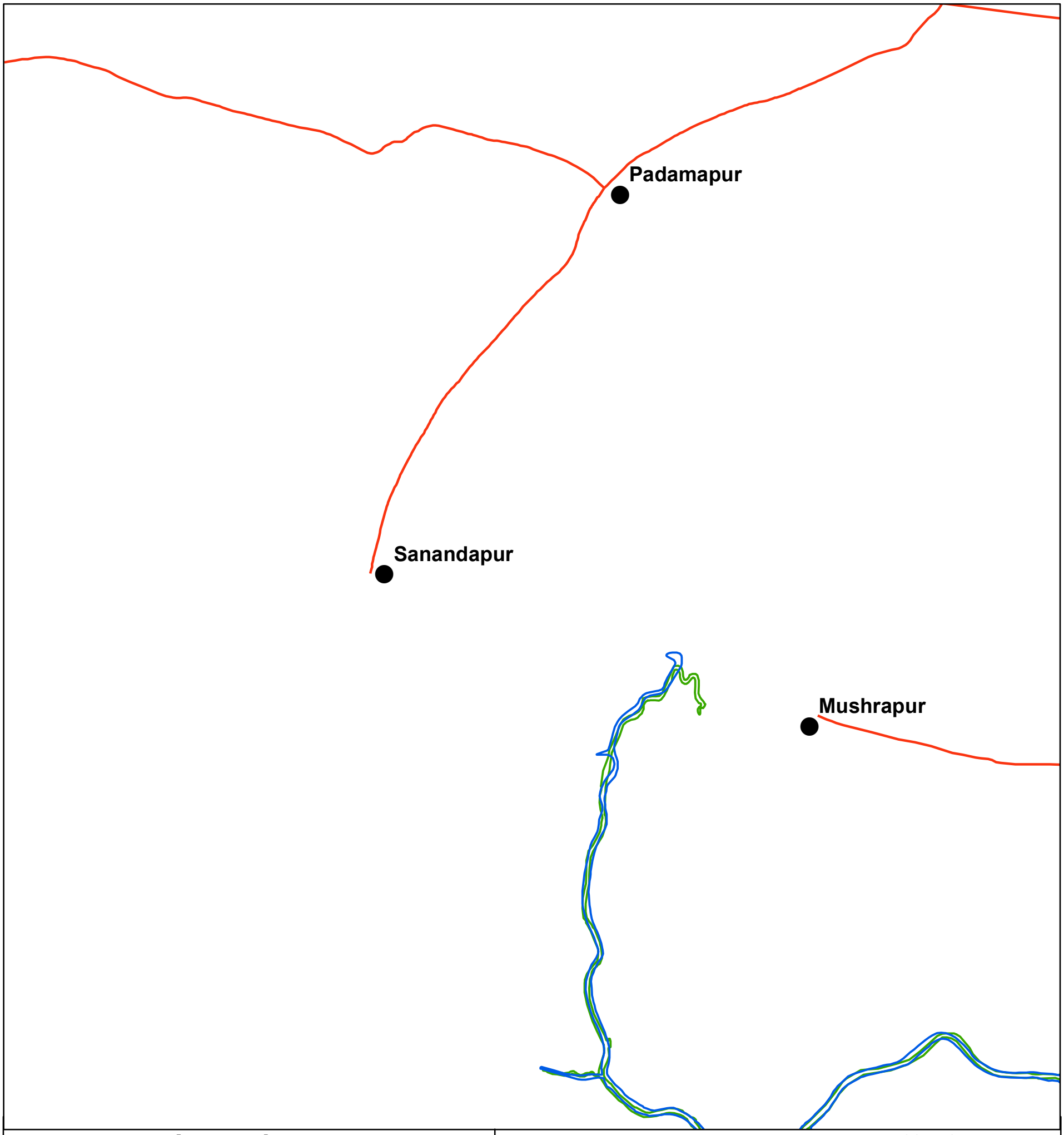
BALESHWAR

SHEET NO. 73K12SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

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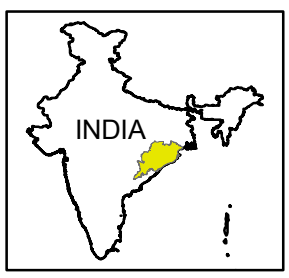
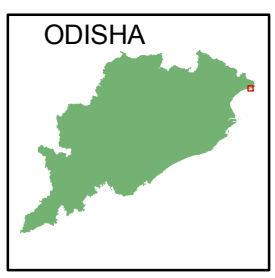
Scale in Km

INDEX TO SHEETS

73K12NW	73K12NE	73K16NW
73K12SW		73K16SW
73L09NW	73L09NE	73L13NW





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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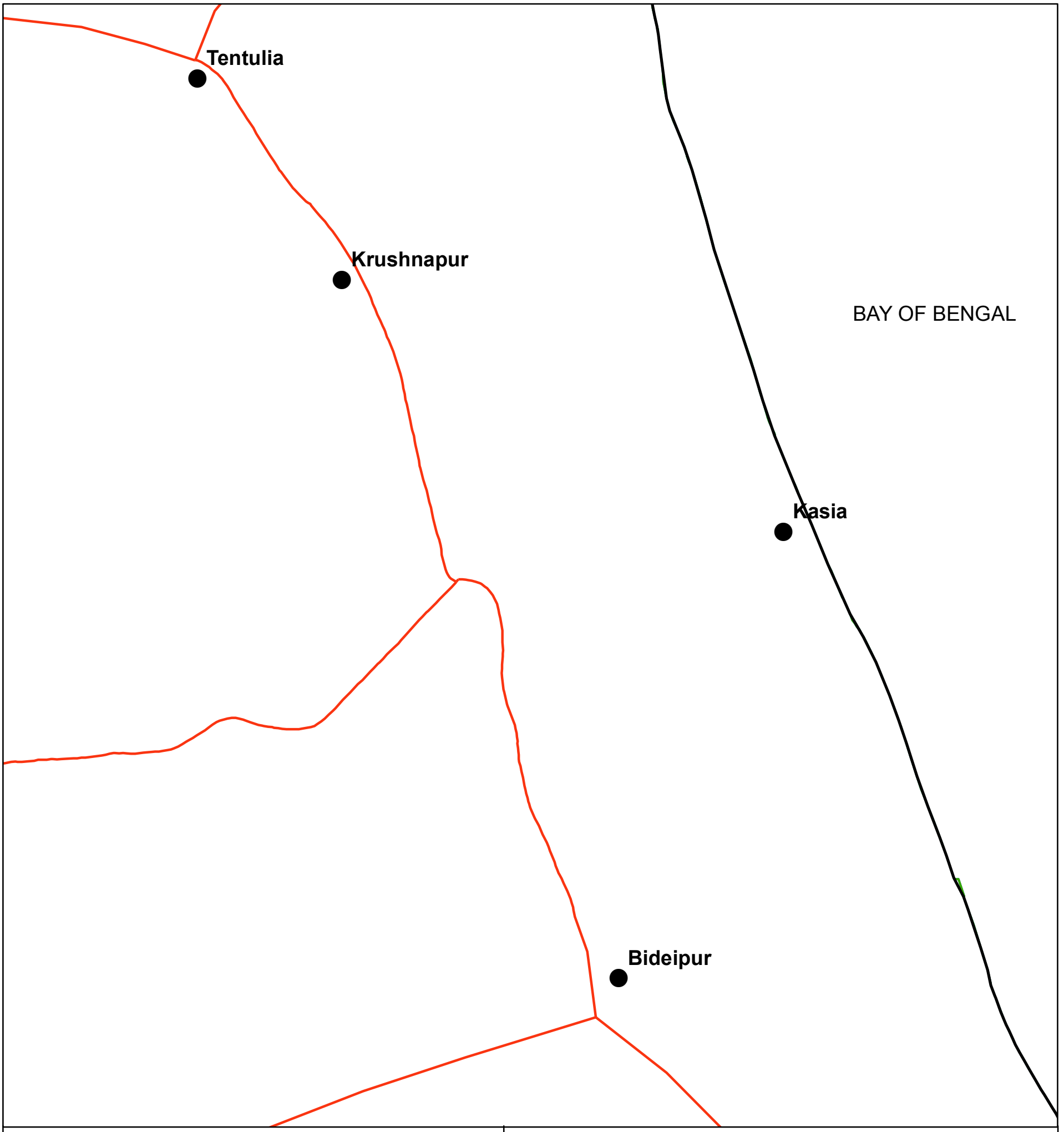
BALESHWAR DISTRICT

SHEET NO. 73K16SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION
- STABLE

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W E
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Scale in Km

INDEX TO SHEETS

73K12NE	73K16NW	SEA
73K12SE		SEA
73L09NE	73L13NW	73L13NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

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SHORELINE CHANGE MAP

ODISHA

BALESHWAR DISTRICT

FOR OFFICIAL USE ONLY

SHEET NO. 73K16SE

BAY OF BENGAL

Legend

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

STABLE

N

W E

S

0 2

Scale in Km

INDEX TO SHEETS

73K16NW	SEA	SEA
73K16SW		SEA
73L13NW	73L13NE	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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BALESHWAR DISTRICT

SHEET NO. 73K16NW

Abhana

Anantpur

Mohanpur

Kantiachara

BAY OF BENGAL

Gamai River

Chudamani

Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION
- STABLE

N

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Scale in Km

INDEX TO SHEETS

73K11SE	73K15SW	73K15SE
73K12NE		SEA
73K12SE	73K16SW	73K16SE

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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BALESHWAR DISTRICT

SHEET NO. 73K15SW

BAHANAGA

GOPALPUR

Talakurunia

Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N

W E

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Scale in Km

INDEX TO SHEETS

73K11NE	73K15NW	73K15NE
73K11SE		73K15SE
73K12NE	73K16NW	SEA

INDIA

ODISHA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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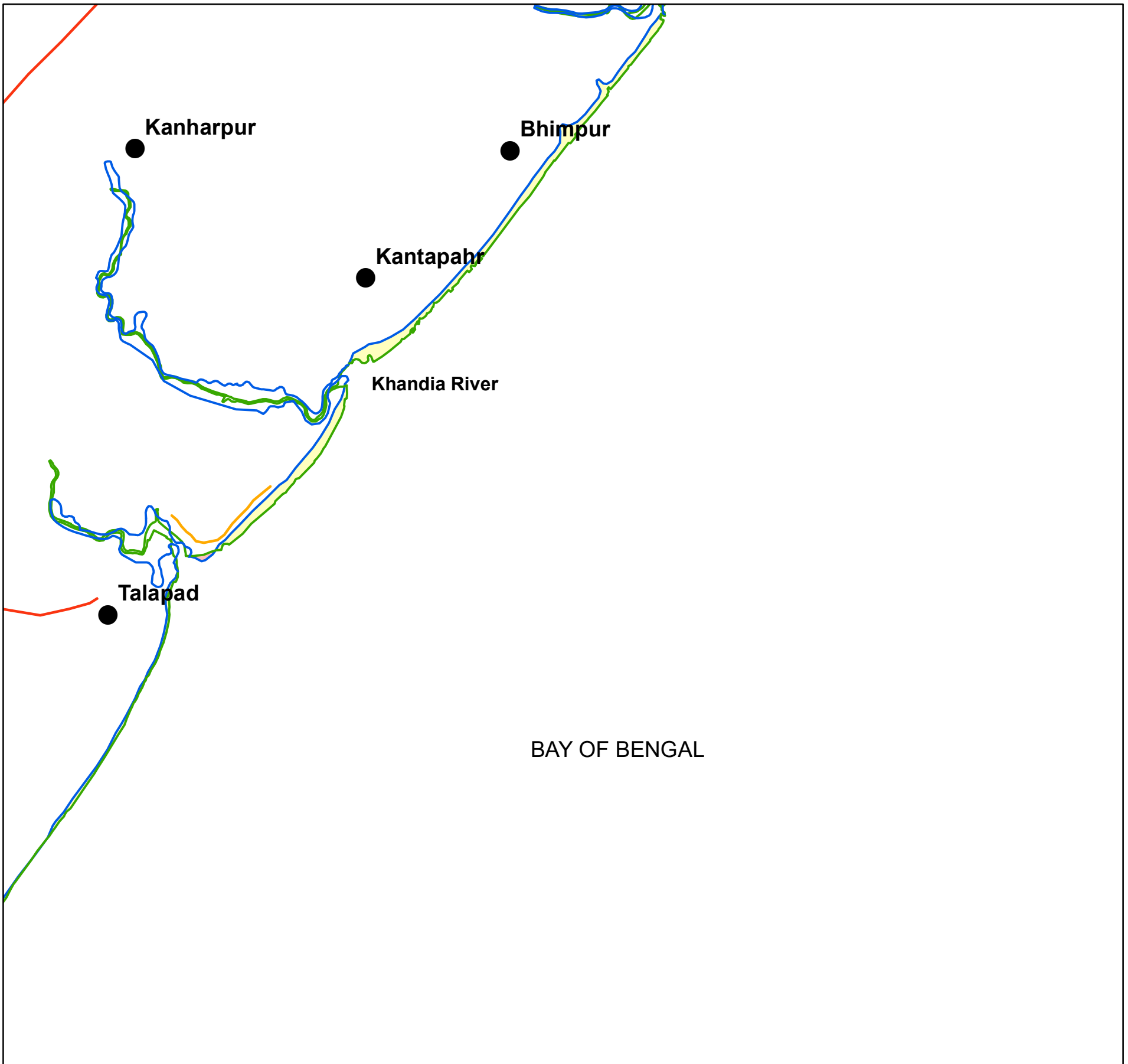
BALESHWAR DISTRICT

SHEET NO. 73K15SE



Legend

- EROSION
- ACCRETION
- SEA WALL
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

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W E
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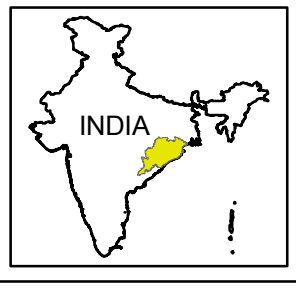
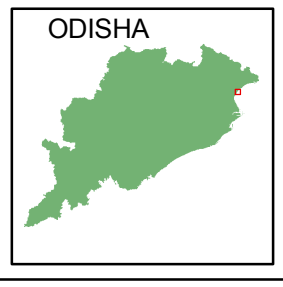
Scale in Km

INDEX TO SHEETS

73K15NW	73K15NE	73O03NW
73K15SW		SEA
73K16NW	73K16NE	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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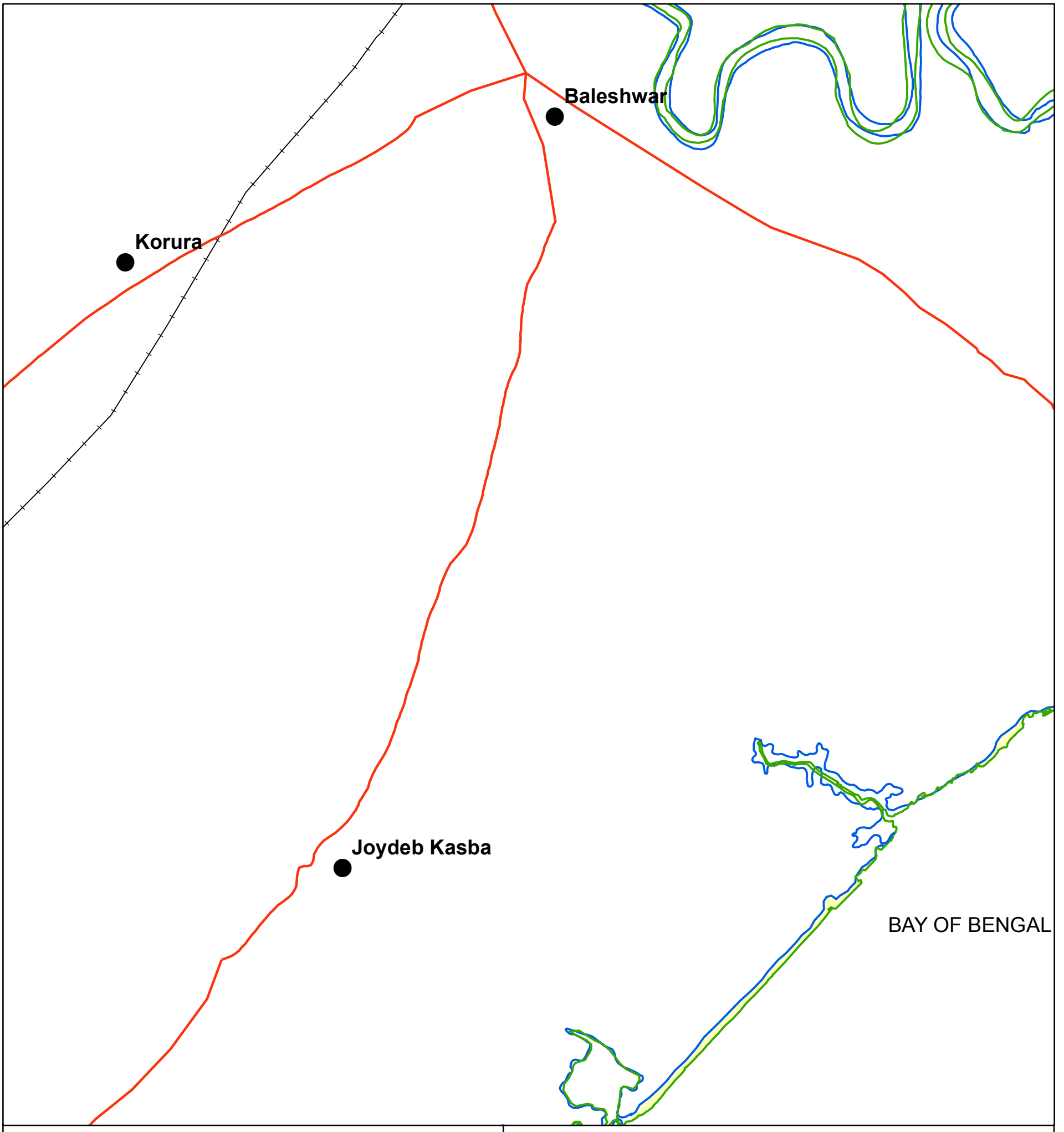
BALESHWAR DISTRICT

SHEET NO. 73K15NE



Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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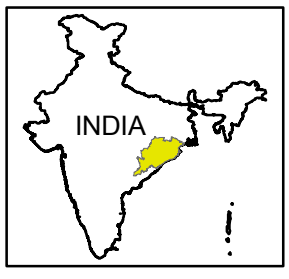
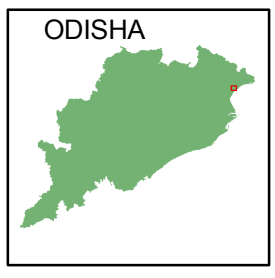
Scale in Km

INDEX TO SHEETS

73K14SW	73K14SE	73O02SW
73K15NW		73O03NW
73K15SW	73K15SE	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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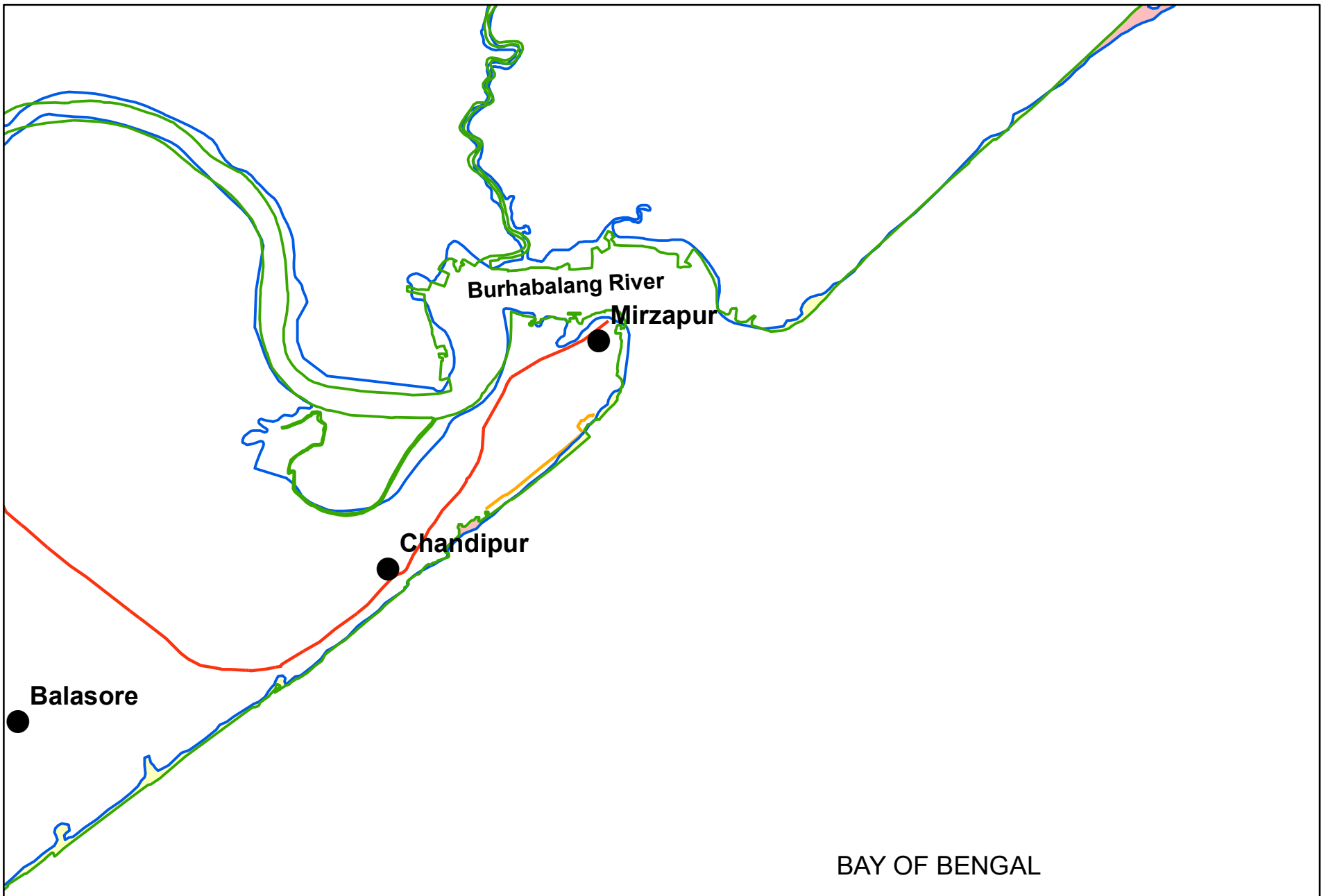
SHORELINE CHANGE MAP

ODISHA

BALESHWAR DISTRICT

FOR OFFICIAL USE ONLY

SHEET NO. 73O03NW



Legend

- EROSION
- ACCRETION
- SEA WALL
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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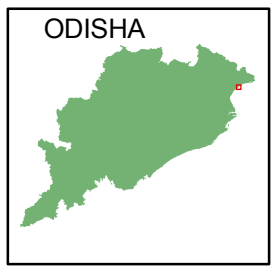
Scale in Km

INDEX TO SHEETS

73K14SE	73O02SW	73O02SE
73K15NE		SEA
73K15SE	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
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SHORELINE CHANGE MAP

ODISHA

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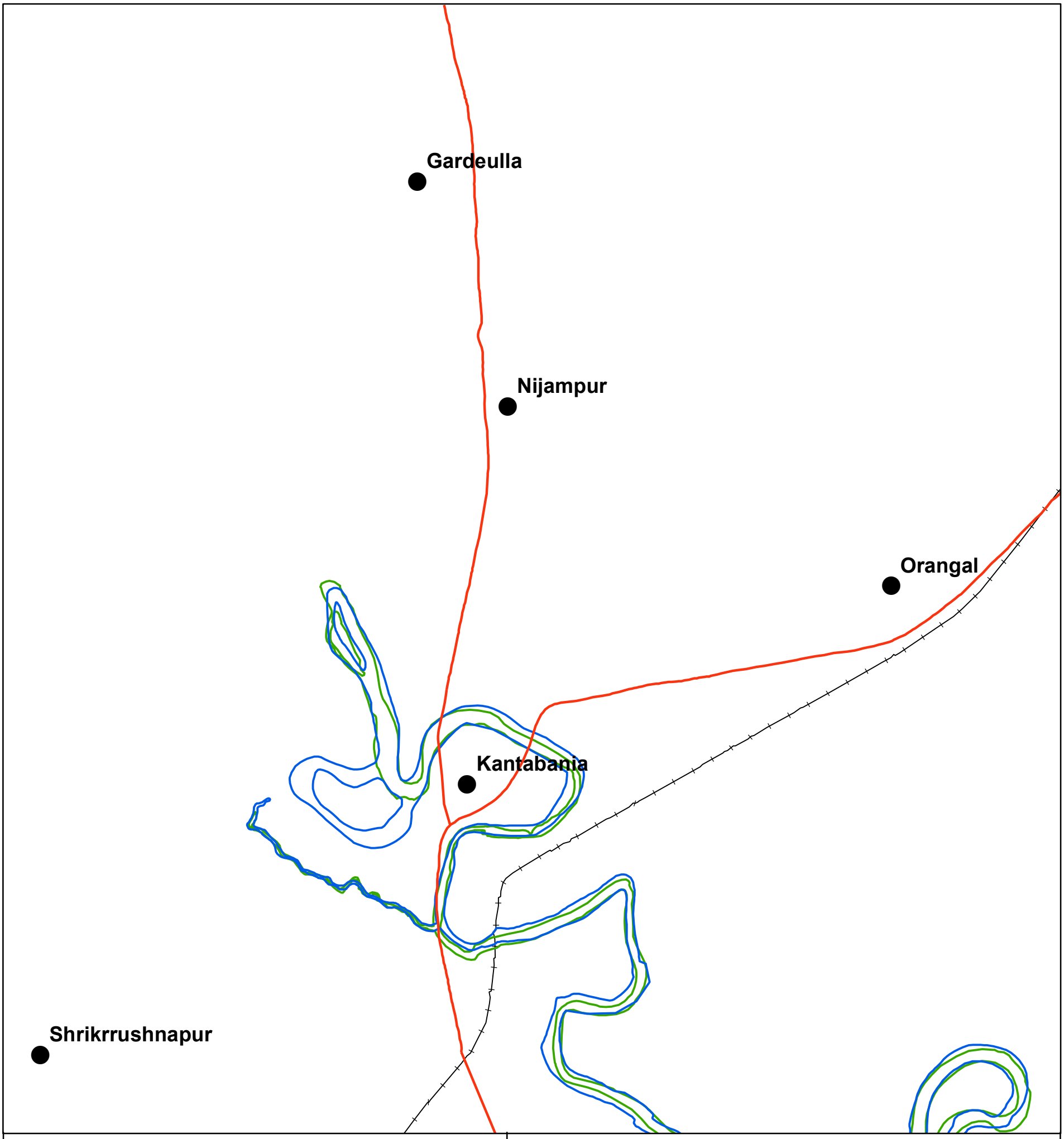
BALESHWAR/MAYURBHANJ DISTRICTS

SHEET NO. 73K14SE



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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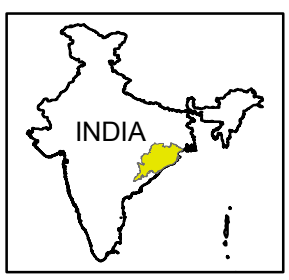
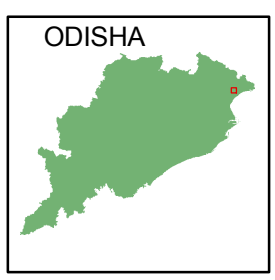
Scale in Km

INDEX TO SHEETS

73K14NW	73K14NE	73O02NW
73K14SW		73O02SW
73K15NW	73K15NE	73O03NW





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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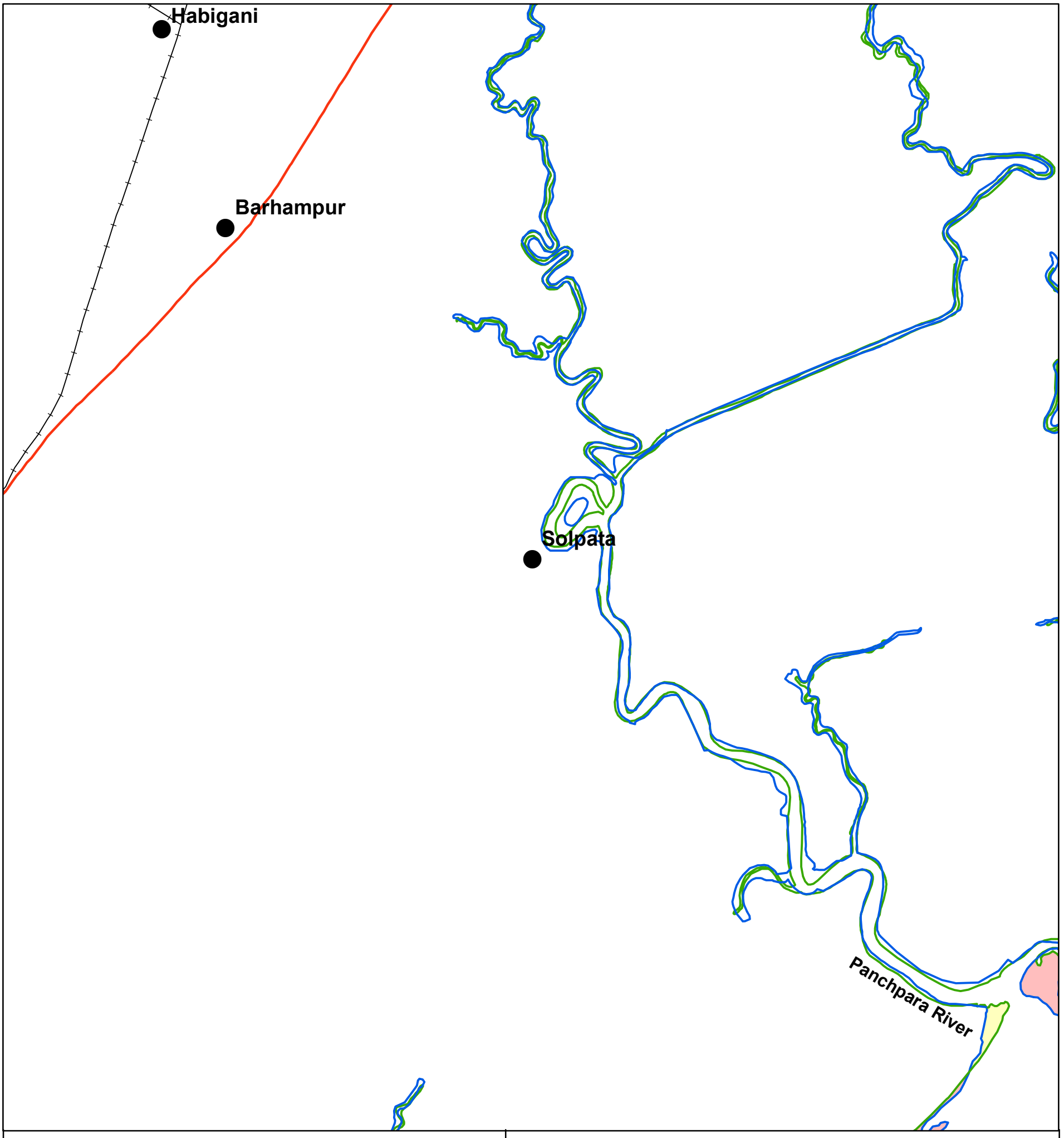
BALESHWAR DISTRICT

SHEET NO. 73O02SW



Legend

- EROSION
- ACCRETION
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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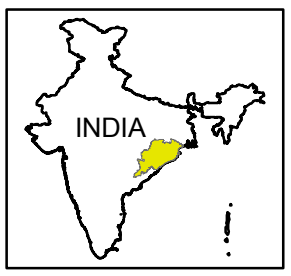
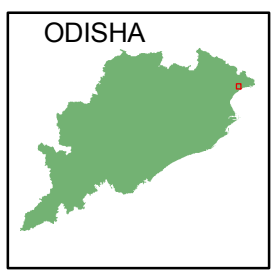
Scale in Km

INDEX TO SHEETS

73K14NE	73O02NW	73O02NE
73K14SE		73O02SE
73K15NE	73O03NW	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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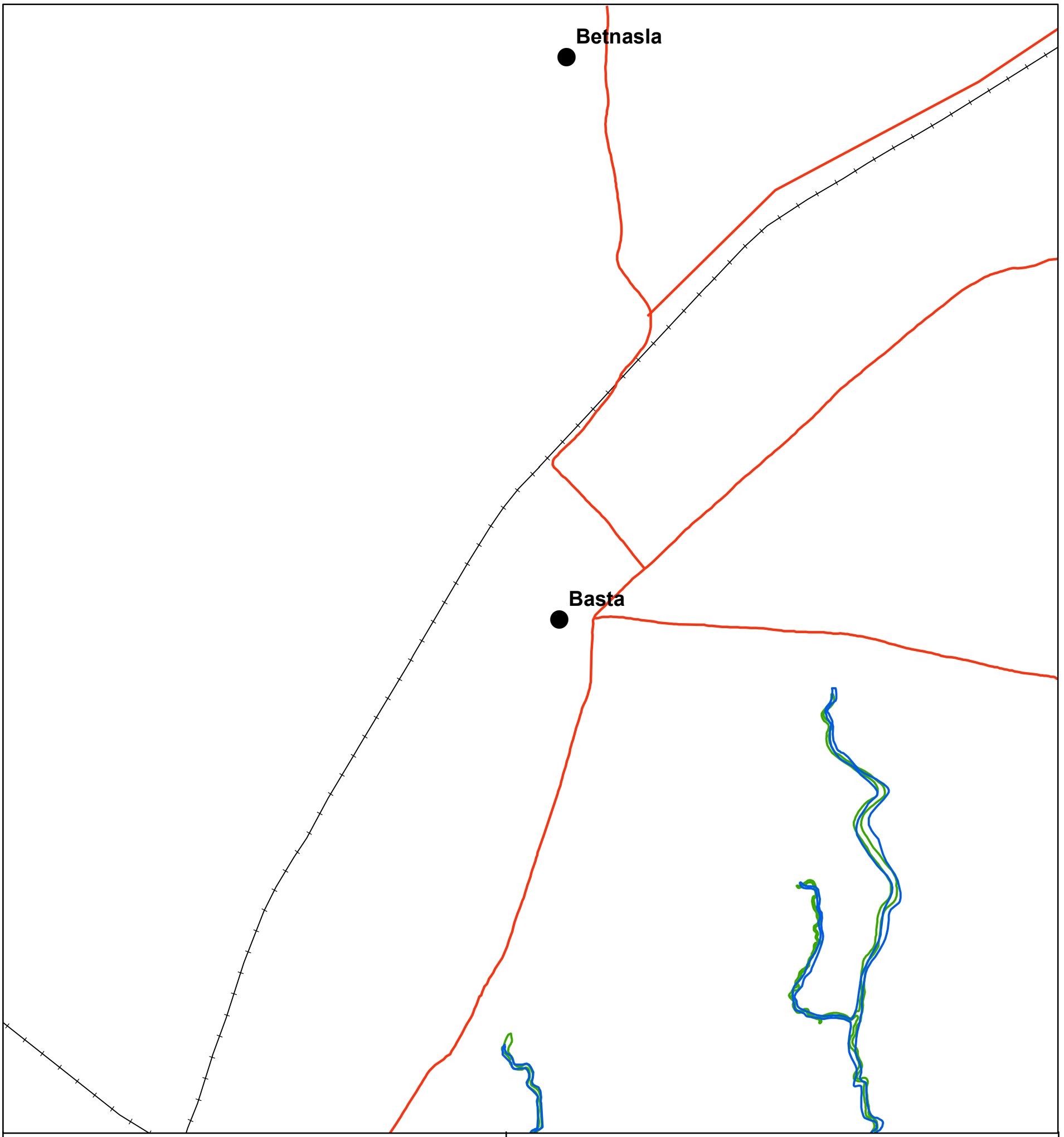
MAYURBHANJ/BALESHWAR DISTRICTS

SHEET NO. 73O02NW



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
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Scale in Km

INDEX TO SHEETS

73K13SE	73O01SW	73O01SE
73K14NE		73O02NE
73K14SE	73O02SW	73O02SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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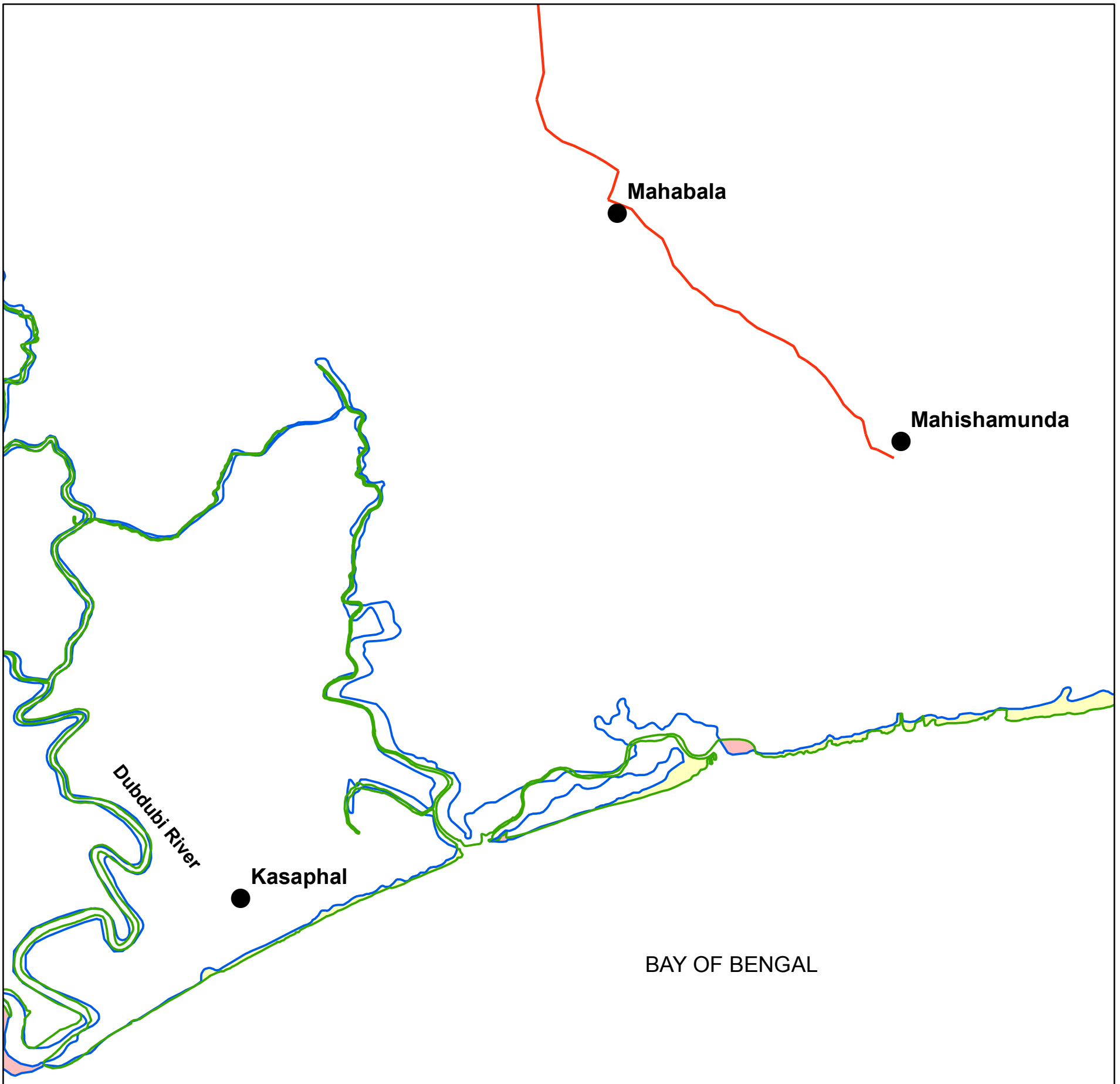
BALESHWAR DISTRICT

SHEET NO. 73O02SE



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
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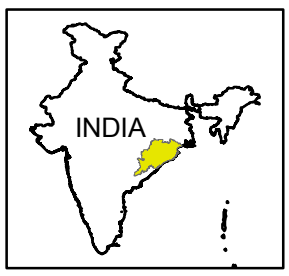
Scale in Km

INDEX TO SHEETS

73O02NW	73O02NE	73O06NW
73O02SW		73O06SW
73O03NW	SEA	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

ODISHA

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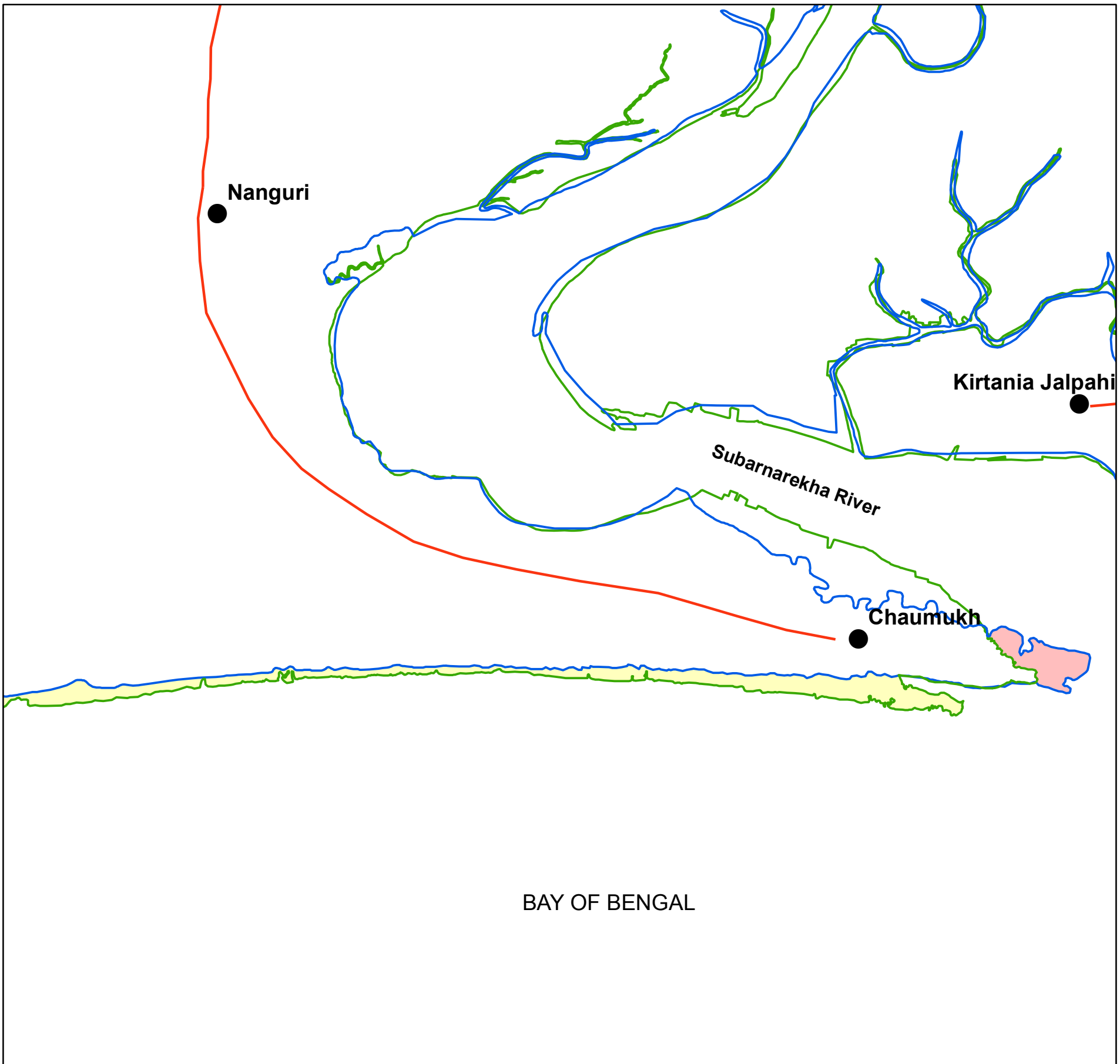
BALESHWAR DISTRICT

SHEET NO. 73O06SW



Legend

- EROSION
- ACCRETION
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ROAD
- HABITATION

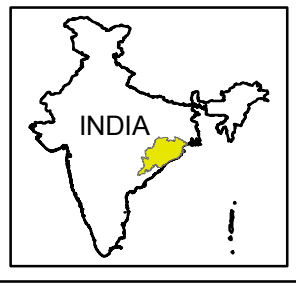
N
W E
S

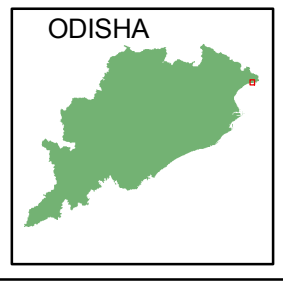
0 2

Scale in Km

INDEX TO SHEETS

73O02NE	73O06NW	73O06NE
73O02SE		73O06SE
SEA	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

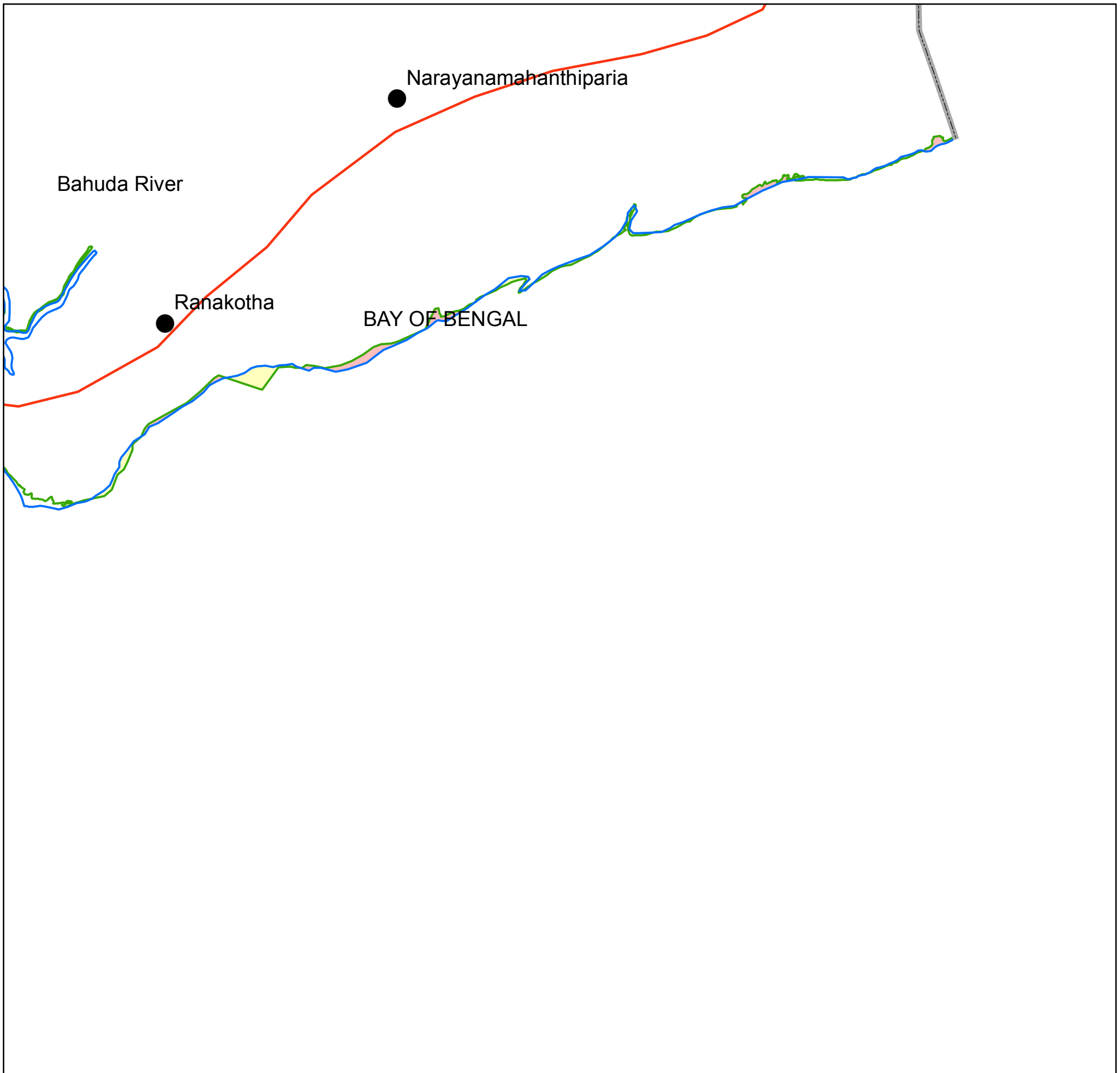
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

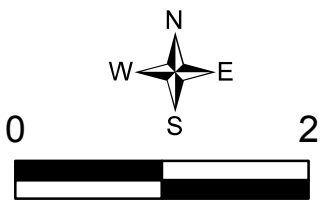
BALESWAR DISTRICT

SHEET NO. 73O06SE



Legend

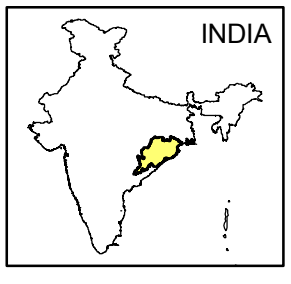
- EROSION
- ACCRETION
- STATE BOUNDARY
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

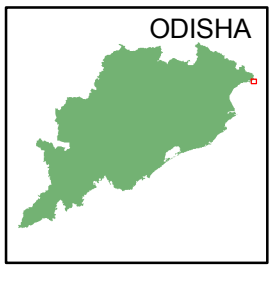


Scale in Km

INDEX TO SHEETS

73O06NW	73O06NE	SEA
73O06SW		SEA
SEA	SEA	SEA





DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

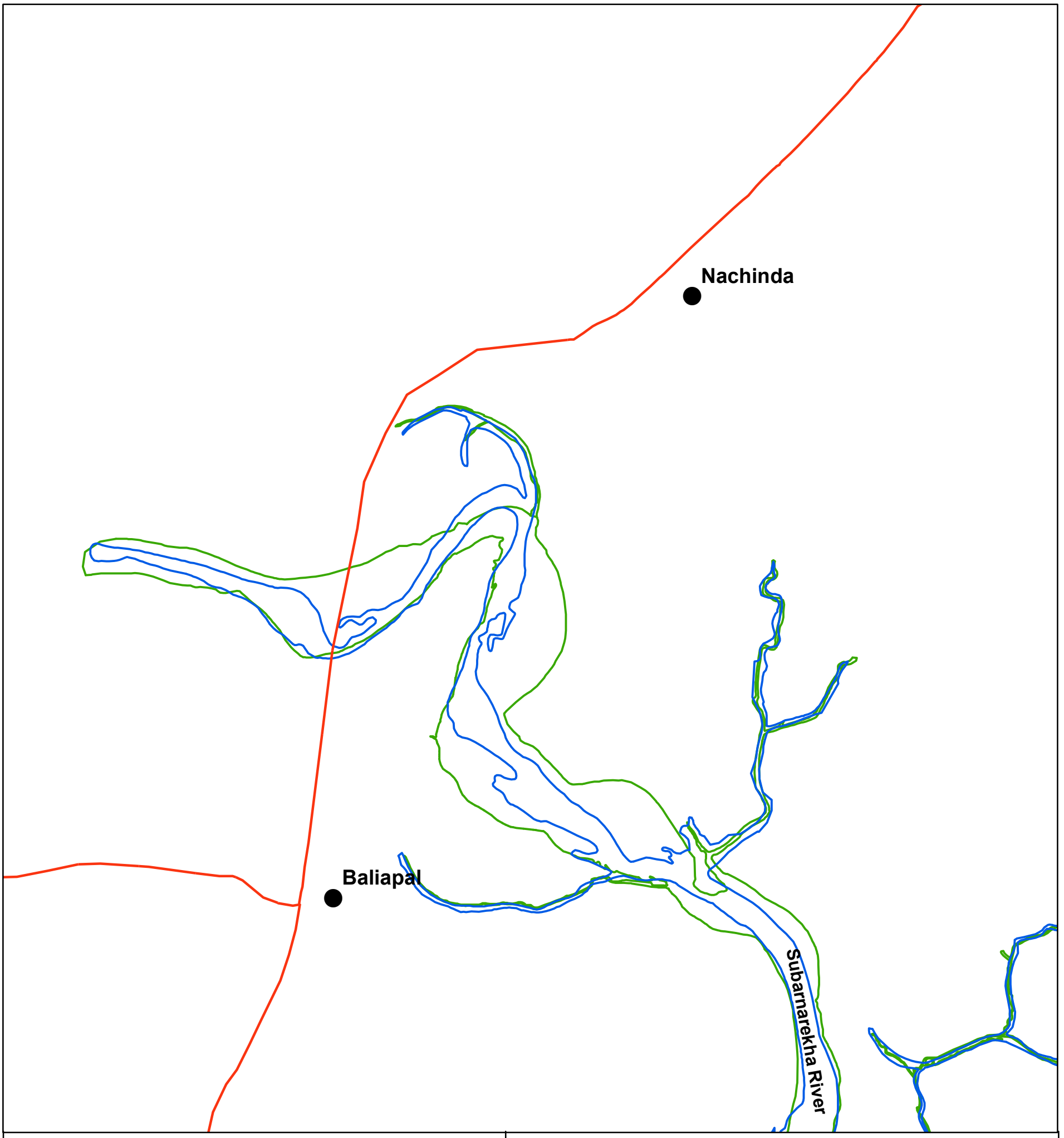
SHORELINE CHANGE MAP

ODISHA

FOR OFFICIAL USE ONLY

BALESHWAR DISTRICT

SHEET NO. 73O06NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

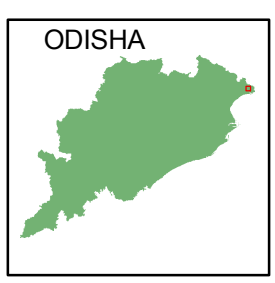
N
W E
S

0 2

Scale in Km

INDEX TO SHEETS

73O01SE	73O05SW	73O05SE
73O02NE		73O06NE
73O02SE	73O06SW	73O06SE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

ODISHA

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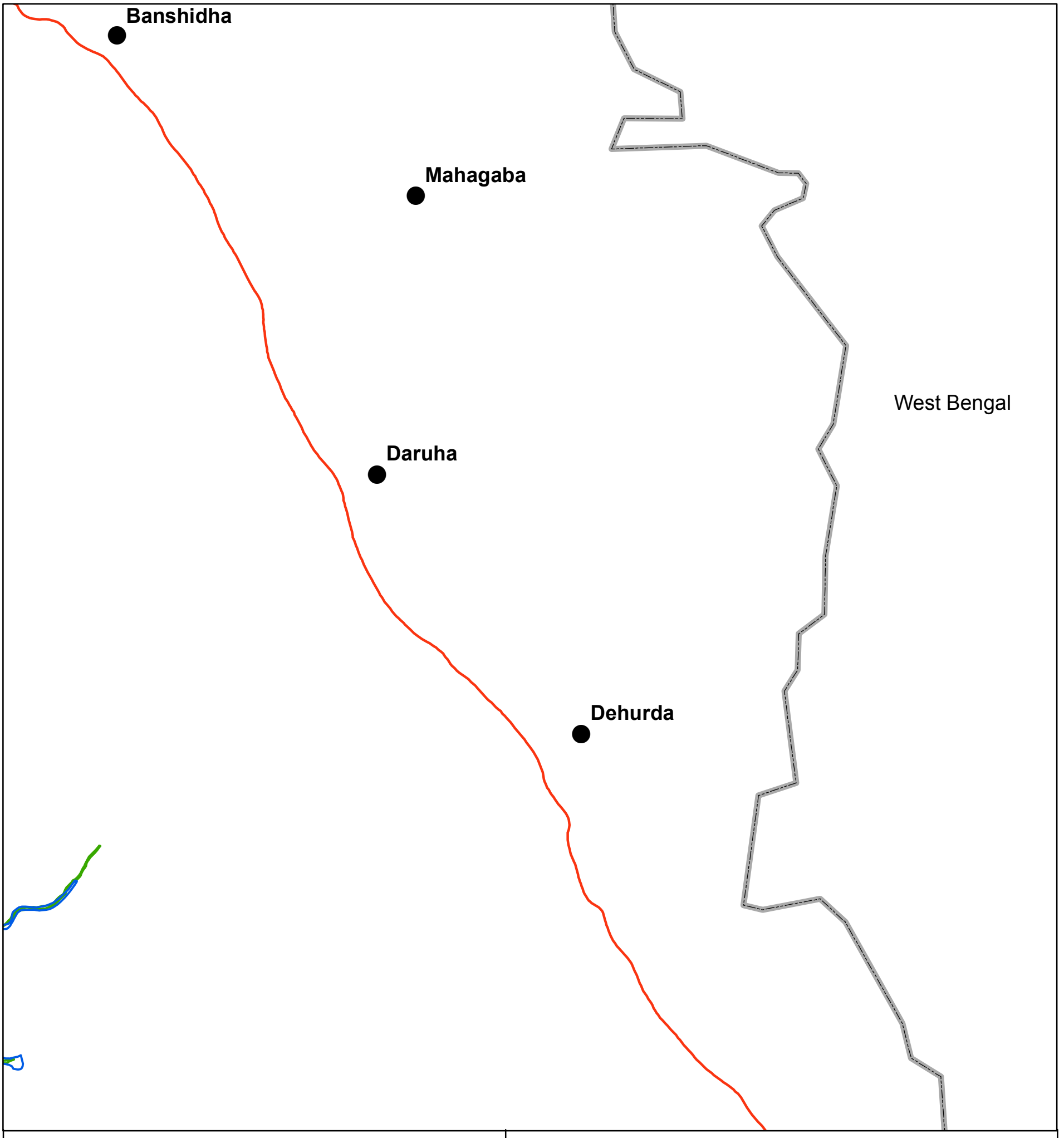
BALESHWAR DISTRICT

SHEET NO. 73O06NE



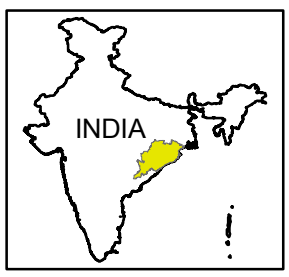
Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- HABITATION

N
W E
S
0 2
Scale in Km

INDEX TO SHEETS

73O05SW	73O05SE	73O09SW
73O06NW		SEA
73O06SW	73O06SE	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

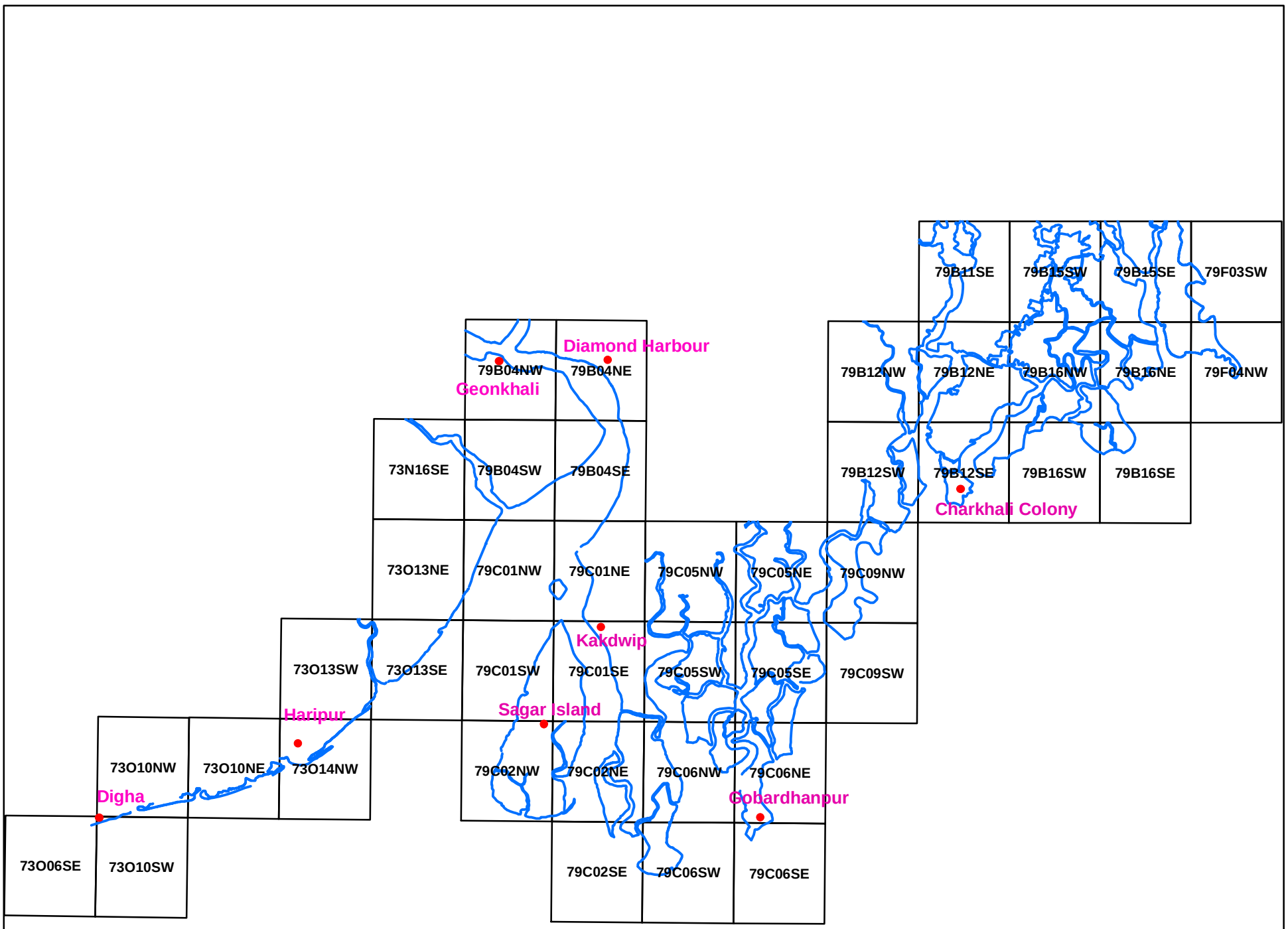
PREPARED BY:
SPACE APPLICATIONS CENTRE, AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

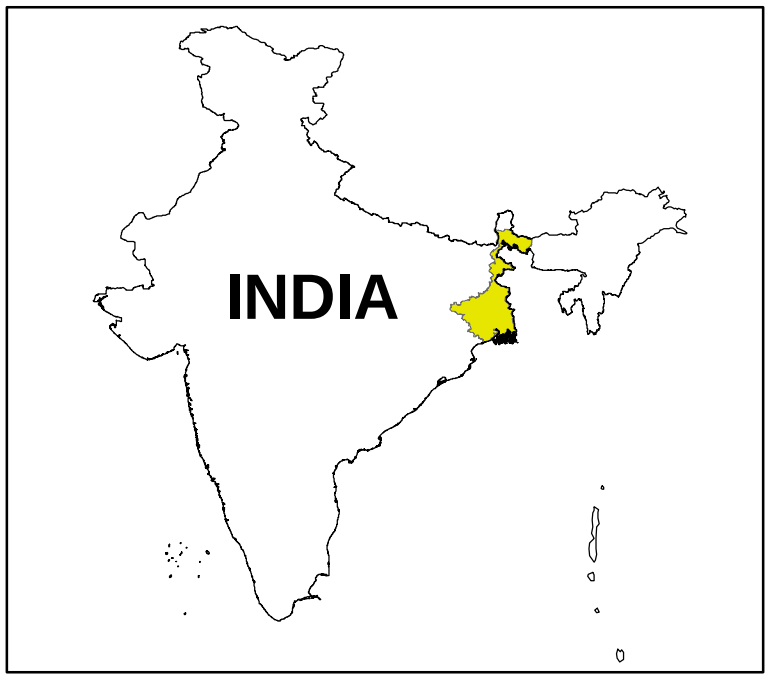
SHORELINE CHANGE MAPS

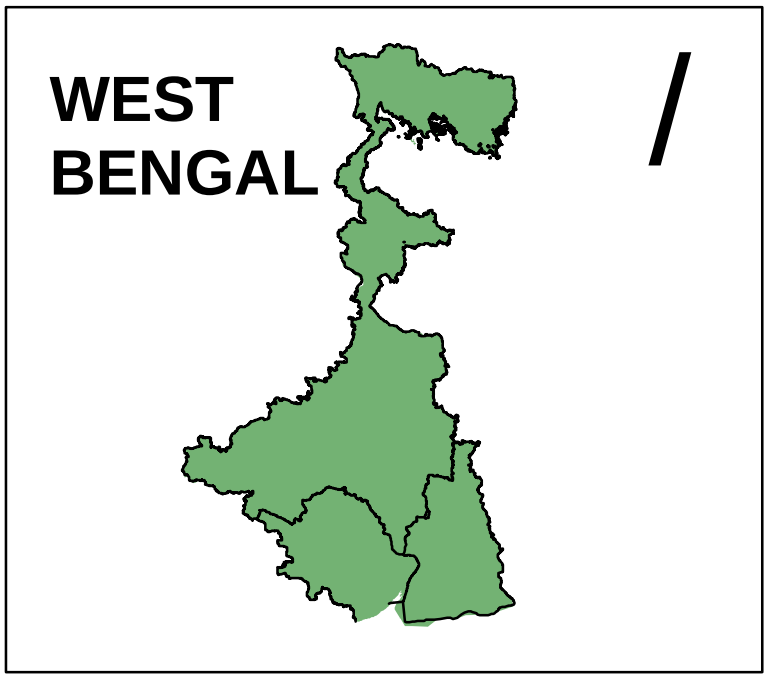
WEST BENGAL

SHORELINE CHANGE MAP

WEST BENGAL

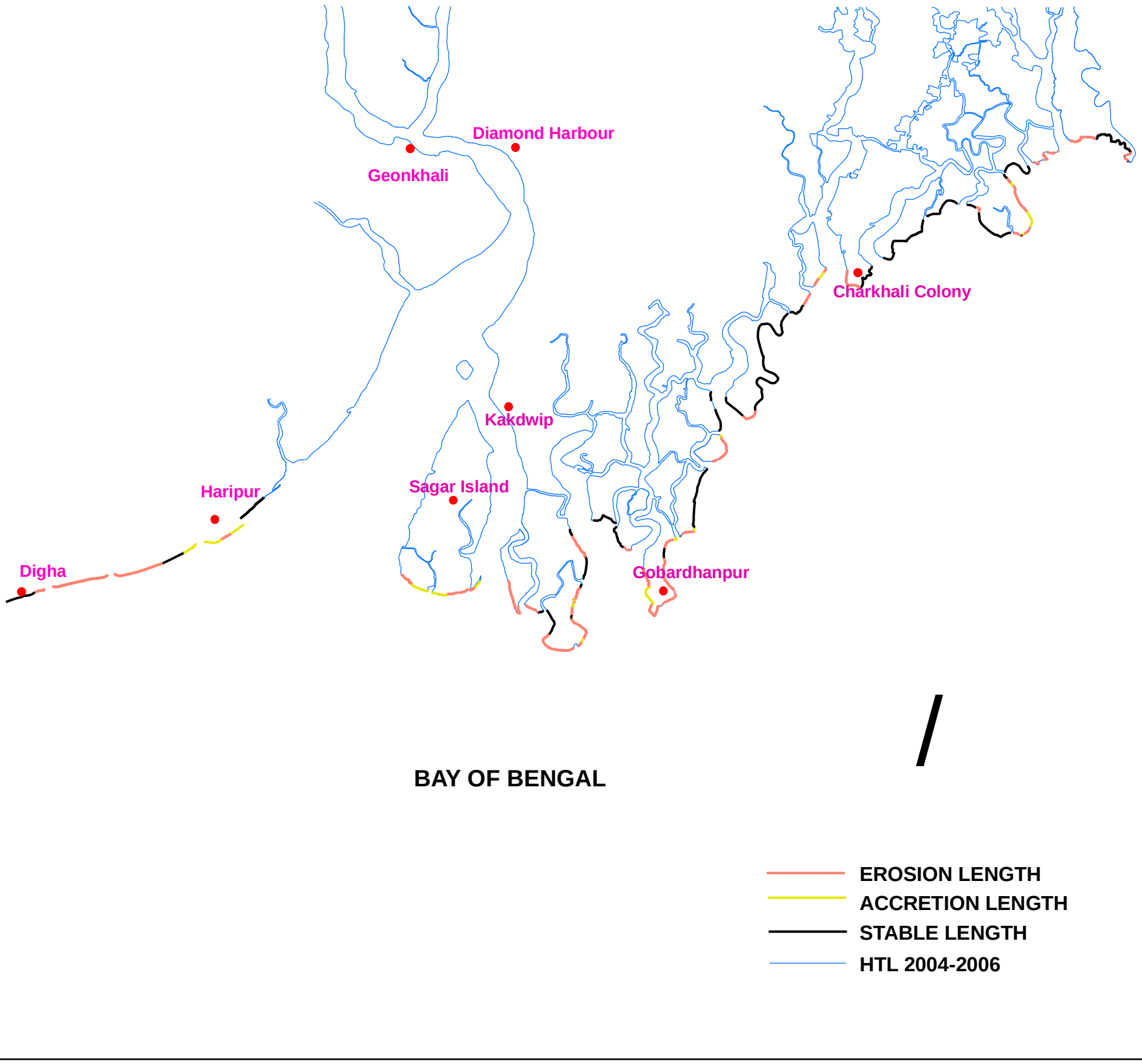


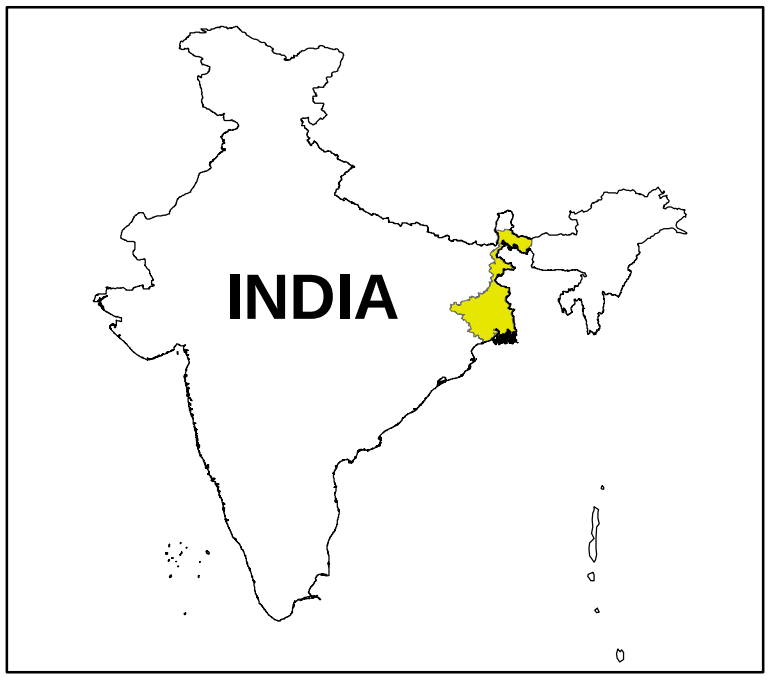




SHORELINE CHANGE MAP

WEST BENGAL





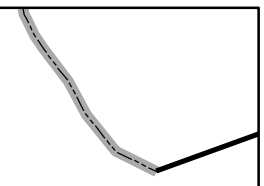
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O06SE



BAY OF BENGAL

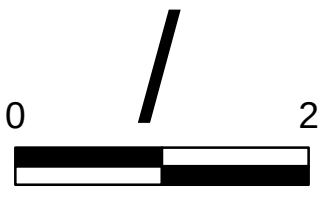
Legend

STATE BOUNDARY

STABLE

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91



INDEX TO SHEETS

73O06 NW	73O06 NE	73O10 NW
73O06 SW		73O10 SW
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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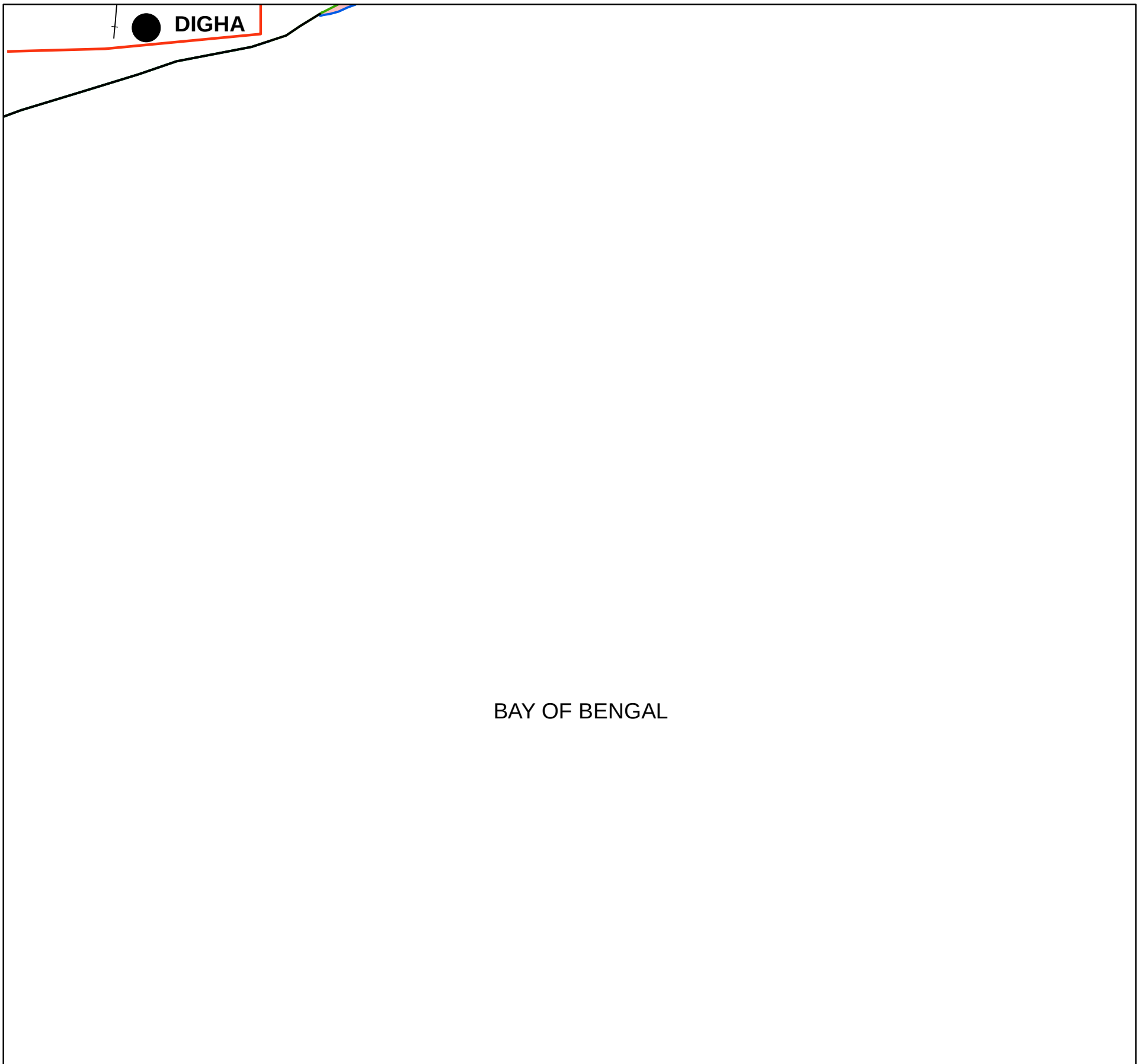
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O10SW



Legend

- EROSION
- STABLE
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73O06 NE	73O10 NW	73O10 NE
73O06 SE		SEA
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

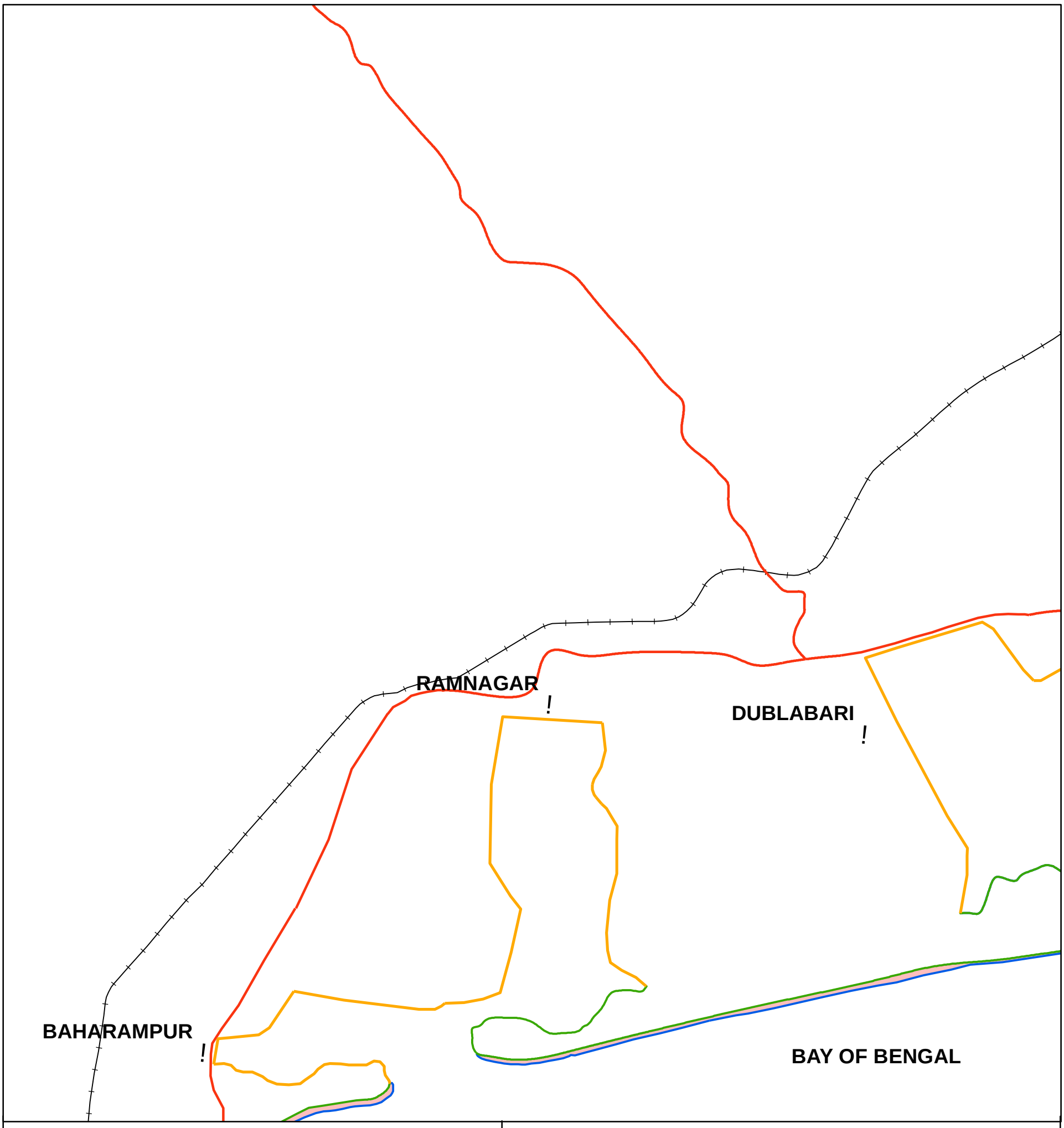
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O10NW



Legend

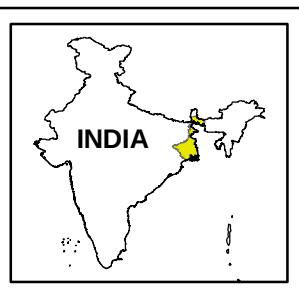
- EROSION
- ROAD
- RAIL
- EMBANKMENT
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73O05 SE	73O09 SW	73O09 SE
73O06 NE		73O10 NE
73O06 SE	73O10 SW	SEA



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

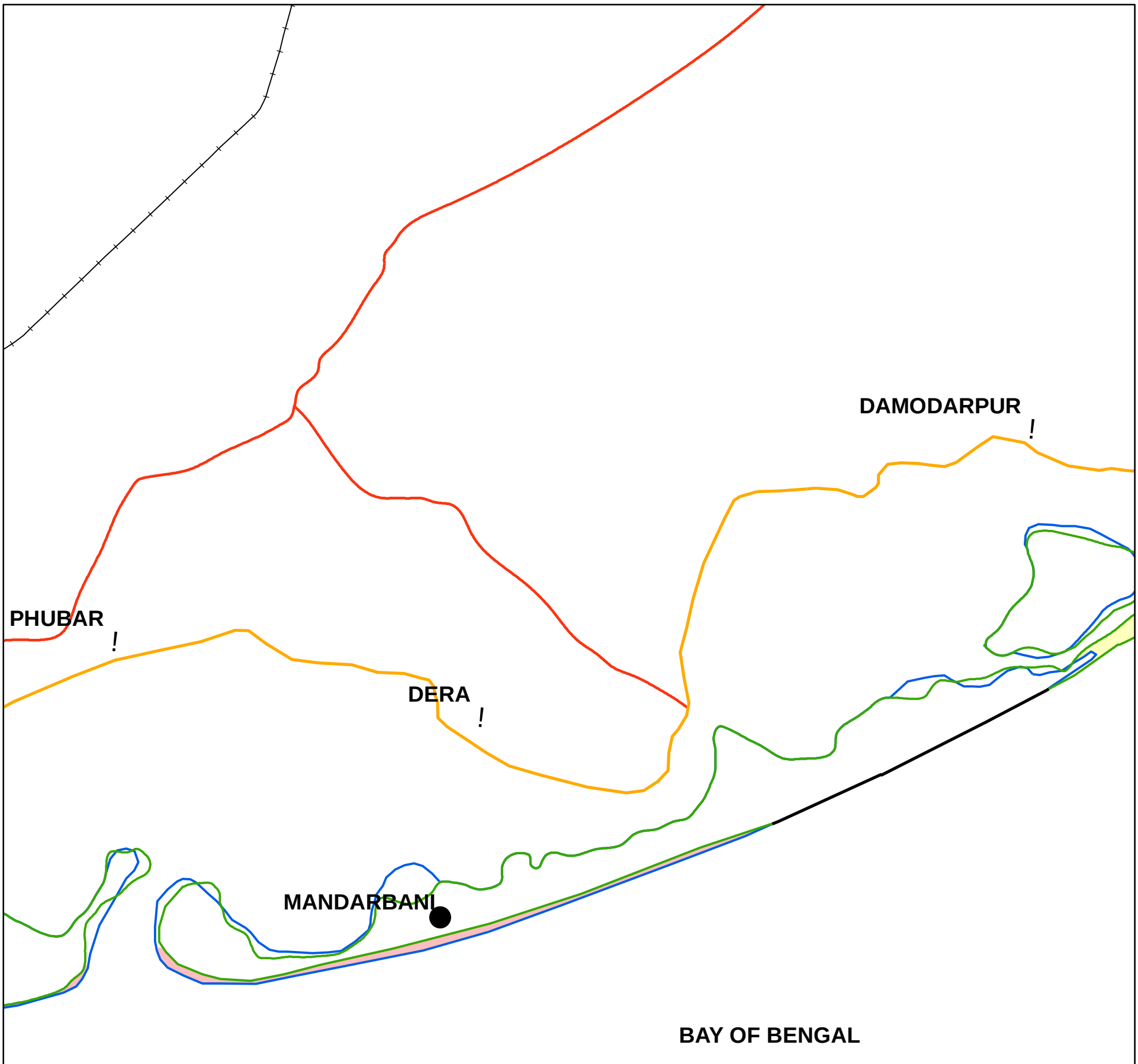
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O10NE



Legend

- EROSION
- ACCRETION
- STABLE
- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- EMBANKMENT

0 2

Scale in Km

INDEX TO SHEETS

73O09 SW	73O09 SE	73O13 SW
73O10 NW		73O14 NW
73O10 SW	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

WEST BENGAL

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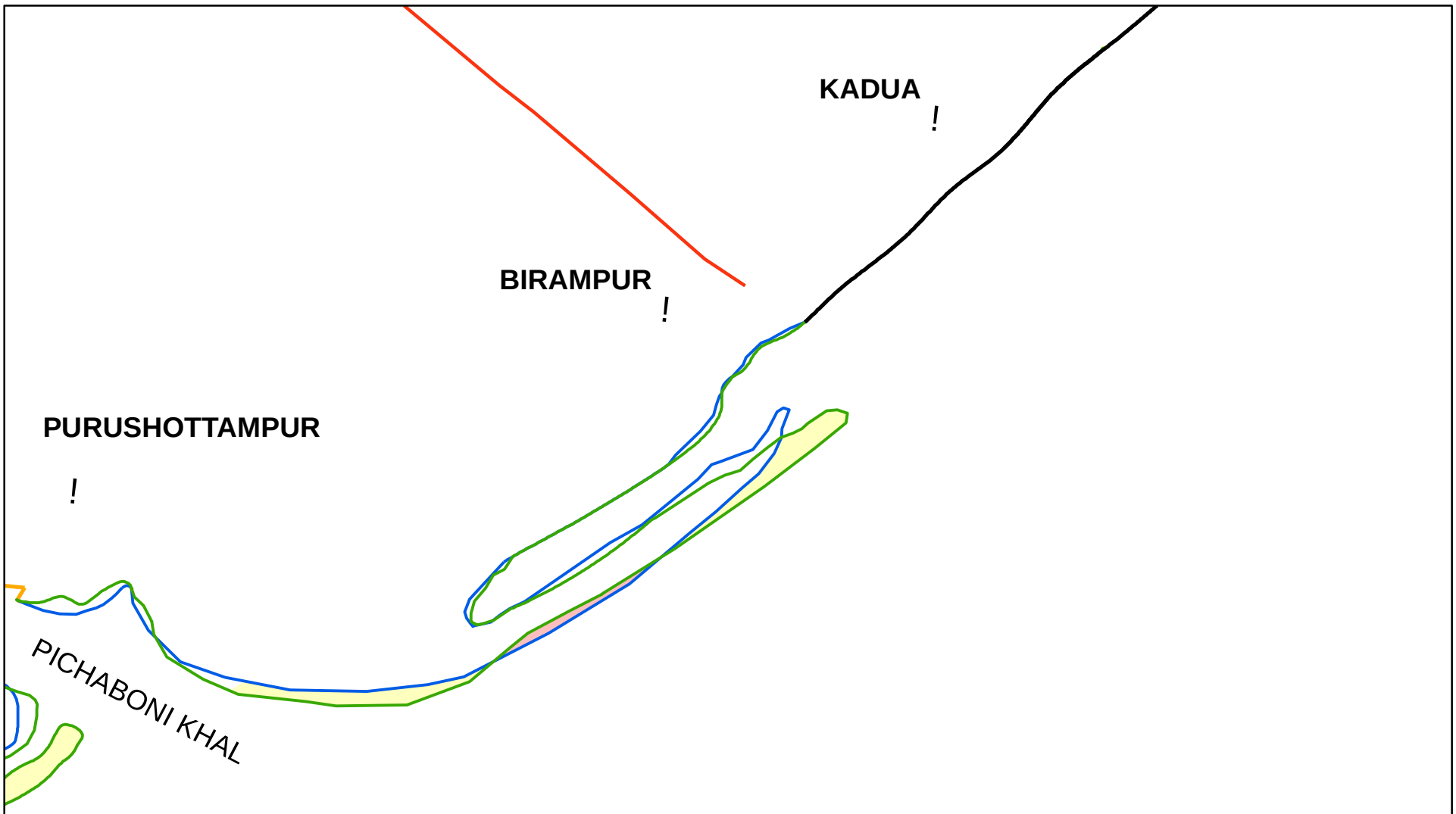
MEDINIPUR DISTRICT

SHEET NO. 73O14NW



Legend

- EROSION
- ACCRETION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- EMBANKMENT

0 2

Scale in Km

INDEX TO SHEETS

73O09 SE	73O13 SW	73O13 SE
73O10 NE		73O14 NE
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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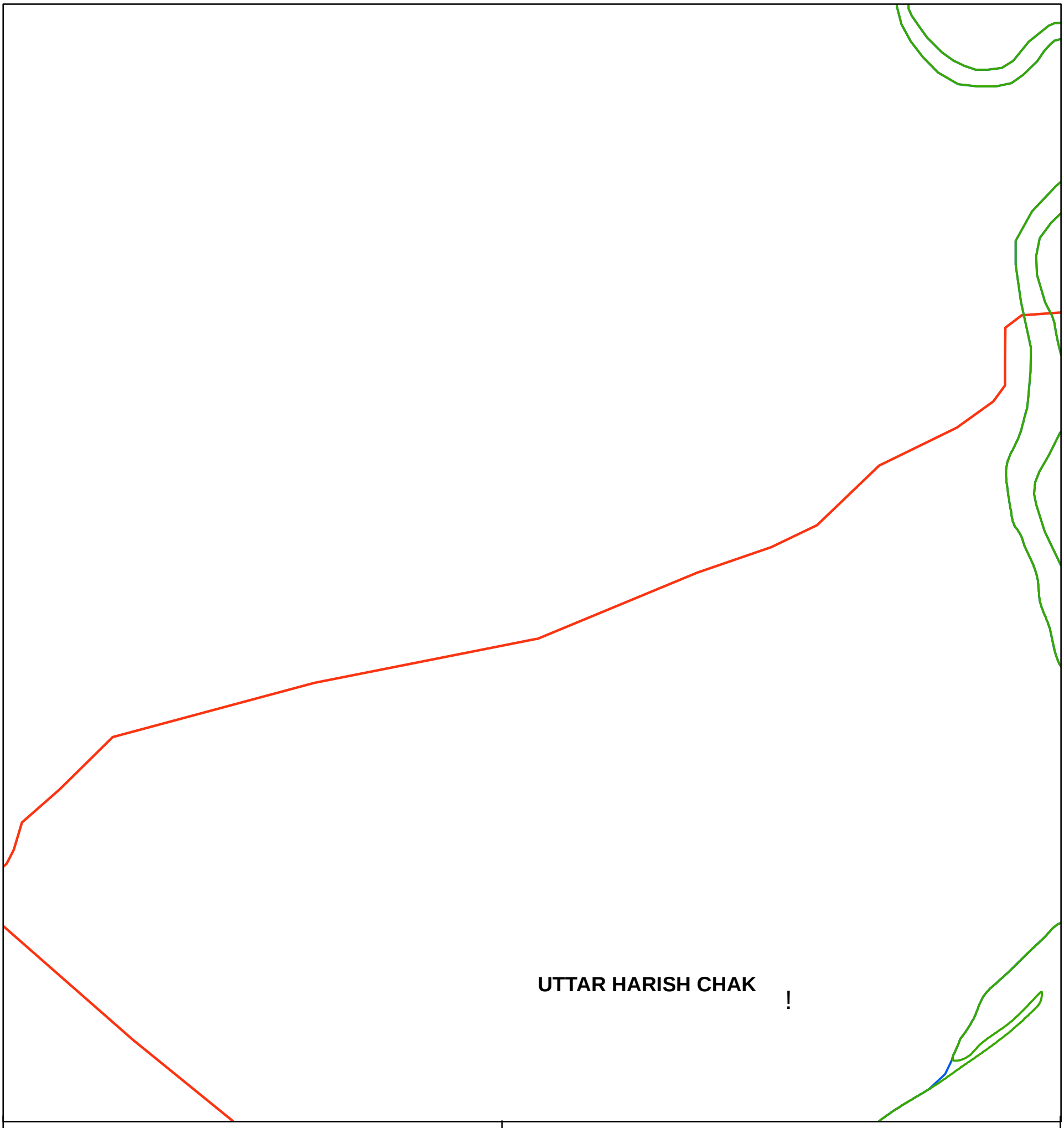
MEDINIPUR DISTRICT

SHEET NO. 73O13SW



Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73O09 NE	73O13 NW	73O13 NE
73O09 SE		73O13 SE
73O10 NE	73O14 NW	73O14 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

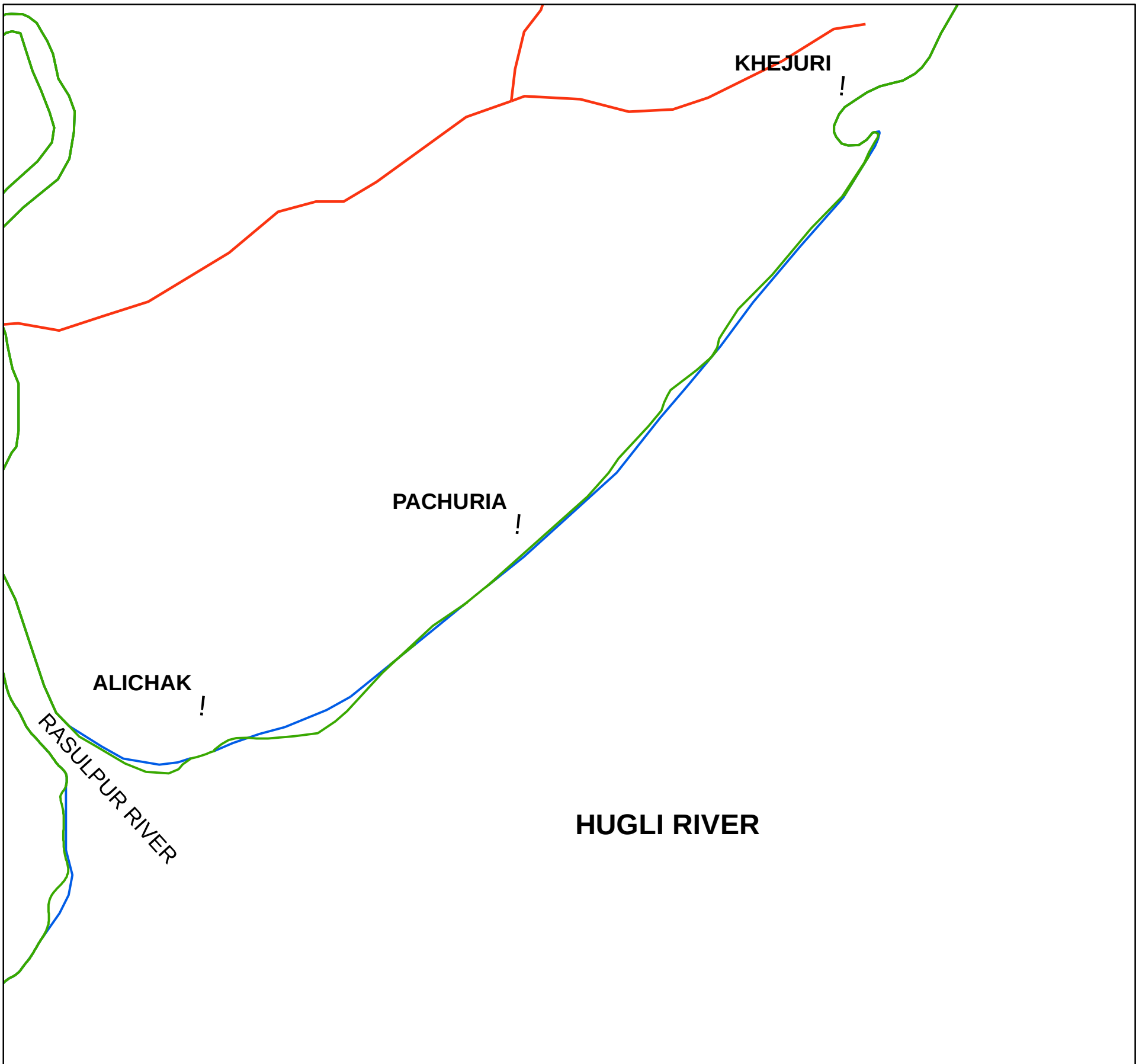
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O13SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73O13 NW	73O13 NE	79C01 NW
73O13 SW		79C01 SW
73O14 NW	73O14 NE	79C02 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR DISTRICT

SHEET NO. 73O13NE

GANGRA !

SAHIBNAGAR !

Legend

ROAD

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73N16 SW	73N16 SE	79B04 SW
73O13 NW		79C01 NW
73O13 SW	73O13 SE	79C01 SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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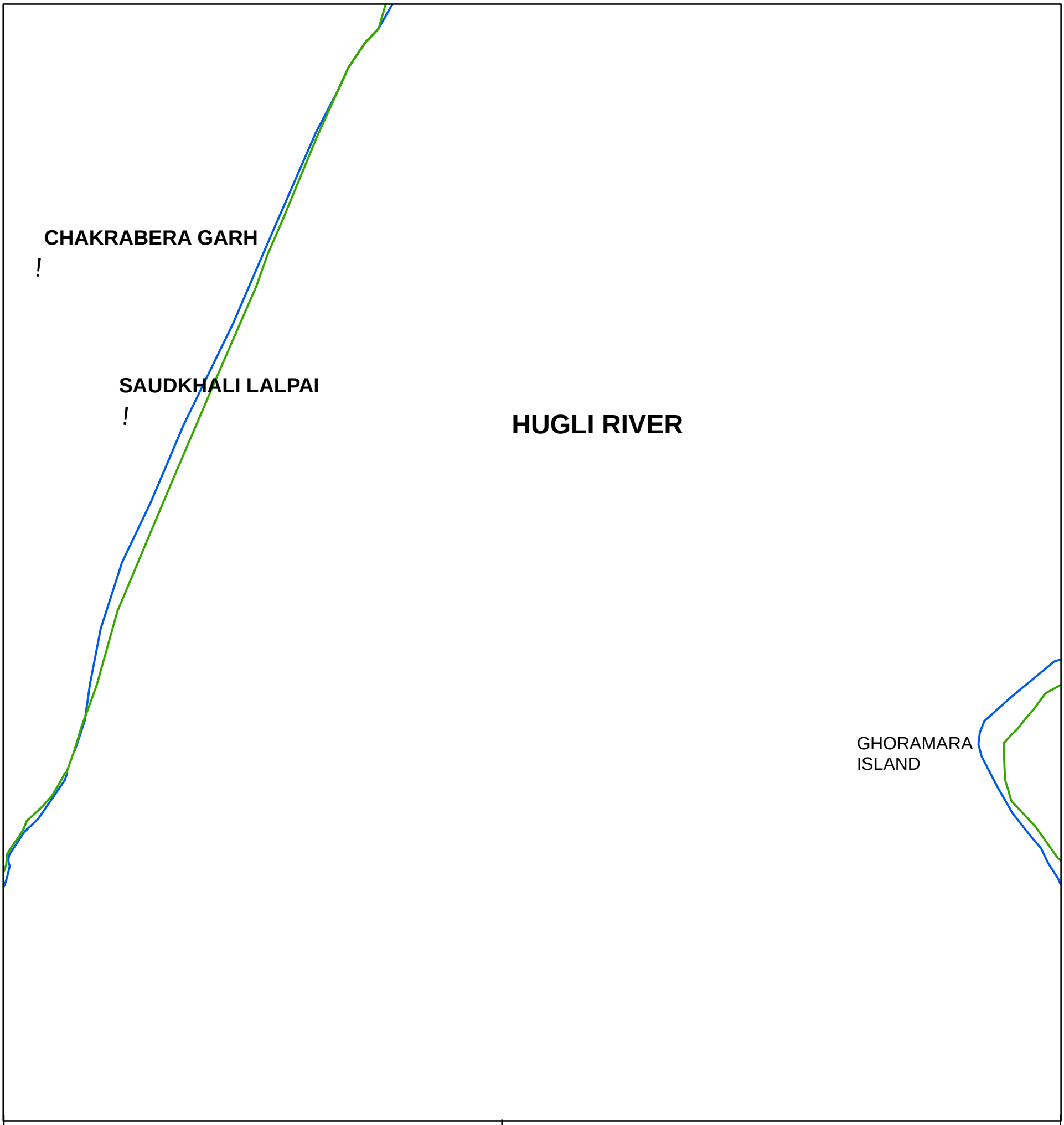
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR AND 24 PARGANAS DISTRICT

SHEET NO. 79C01NW



Legend

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73N16 SE	79B04 SW	79B04 SE
73O13 NE		79C01 NE
73O13 SE	79C01 SW	79C01 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

WEST BENGAL

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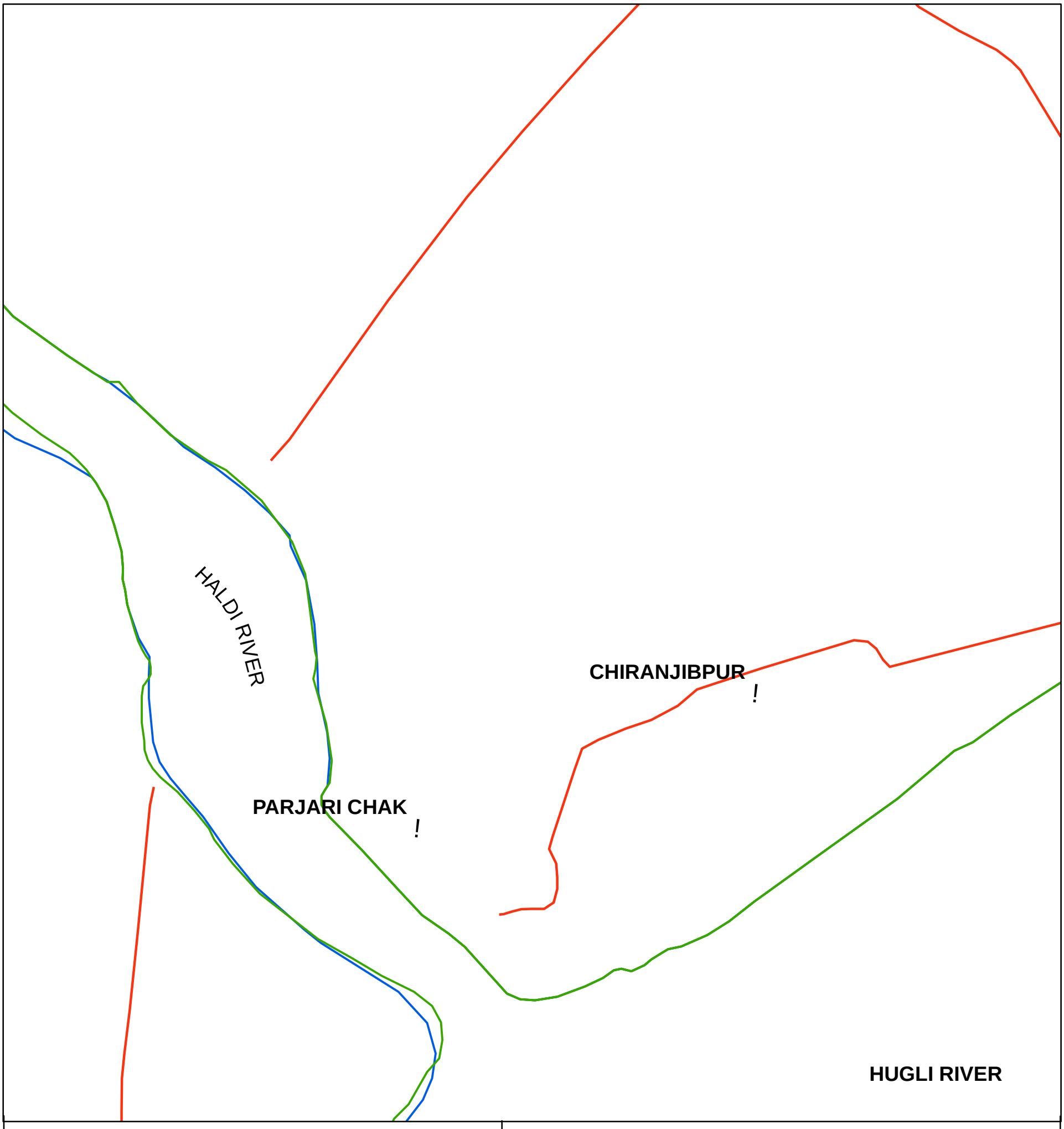
MEDINIPUR DISTRICTS

SHEET NO. 79B04SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73N16 NE	79B04 NW	79B04 NE
73N16 SE		79B04 SE
73O13 NE	79C01 NW	79C01 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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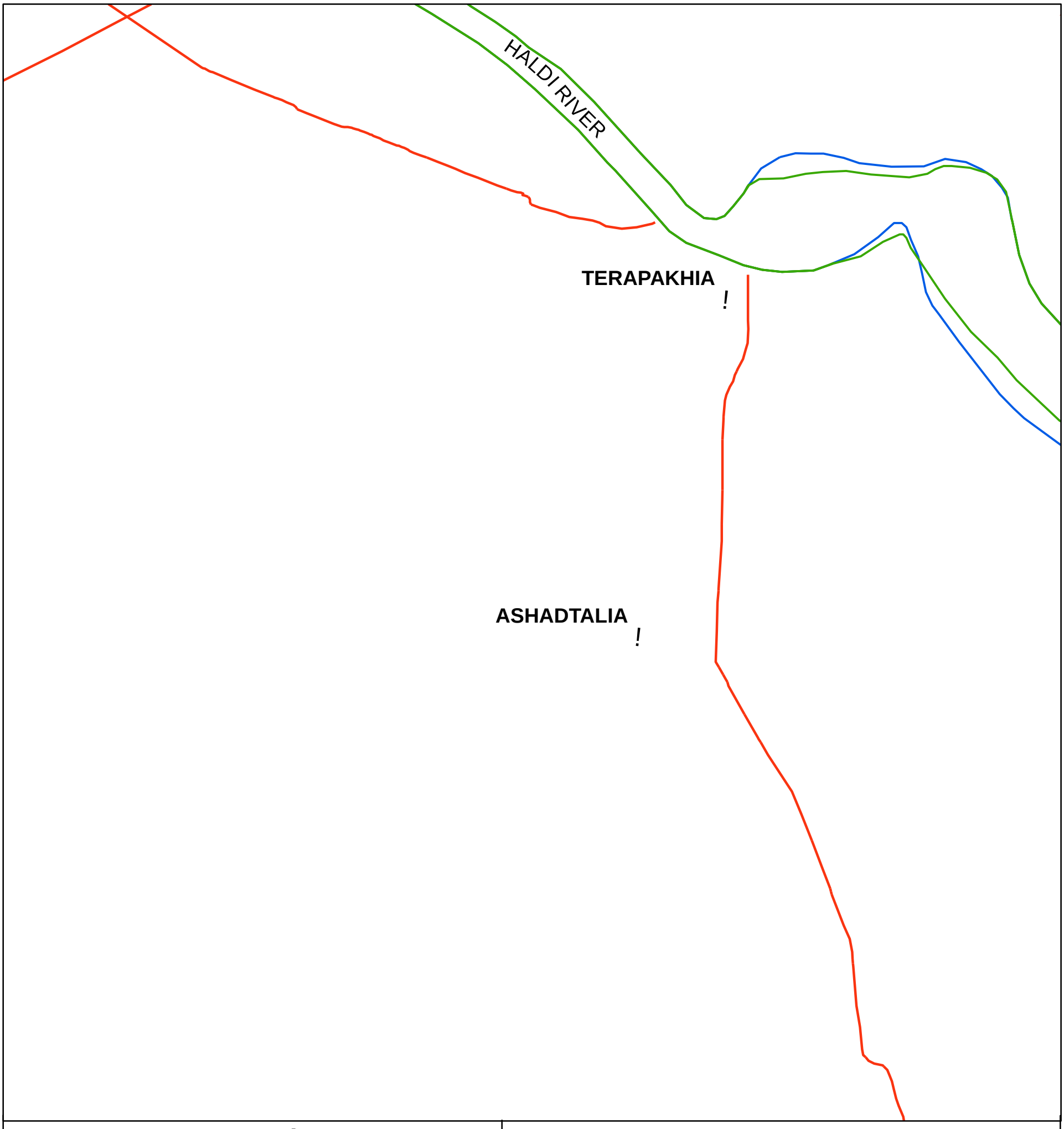
MEDINIPUR AND HAORA DISTRICTS

SHEET NO. 73N16SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73N16 NW	73N16 NE	79B04 NW
73N16 SW		79B04 SW
73O13 NW	73O13 NE	79C01 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

WEST BENGAL

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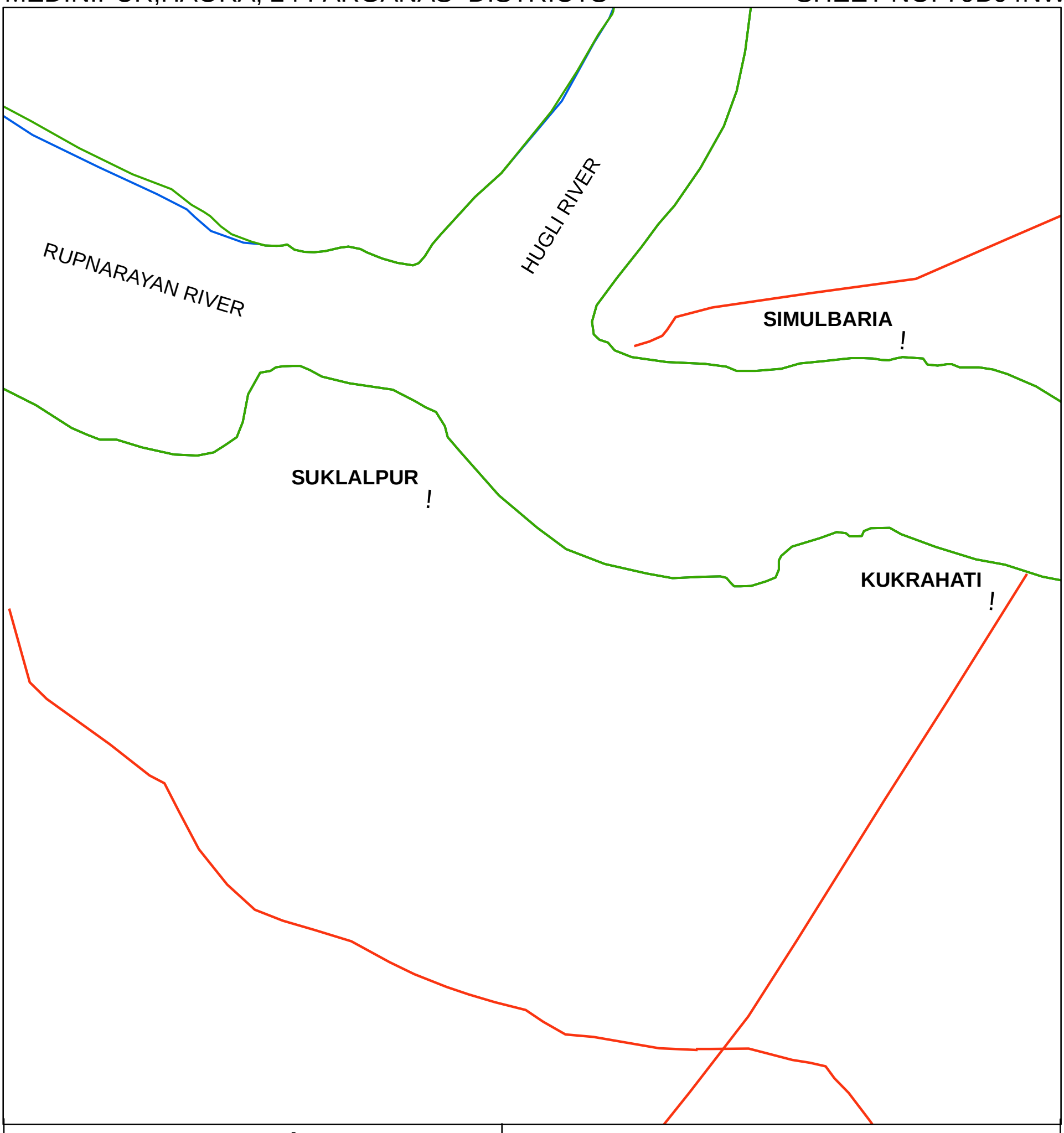
MEDINIPUR,HAORA, 24 PARGANAS DISTRICTS

SHEET NO. 79B04NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73N15 SE	79B03 SW	79B03 SE
73N16 NE		79B04 NE
73N16 SE	79B04 SW	79B04 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SPACE APPLICATIONS CENTRE , AHMEDABAD
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SHORELINE CHANGE MAP

WEST BENGAL

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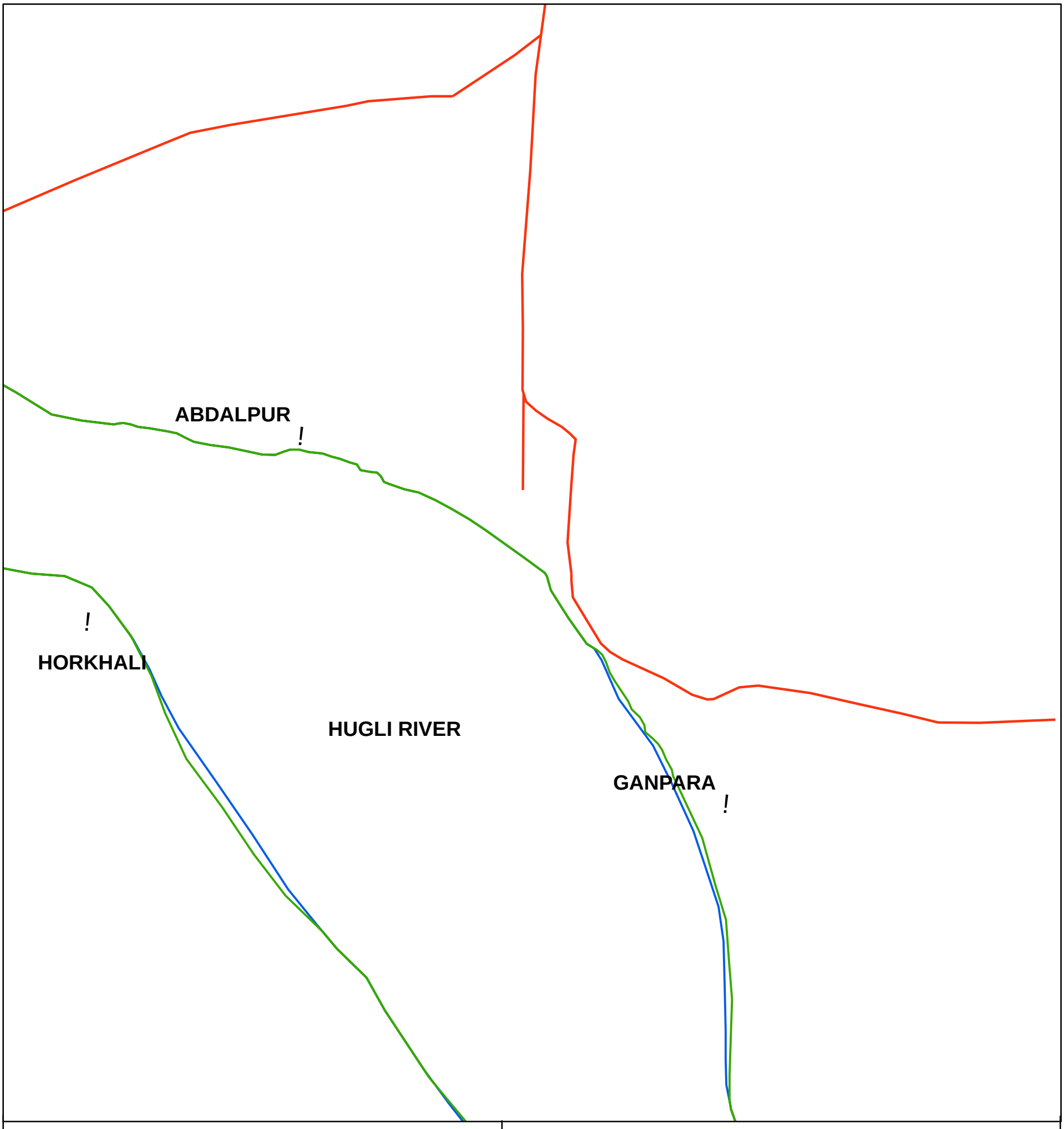
MEDINIPUR AND 24 PARGANAS DISTRICTS

SHEET NO. 79B04NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B03 SW	79B03 SE	79B07 SW
79B04 NW		79B08 NW
79B04 SW	79B04 SE	79B08 SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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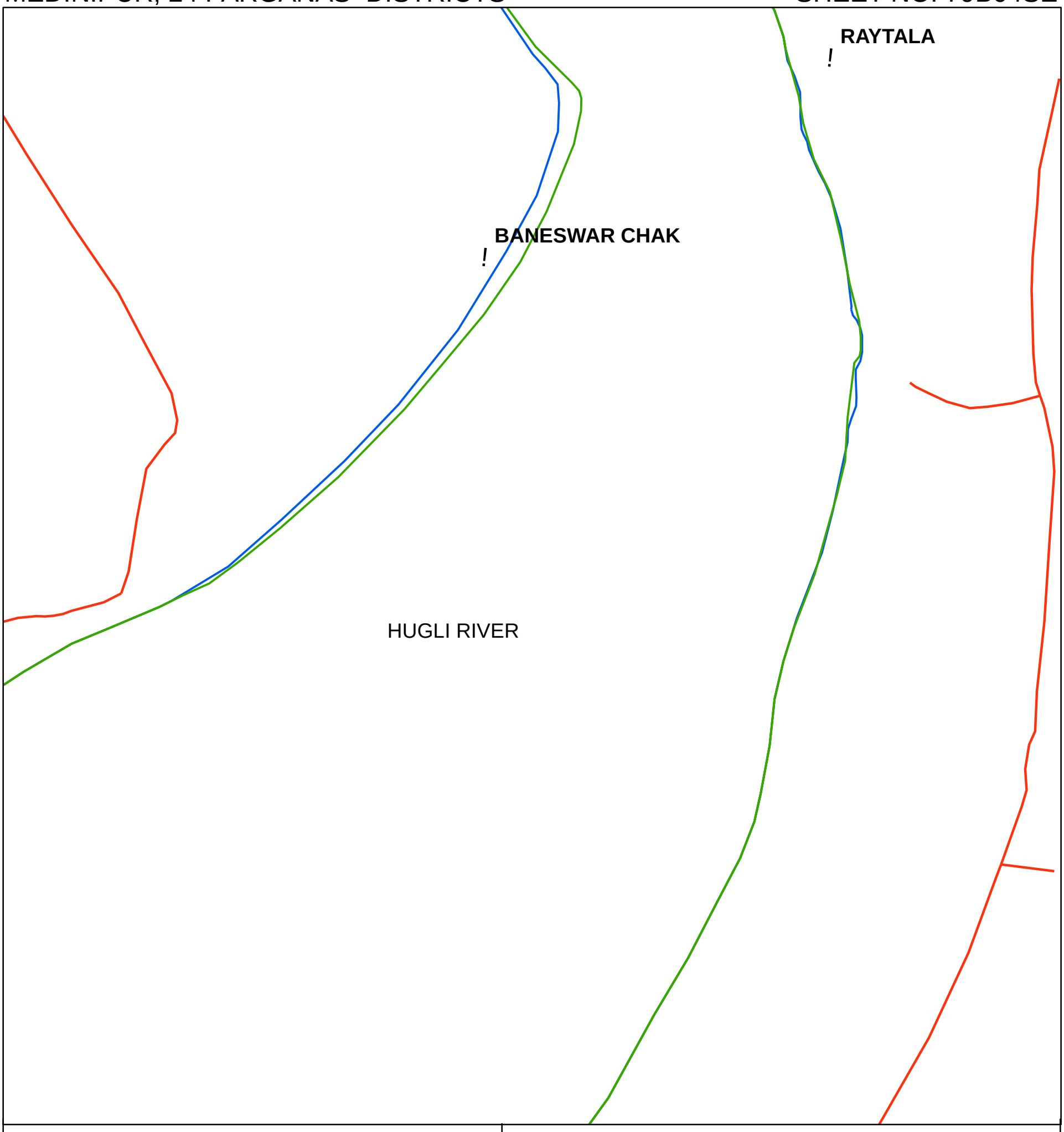
MEDINIPUR, 24 PARGANAS DISTRICTS

SHEET NO. 79B04SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B04 NW	79B04 NE	79B08 NW
79B04 SW		79B08 SW
79C01 NW	79C01 NE	79C05 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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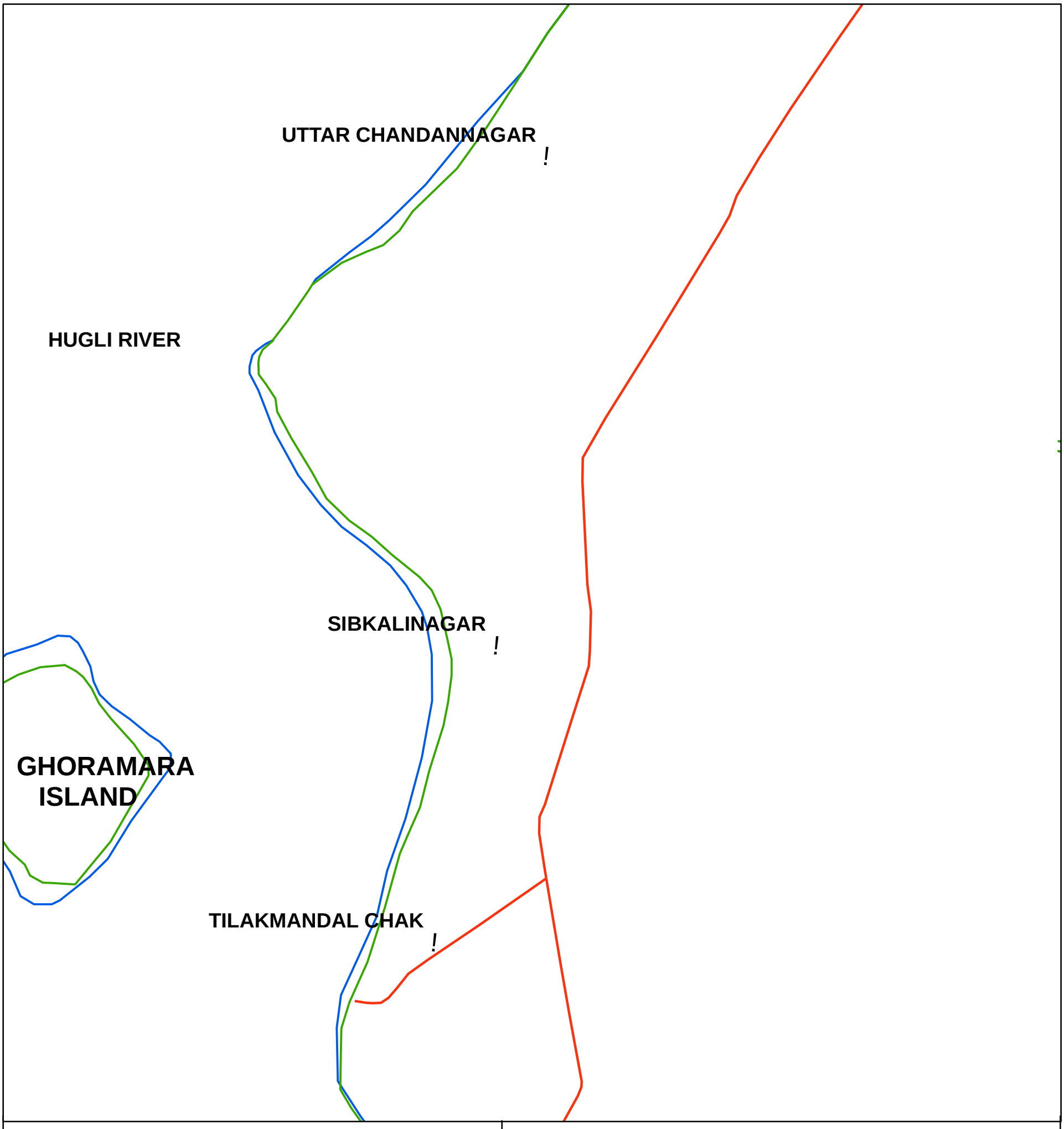
MEDINIPUR AND 24 PARGANAS DISTRICT

SHEET NO. 79C01NE



Legend

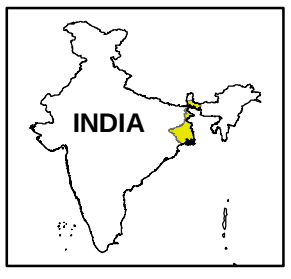
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B04 SW	79B04 SE	79B08 SW
79C01 NW		79C05 NW
79C01 SW	79C01 SE	79C05 SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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AND CENTRAL WATER COMMISSION, NEW DELHI

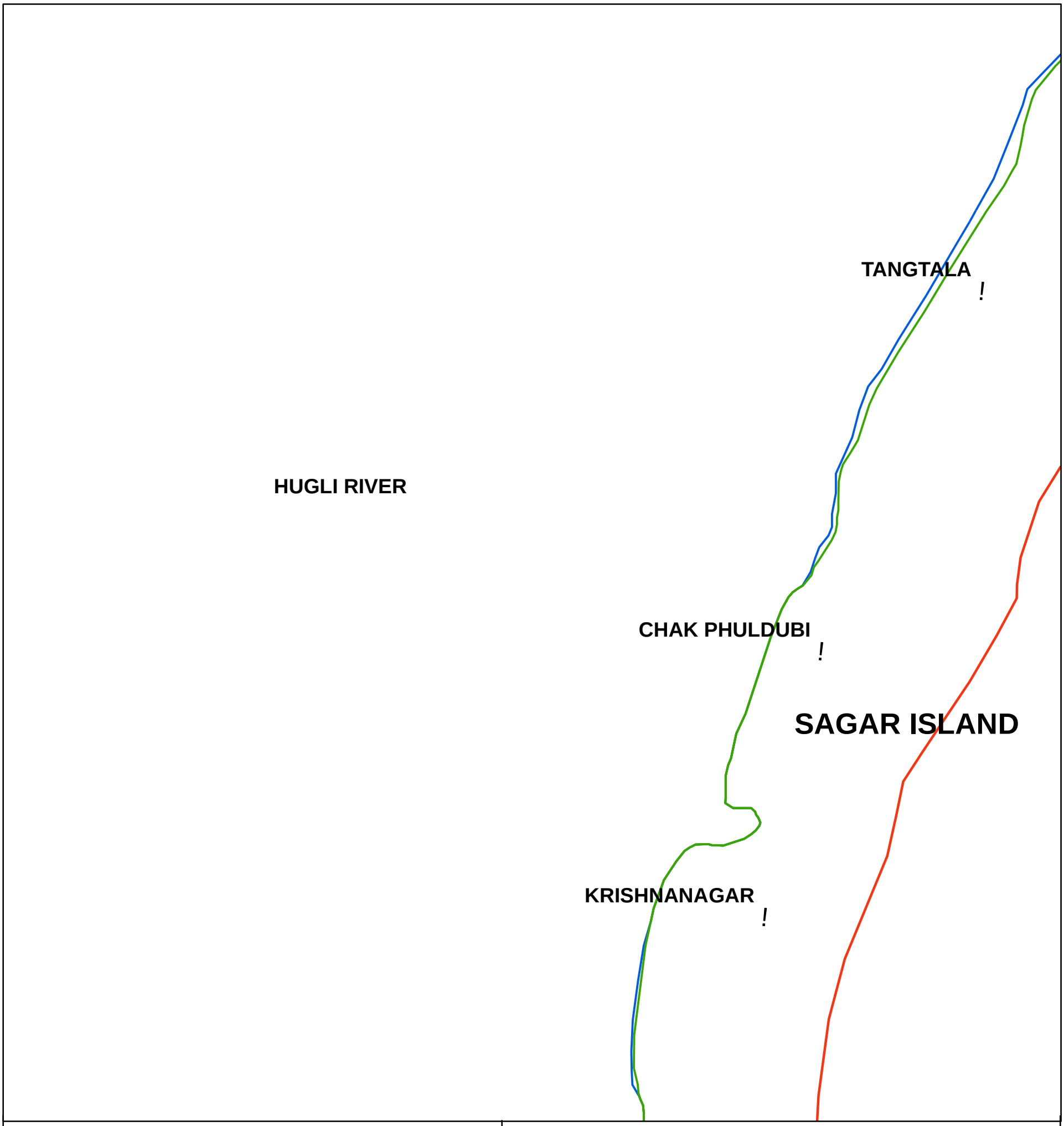
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

MEDINIPUR AND 24 PARGANAS DISTRICTS

SHEET NO. 79C01SW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

73O13 NE	79C01 NW	79C01 NE
73O13 SE		79C01 SE
73O14 NE	79C02 NW	79C02 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

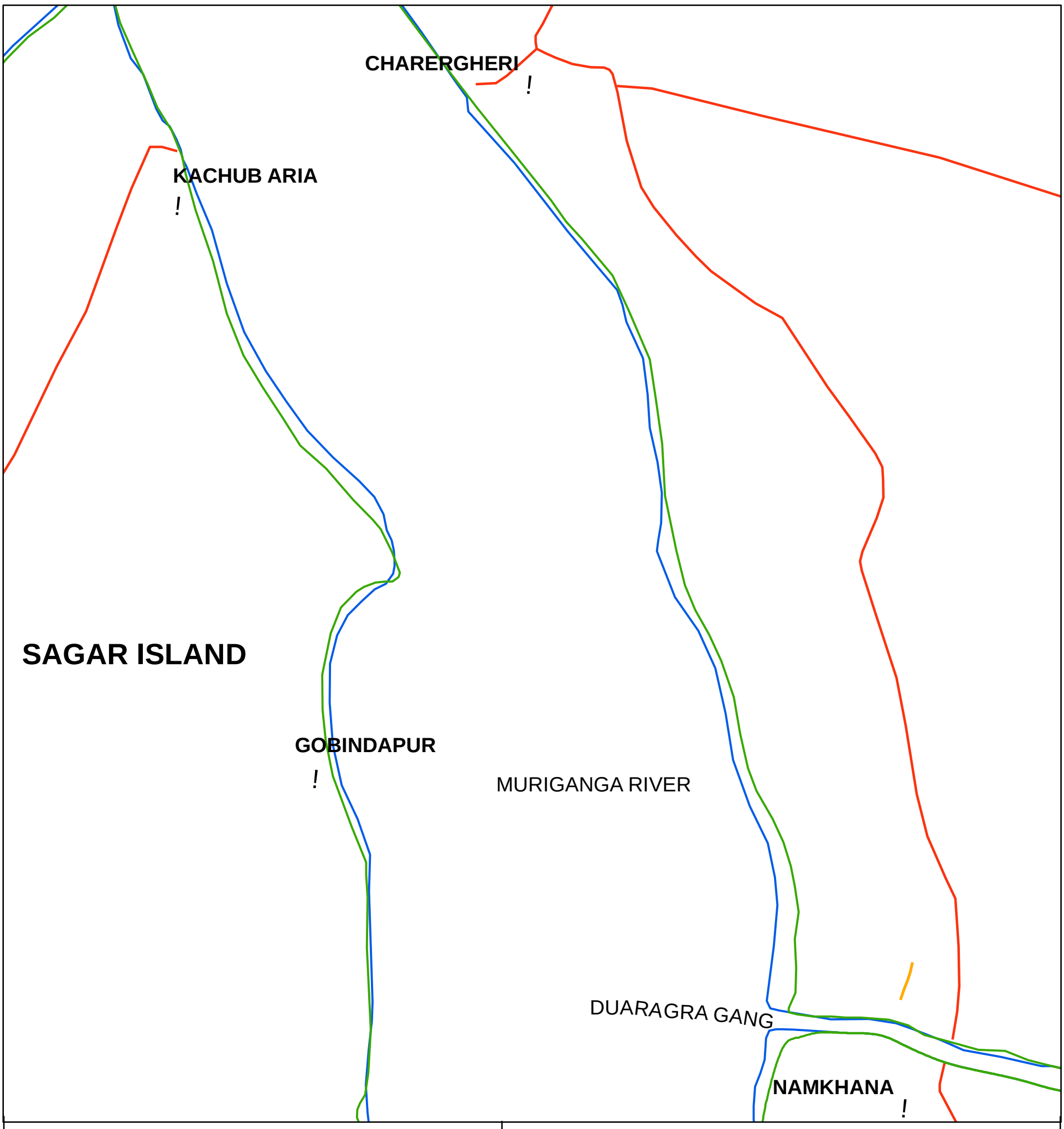
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

24 PARGANAS DISTRICT

SHEET NO. 79C01SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- CONCRETE WALL

0 2

Scale in Km

INDEX TO SHEETS

79C01 NW	79C01 NE	79C05 NW
79C01 SW		79C05 SW
79C02 NW	79C02 NE	79C06 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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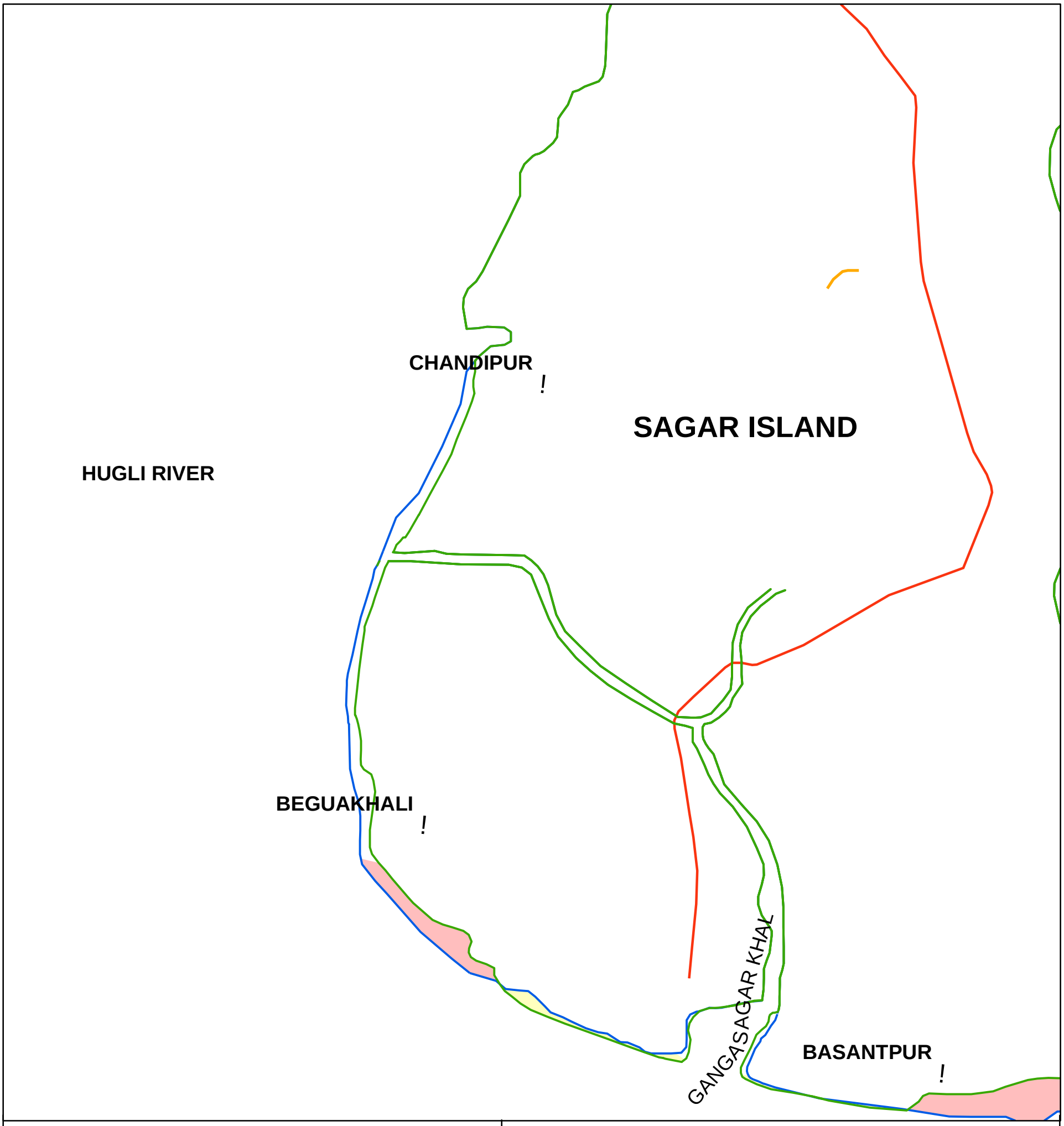
24 PARGANAS DISTRICT

SHEET NO. 79C02NW



Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- **CONCRETE WALL**

0 2

Scale in Km

INDEX TO SHEETS

73O13 SE	79C01 SW	79C01 SE
73O14 NE		79C02 NE
SEA	79C02 SW	79C02 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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24 PARGANAS DISTRICT

SHEET NO. 79C02NE

MRITYUNJOYNAGAR

NARAYANGANJ

PITT'S CREEK

MURI GANGA

CHEMAGAR GANG

BAGDANGA

RAJNAGAR

MAHISANI ISLAND

SHIBPUR

PITT'S CREEK

Legend

- EROSION
- ACCRETION
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79C01 SW	79C01 SE	79C05 SW
79C02 NW		79C06 NW
79C02 SW	79C02 SE	79C06 SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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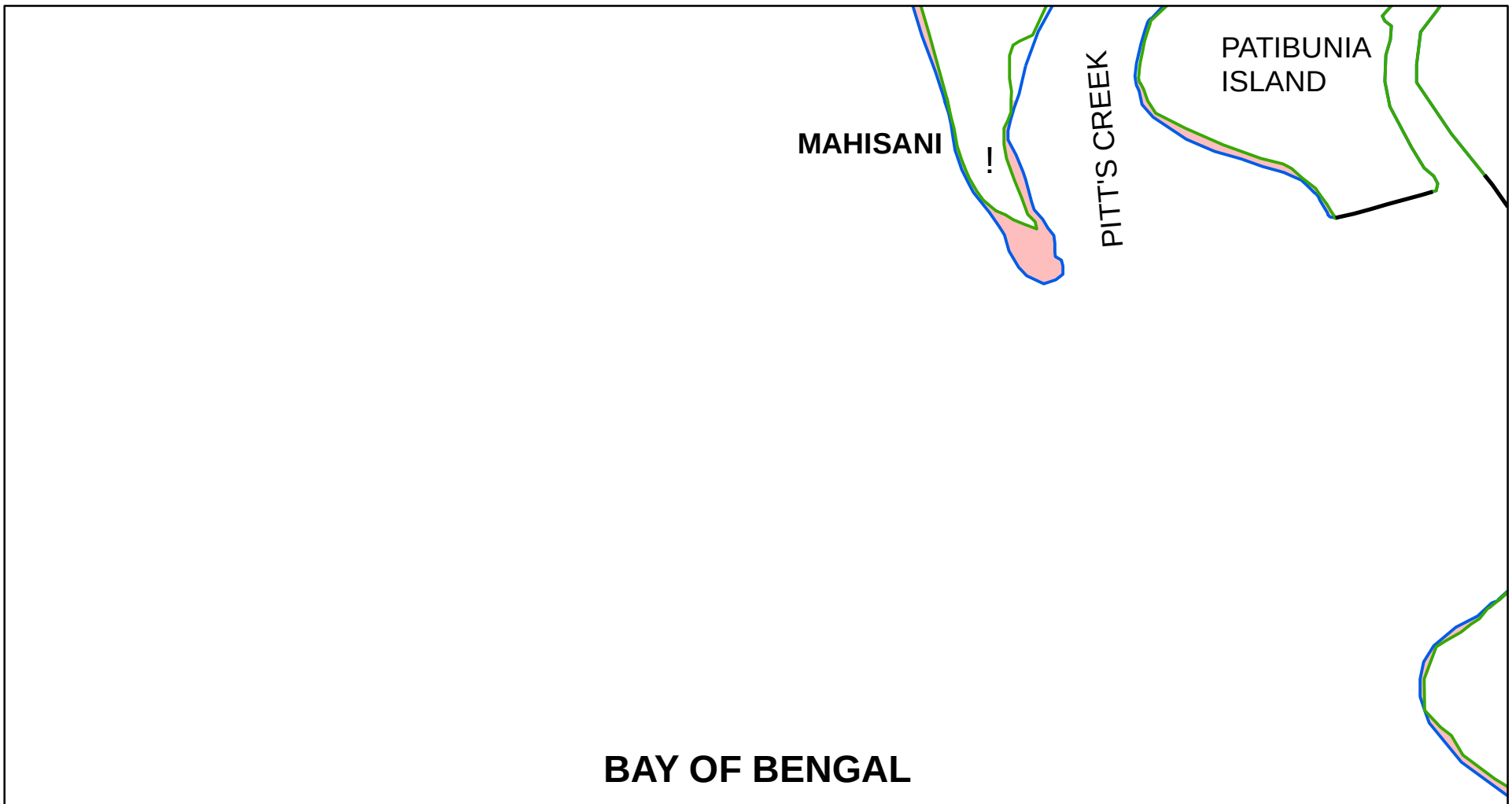
24 PARGANAS DISTRICT

SHEET NO. 79C02SE



Legend

- EROSION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79C02 NW	79C02 NE	79C06 NW
79C02 SW		79C06 SW
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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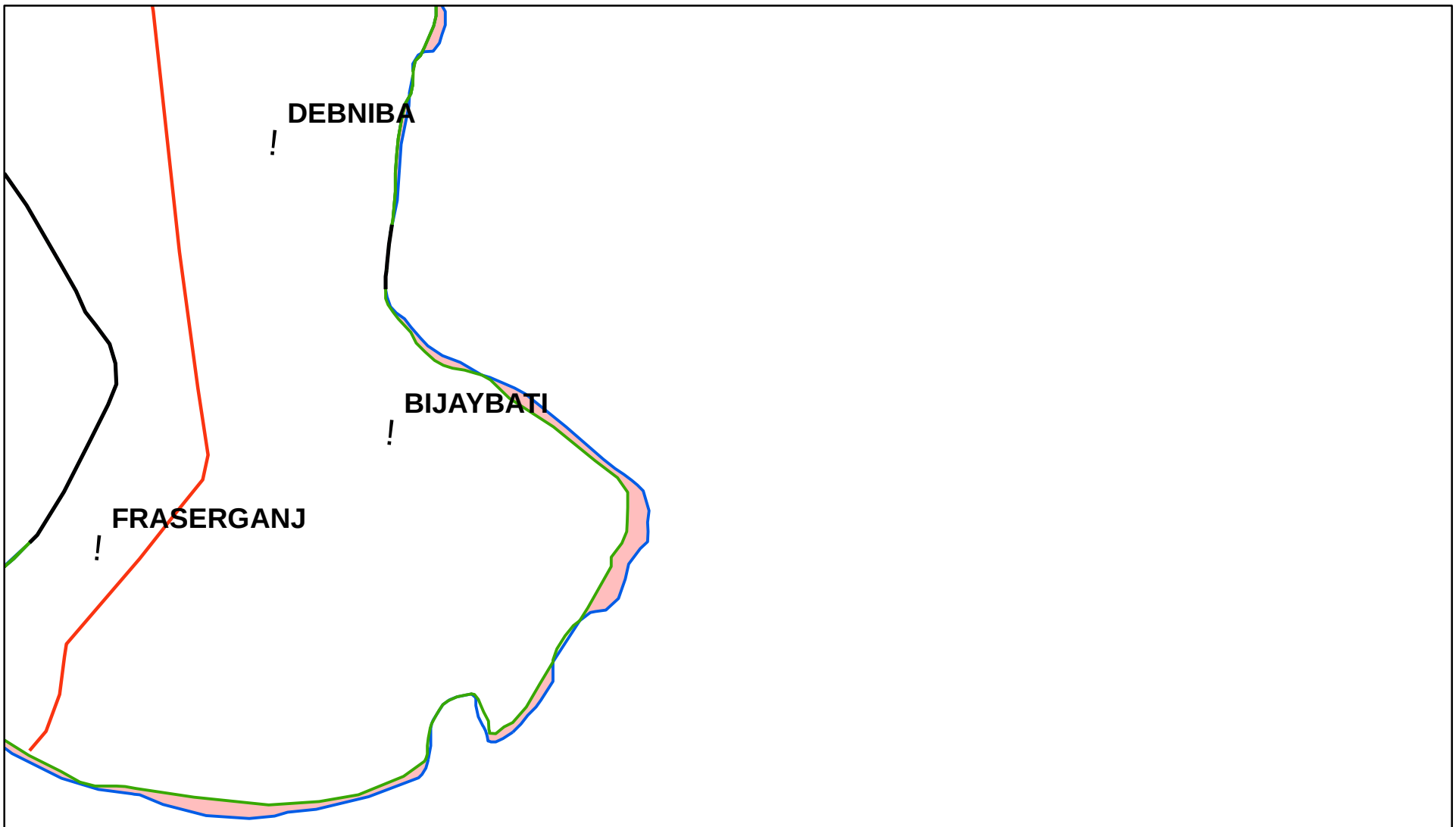
24 PARGANAS DISTRICT

SHEET NO. 79C06SW



Legend

- EROSION
- ACCRETION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- ROAD

0 2

Scale in Km

INDEX TO SHEETS

79C02 NE	79C06 NW	79C06 NE
79C02 SE		79C06 SE
SEA	SEA	SEA

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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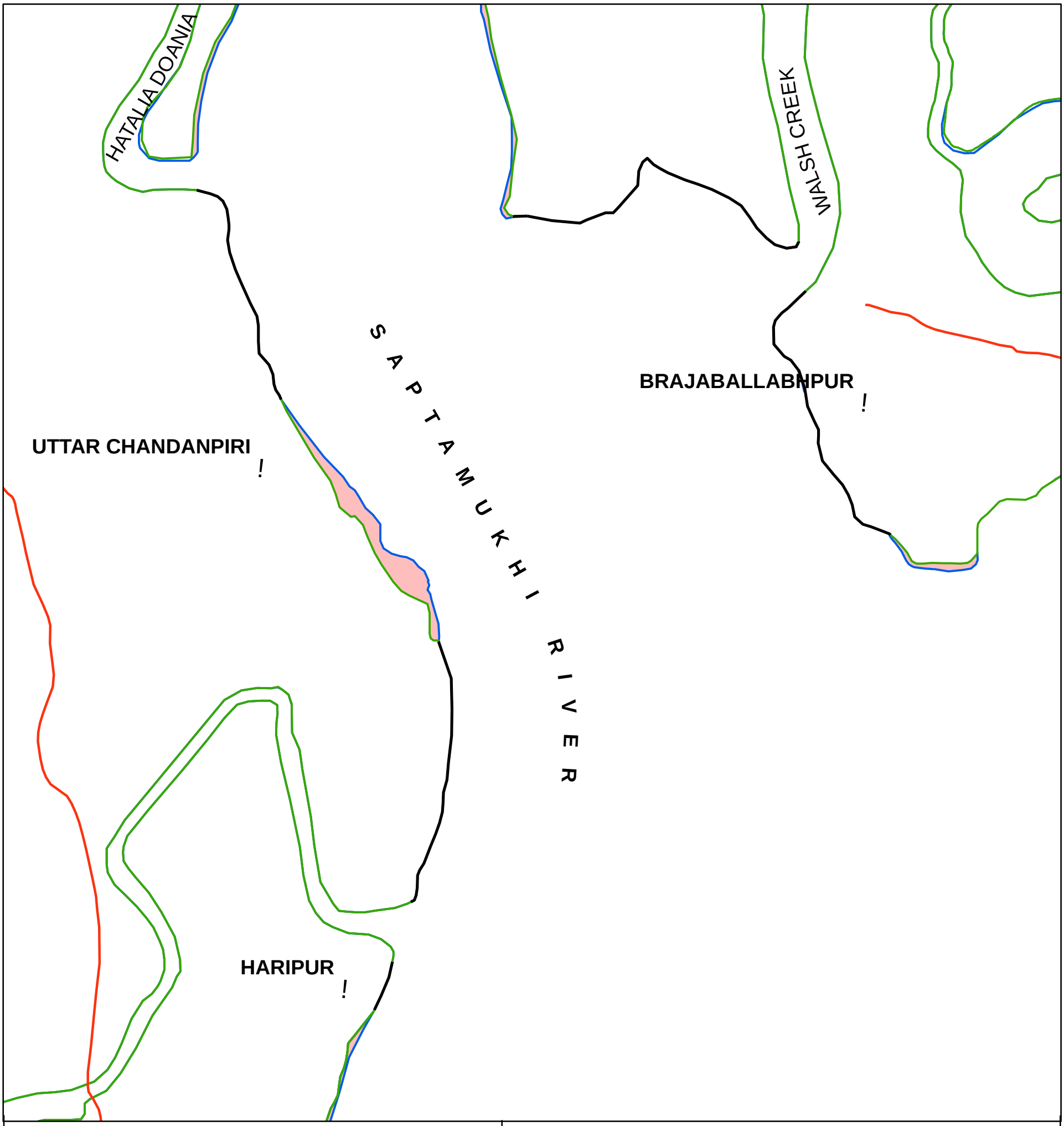
24 PARGANAS DISTRICT

SHEET NO. 79C06NW



Legend

- EROSION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- ROAD

0 2

Scale in Km

INDEX TO SHEETS

79C01 SE	79C05 SW	79C05 SE
79C02 NE		79C06 NE
79C02 SE	79C06 SW	79C06 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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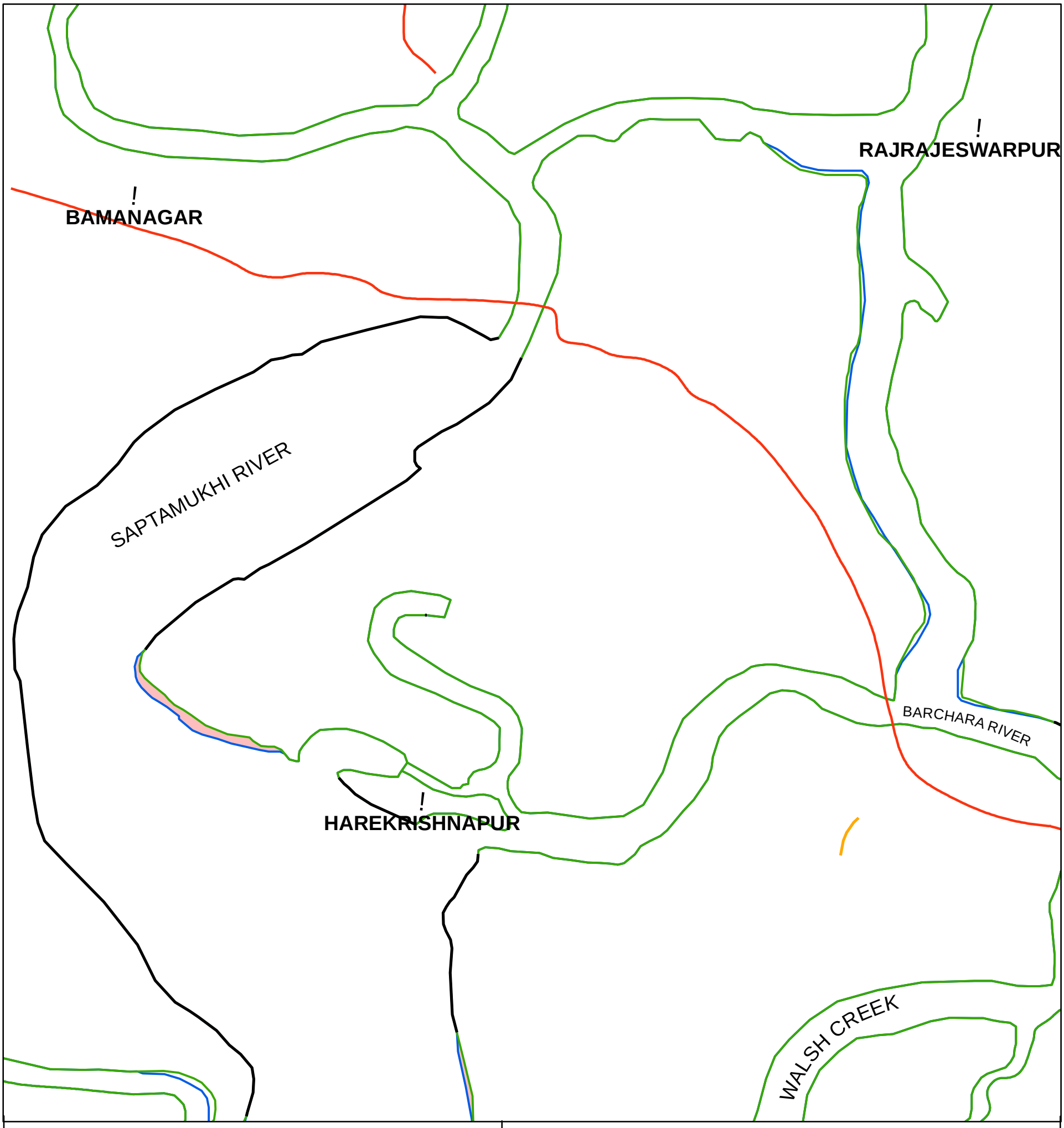
24 PARGANAS DISTRICT

SHEET NO. 79C05SW



Legend

- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- CONCRETE WALL

0 2

Scale in Km

INDEX TO SHEETS

79C01 NE	79C05 NW	79C05 NE
79C01 SE		79C05 SE
79C02 NE	79C06 NW	79C06 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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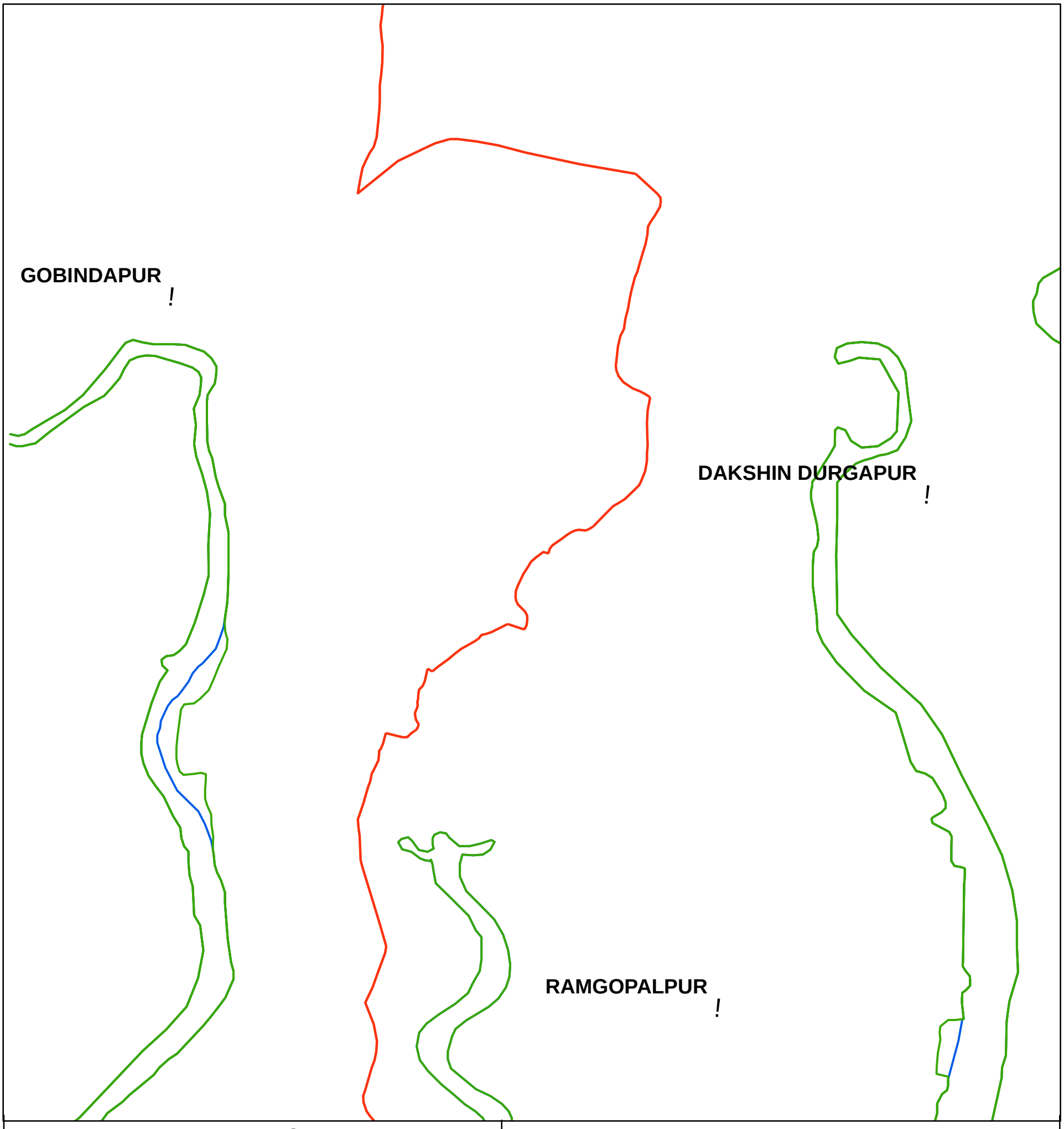
24 PARGANAS DISTRICT

SHEET NO. 79C05NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B04 SE	79B08 SW	79B08 SE
79C01 NE		79C05 NE
79C01 SE	79C05 SW	79C05 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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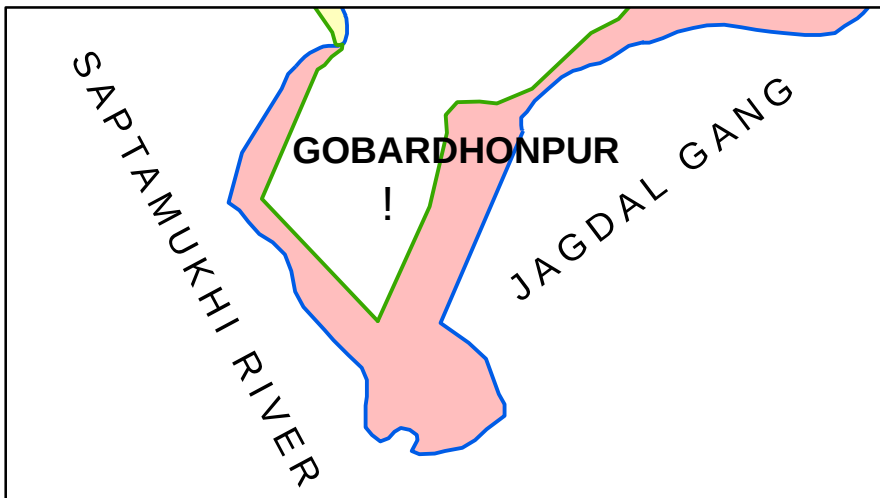
24 PARGANAS DISTRICT

SHEET NO. 79C06SE



BAY OF BENGAL

Legend

EROSION

ACCRETION

HIGH-TIDE LINE 2004-06

HIGH-TIDE LINE 1989-91

! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79C06 NW	79C06 NE	79C10 NW
79C06 SW		79C10 SW
SEA	SEA	SEA

DATA SOURCE:

SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:

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AND CENTRAL WATER COMMISSION, NEW DELHI

SHORELINE CHANGE MAP

WEST BENGAL

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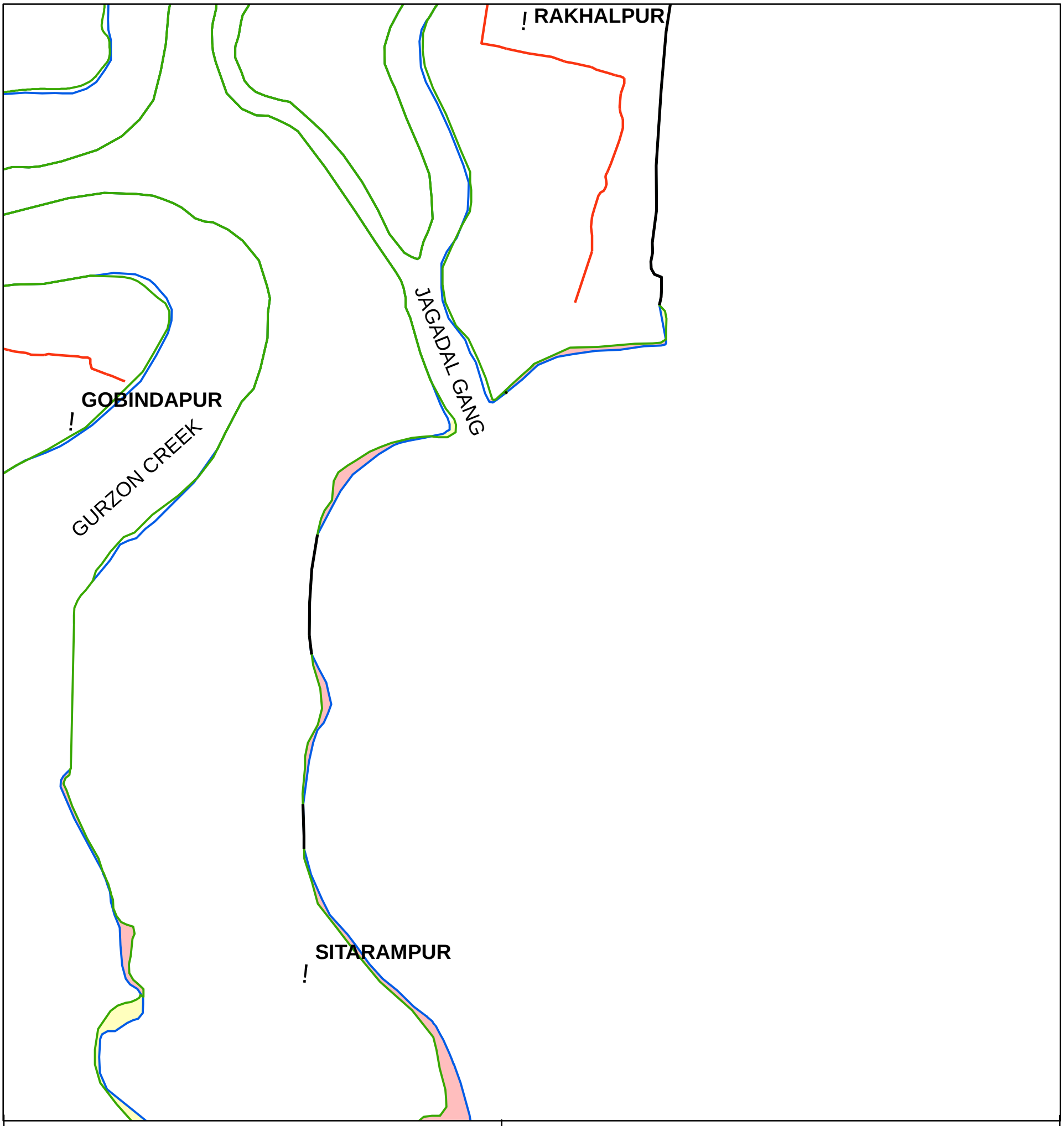
24 PARGANAS DISTRICT

SHEET NO. 79C06NE



Legend

- EROSION
- ACCRETION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- ROAD

0 2

Scale in Km

INDEX TO SHEETS

79C05 SW	79C05 SE	79C09 SW
79C06 NW		79C10 NW
79C06 SW	79C06 SE	79C10 SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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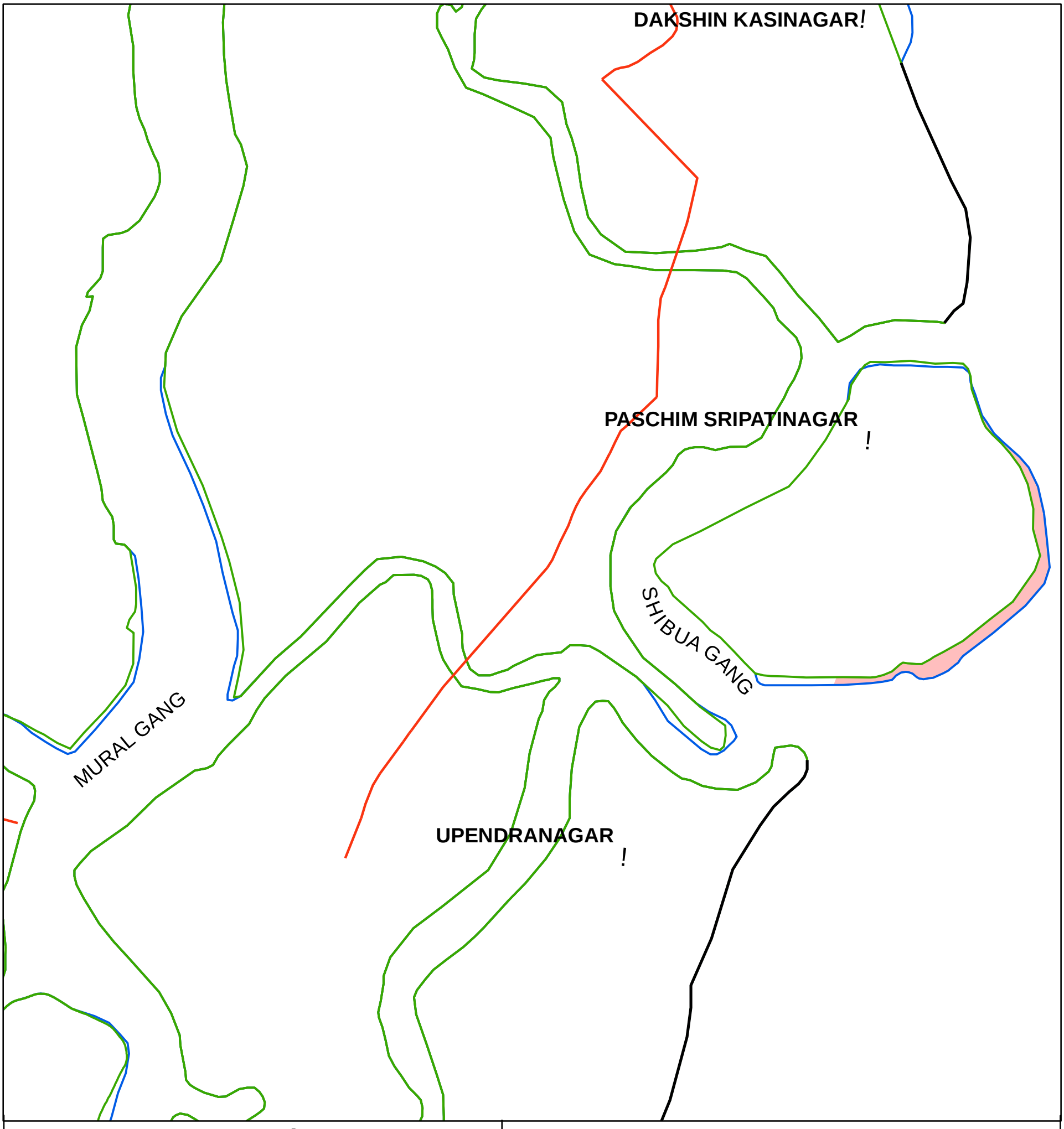
24 PARGANAS DISTRICT

SHEET NO. 79C05SE



Legend

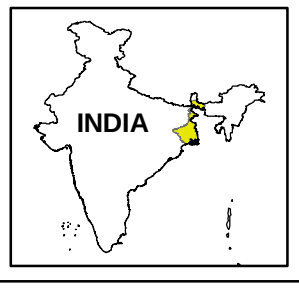
- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79C05 NW	79C05 NE	79C09 NW
79C05 SW		79C09 SW
79C06 NW	79C06 NE	79C10 NW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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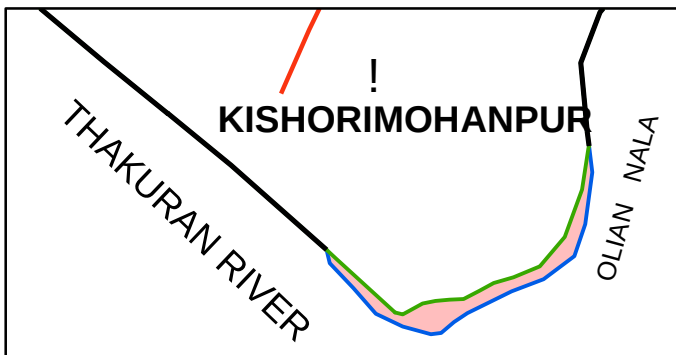
SOUTH 24 PARGANAS DISTRICT

SHEET NO. 79C09SW



BAY OF BENGAL

Legend

- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79C05 NE	79C09 NW	79C09 NE
79C05 SE		79C09 SE
79C06 NE	79C10 NW	79C10 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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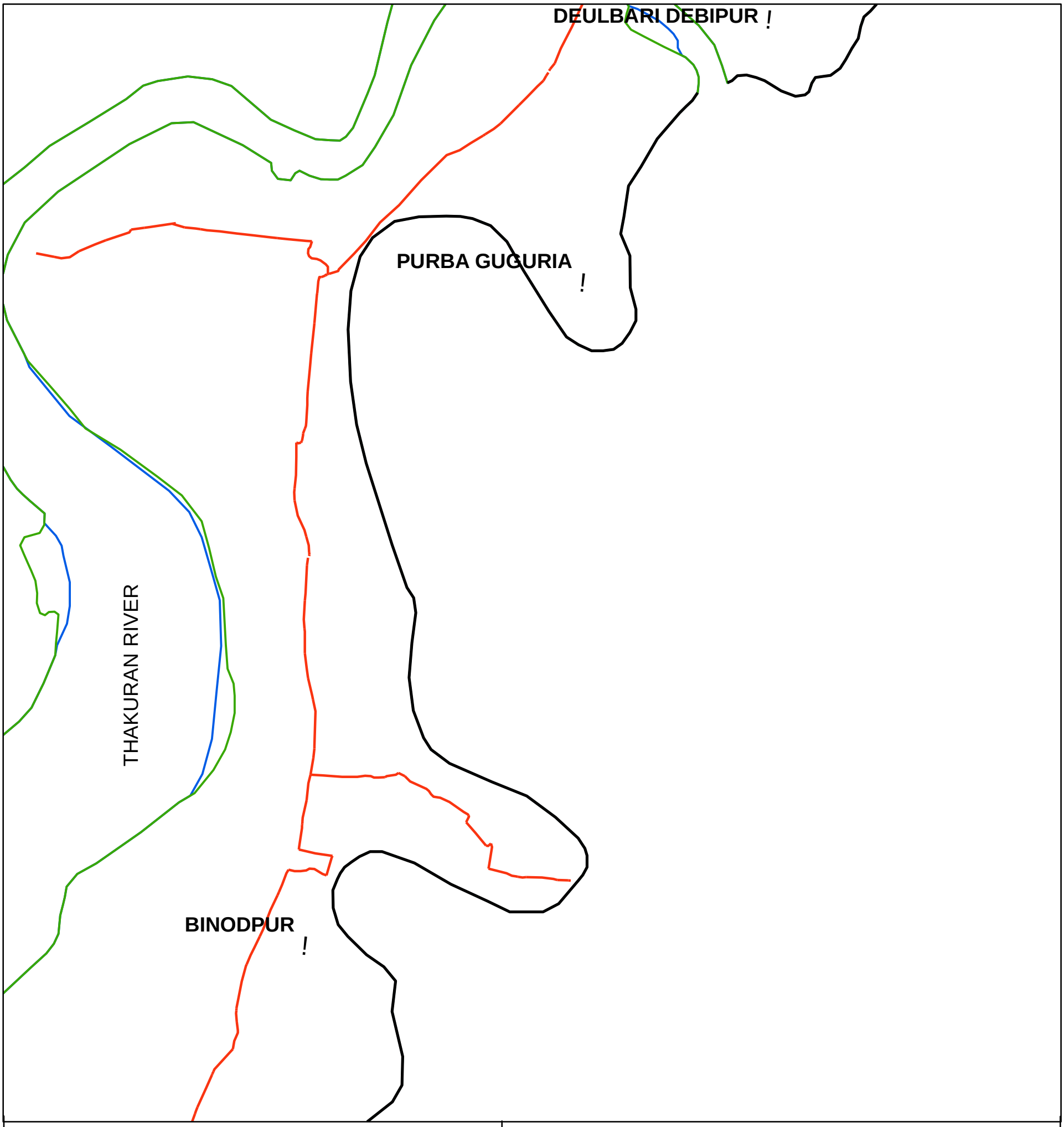
24 PARGANAS DISTRICT

SHEET NO. 79C09NW



Legend

- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B08 SE	79B12 SW	79B12 SE
79C05 NE		79C09 NE
79C05 SE	79C09 SW	79C09 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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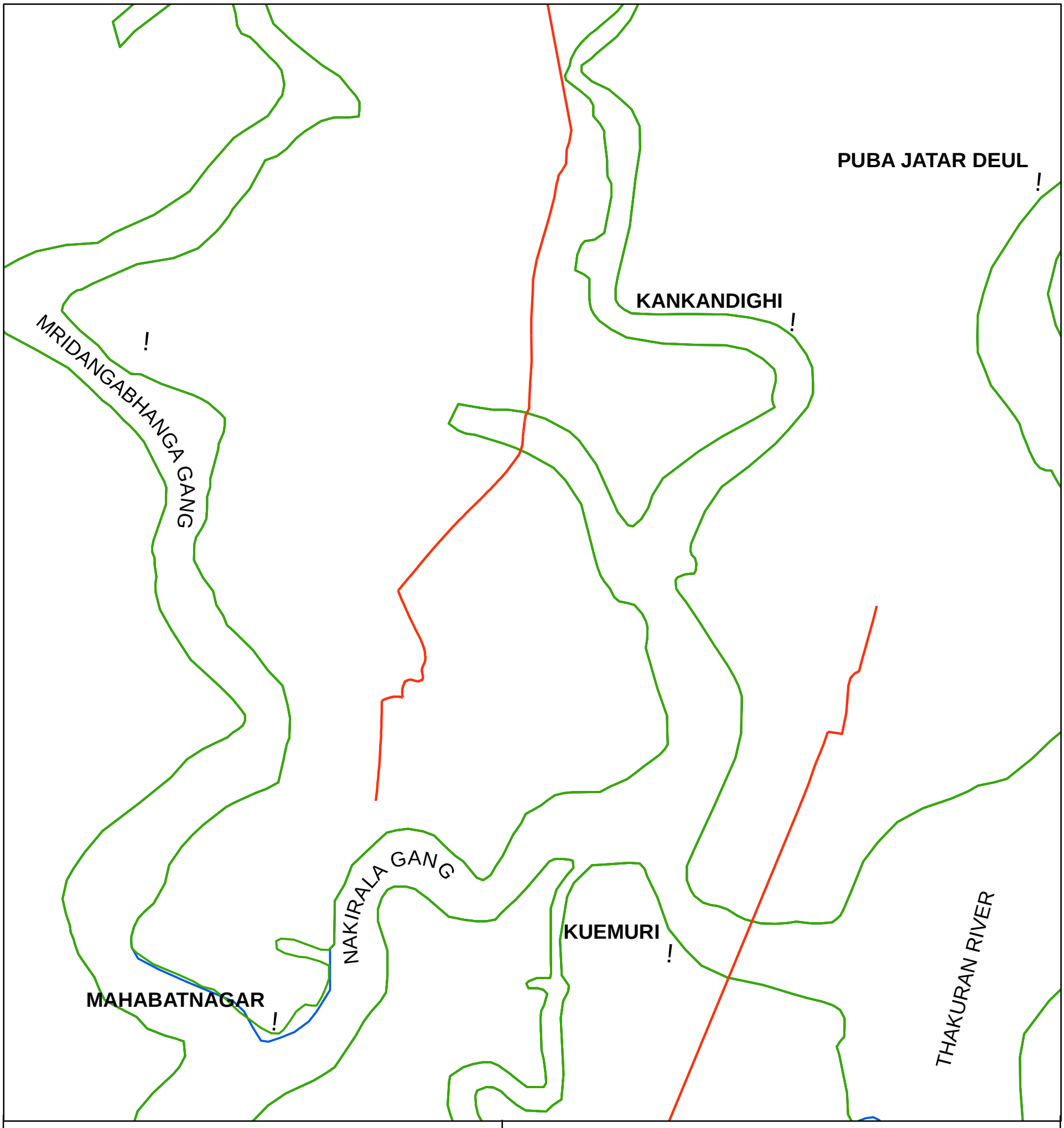
24 PARGANAS DISTRICT

SHEET NO. 79C05NE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B08 SW	79B08 SE	79B12 SW
79C05 NW		79C09 NW
79C05 SW	79C05 SE	79C09 SW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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24 PARGANAS DISTRICT

SHEET NO. 79B12SW

KULTALA GANG

NABIPUKR NALA

KAIKHALI !

DEULBARI !

THAKURAN RIVER

DAKSHIN DURGAPUR !

Legend

- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B08 NE	79B12 NW	79B12 NE
79B08 SE		79B12 SE
79C05 NE	79C09 NW	79C09 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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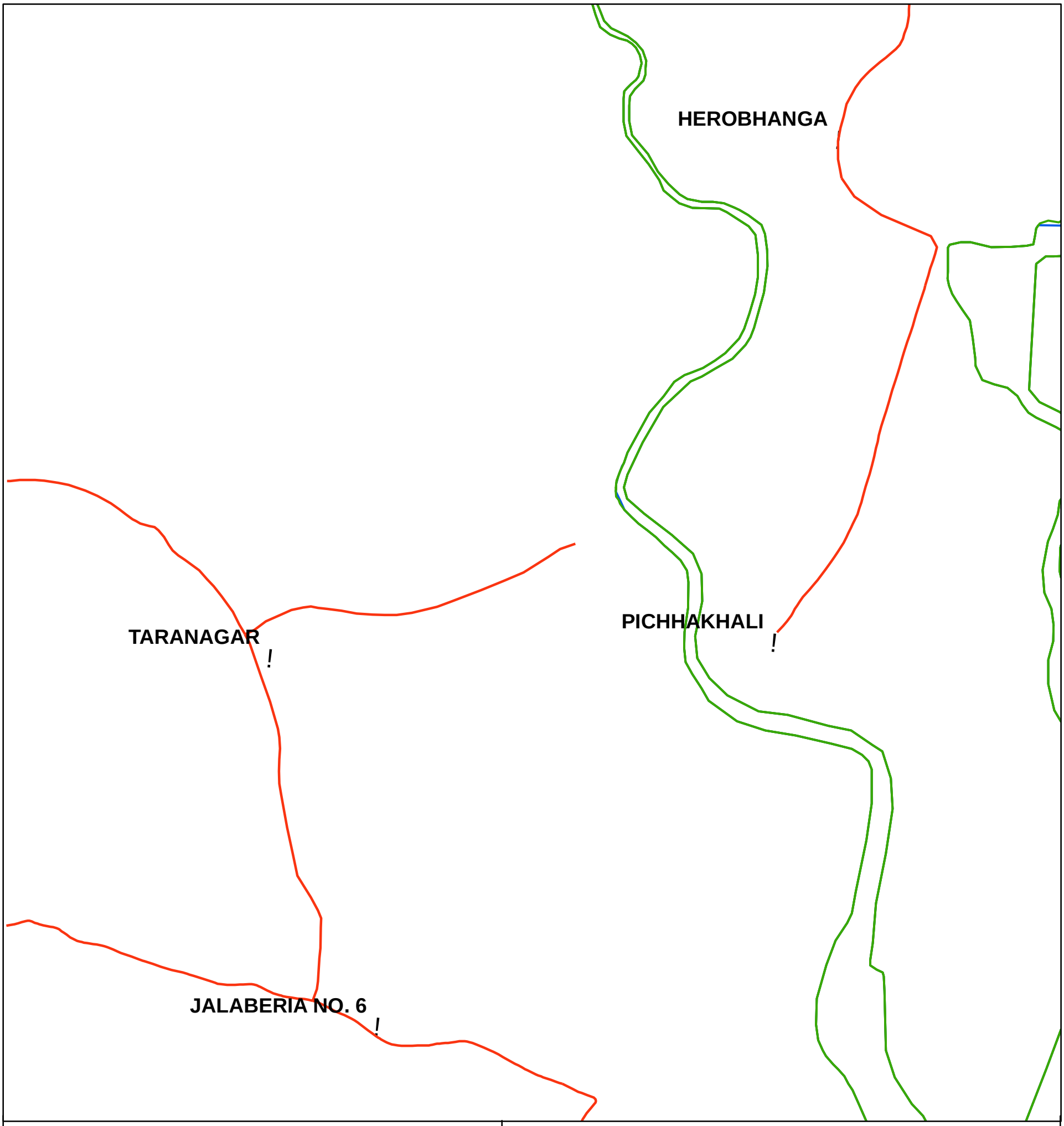
24 PARGANAS DISTRICT

SHEET NO. 79B12NW



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B07 SE	79B11 SW	79B11 SE
79B08 NE		79B12 NE
79B08 SE	79B12 SW	79B12 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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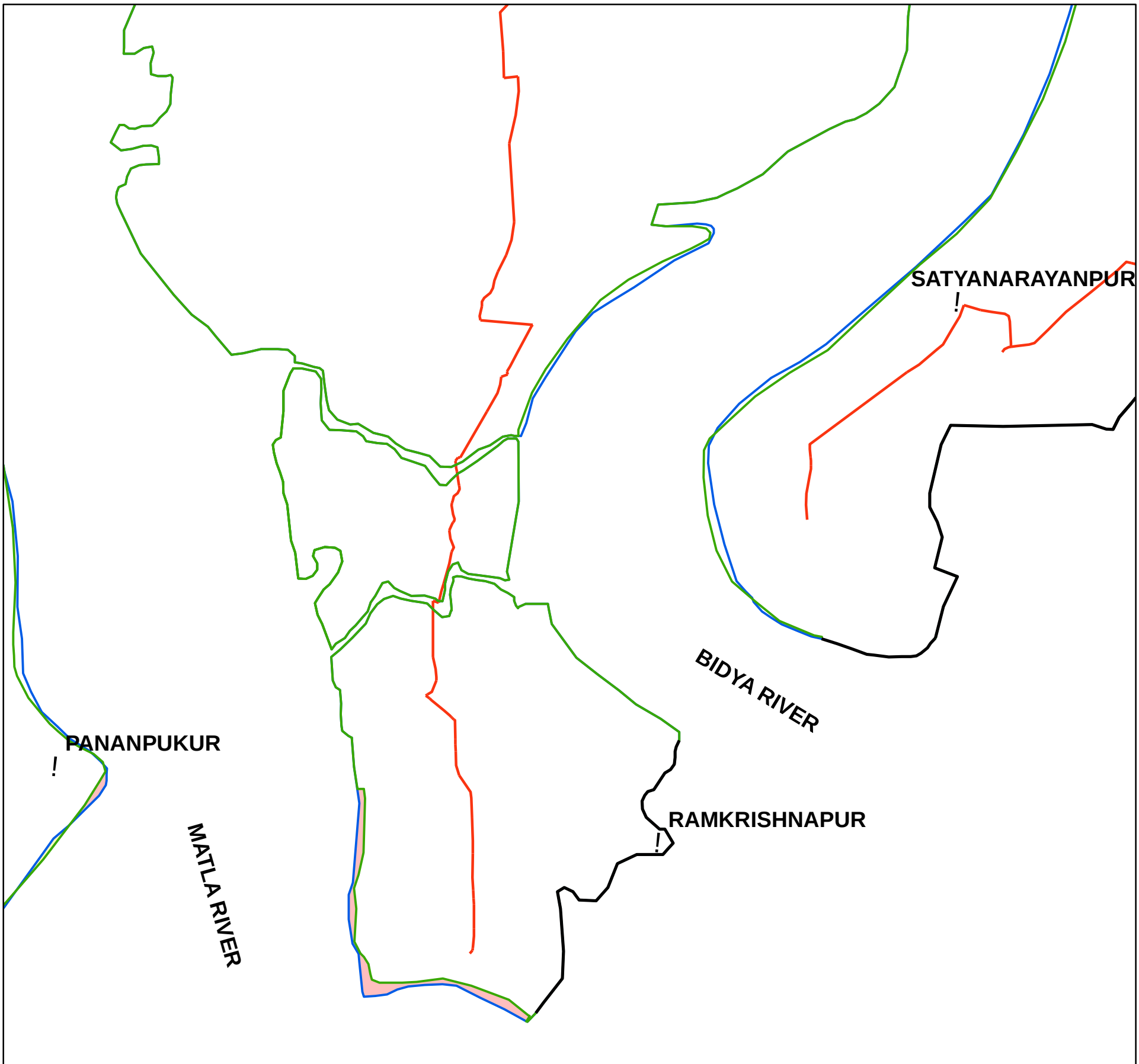
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

24 PARGANAS DISTRICT

SHEET NO. 79B12SE



Legend

- EROSION
- ACCRETION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B12 NW	79B12 NE	79B16 NW
79B12 SW		79B16 SW
79C09 NW	79C09 NE	79C13 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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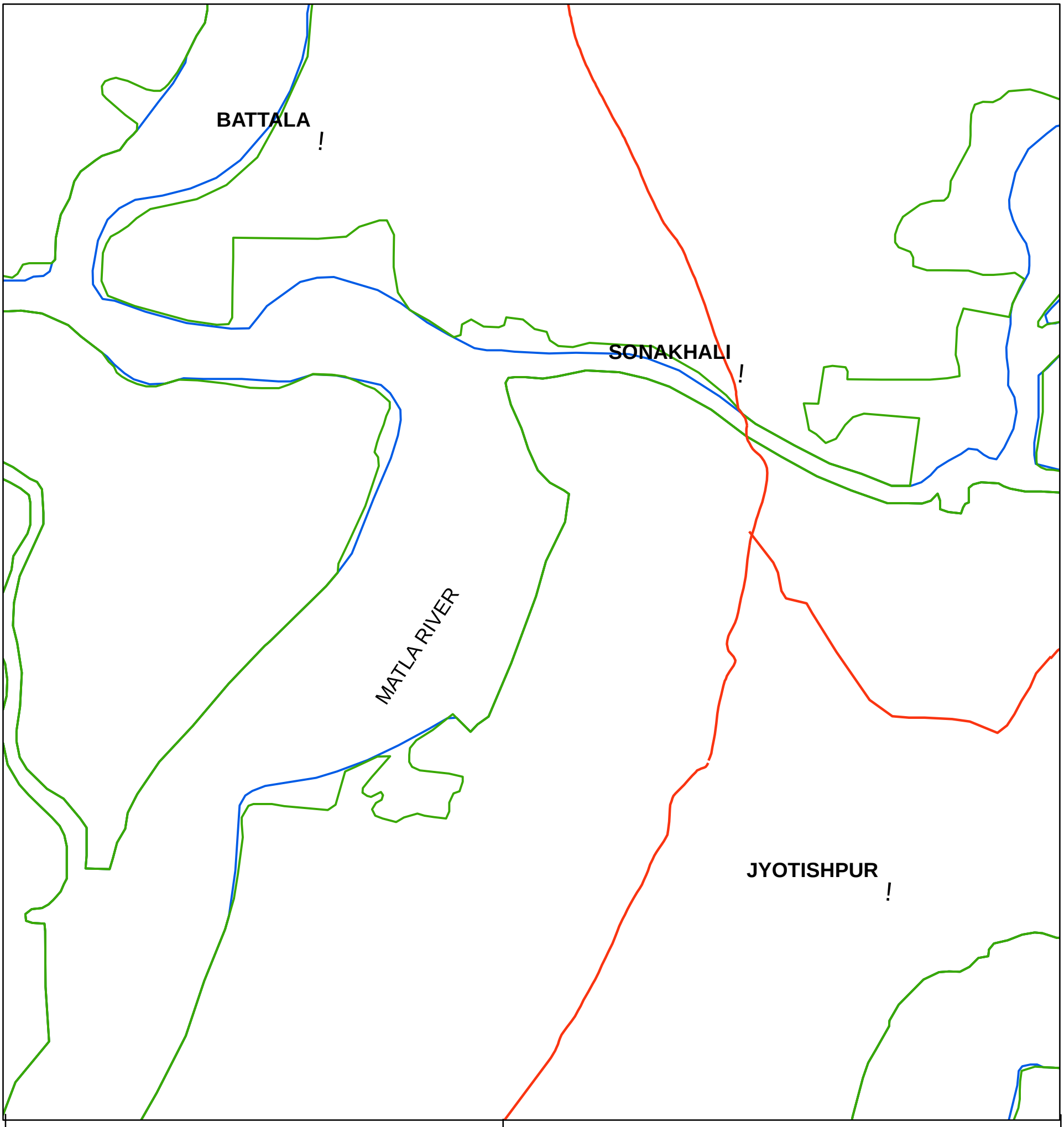
24 PARGANAS DISTRICT

SHEET NO. 79B12NE



Legend

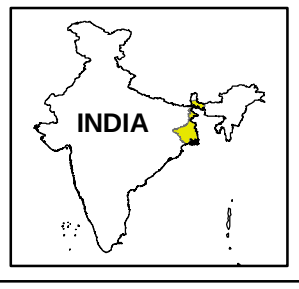
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B11 SW	79B11 SE	79B15 SW
79B12 NW		79B16 NW
79B12 SW	79B12 SE	79B16 SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
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SHORELINE CHANGE MAP

WEST BENGAL

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24 PARGANAS DISTRICT

SHEET NO. 79B11SE

KHAS KUMARKHALI

MAUKHALI

KHERIA

MATLA RIVER

Legend

- ROAD
- RAIL
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B11 NW	79B11 NE	79B15 NW
79B11 SW		79B15 SW
79B12 NW	79B12 NE	79B16 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

WEST BENGAL

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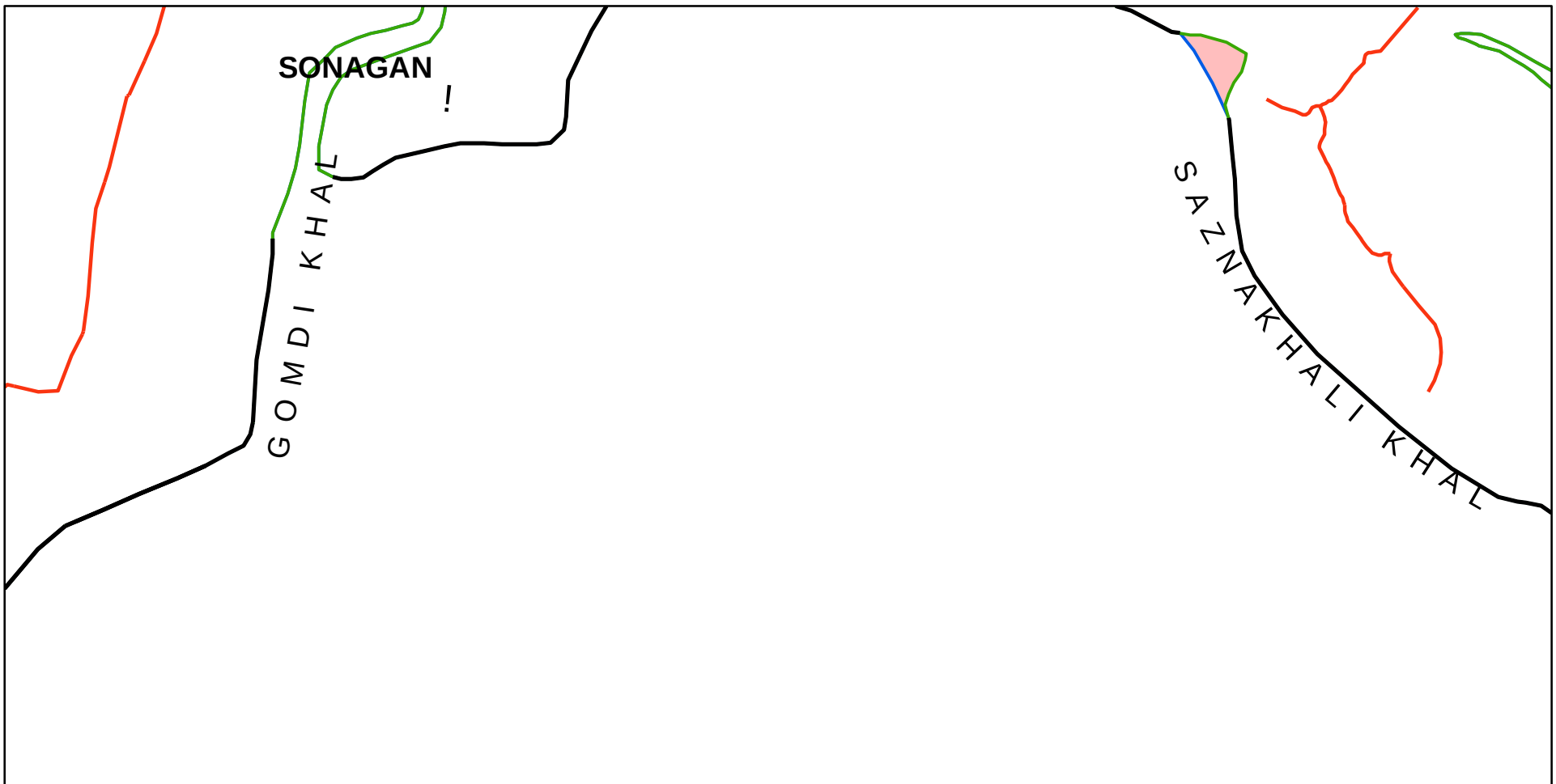
24 PARGANAS DISTRICT

SHEET NO. 79B16SW



Legend

- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B12 NE	79B16 NW	79B16 NE
79B12 SE		79B16 SE
79C09 NE	79C13 NW	79C13 NE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

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SHORELINE CHANGE MAP

WEST BENGAL

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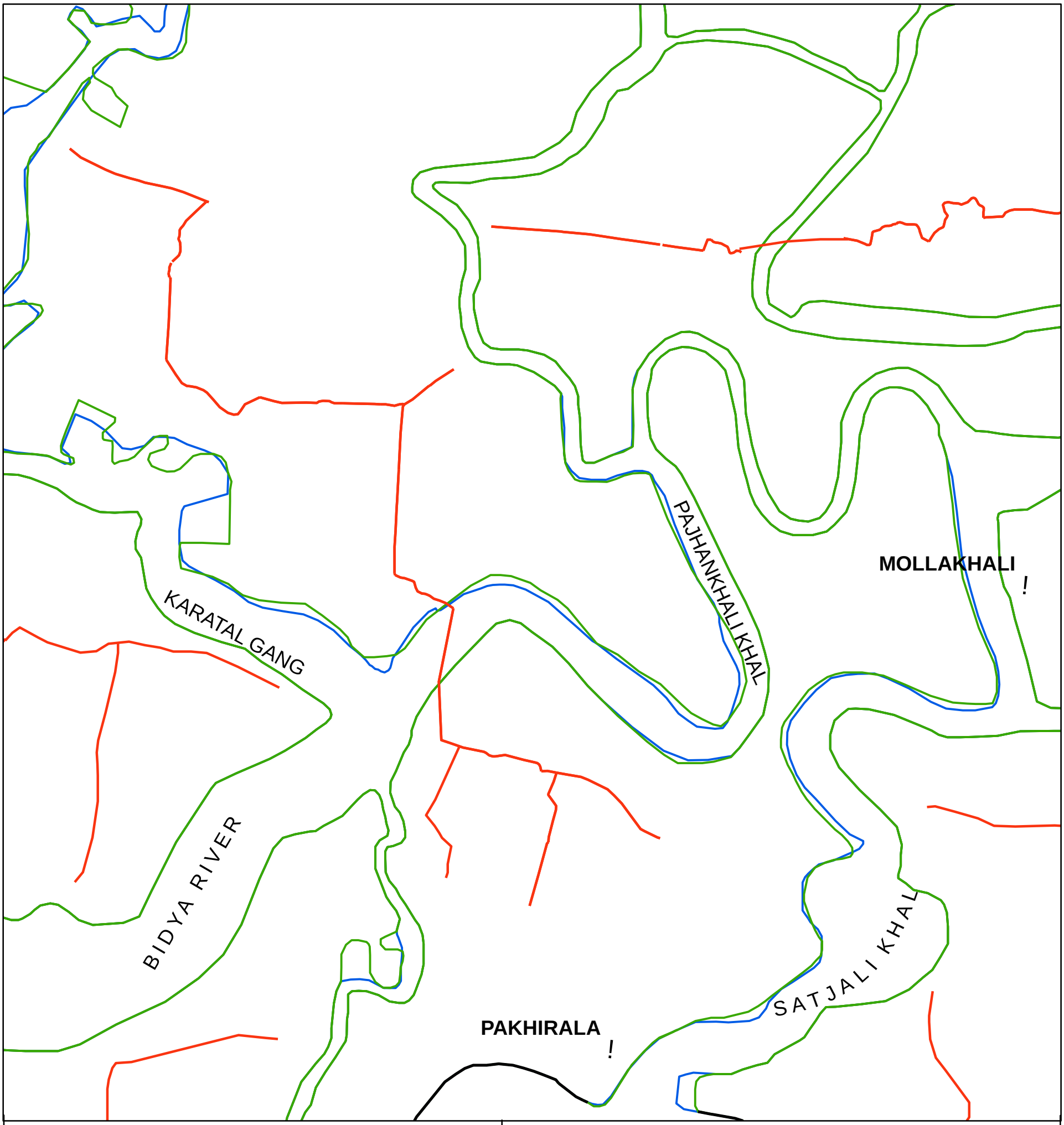
24 PARGANAS DISTRICT

SHEET NO. 79B16NW



Legend

- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B11 SE	79B15 SW	79B15 SE
79B12 NE		79B16 NE
79B12 SE	79B16 SW	79B16 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

WEST BENGAL

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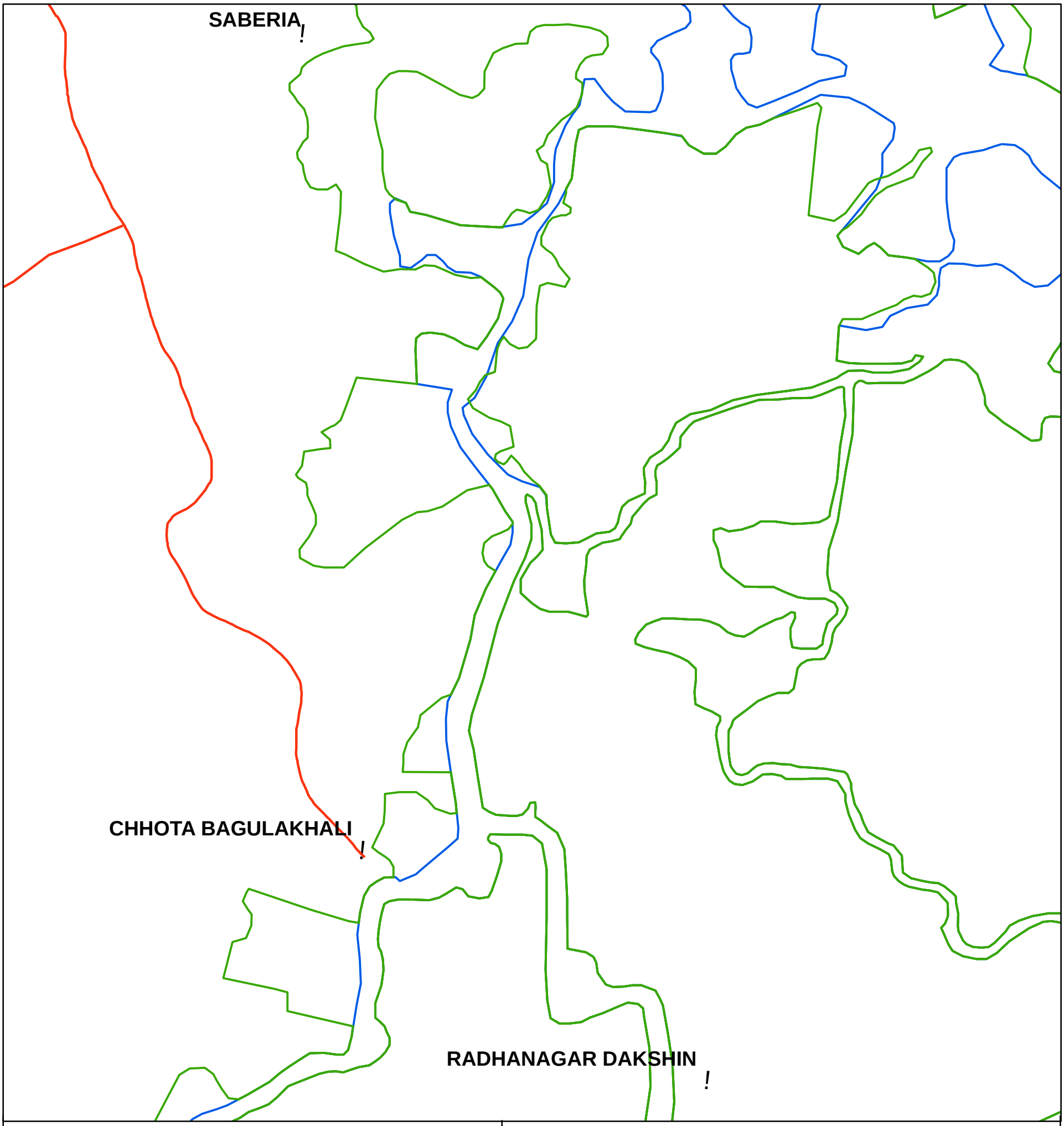
24 PARGANAS DISTRICT

SHEET NO. 79B15SW



Legend

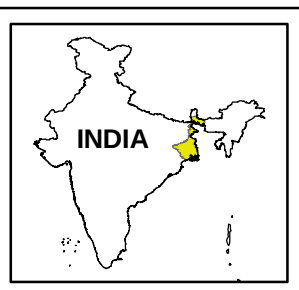
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B11 NE	79B15 NW	79B15 NE
79B11 SE		79B15 SE
79B12 NE	79B16 NW	79B16 NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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SHORELINE CHANGE MAP

WEST BENGAL

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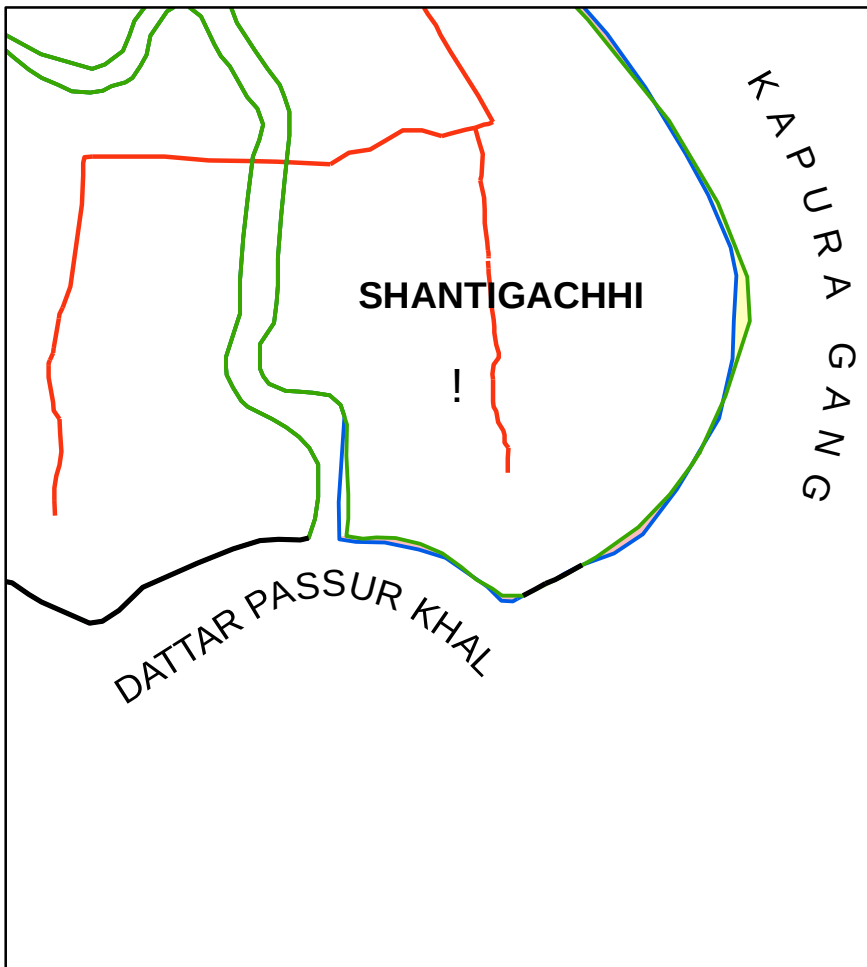
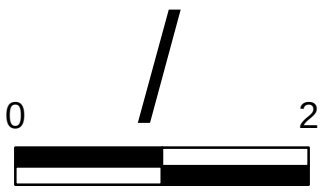
24 PARGANAS DISTRICT

SHEET NO. 79B16SE



Legend

- EROSION
- ACCRETION
- STABLE
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION
- ROAD



INDEX TO SHEETS

79B16 NW	79B16 NE	79F04 NW
79B16 SW		79F04 SW
79C13 NW	79C13 NE	79G01 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

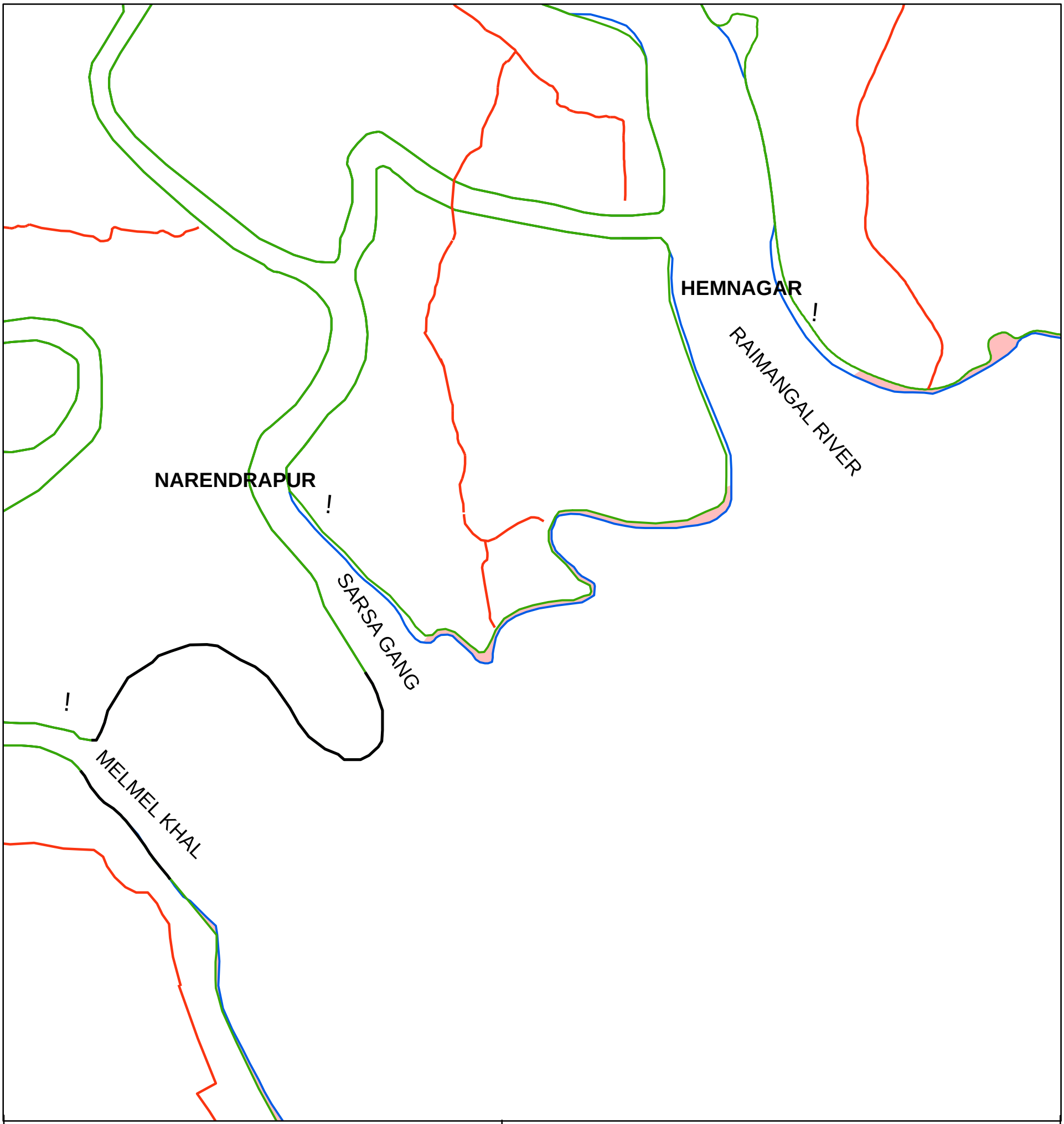
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

NORTH 24 PARGANAS DISTRICT

SHEET NO. 79B16NE



Legend

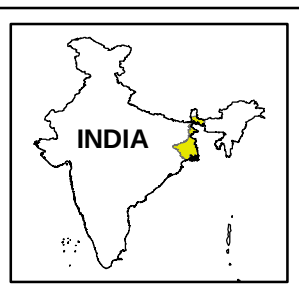
- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 — 2

Scale in Km

INDEX TO SHEETS

79B15 SW	79B15 SE	79F03 SW
79B16 NW		79F04 NW
79B16 SW	79B16 SE	79F04 SW



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

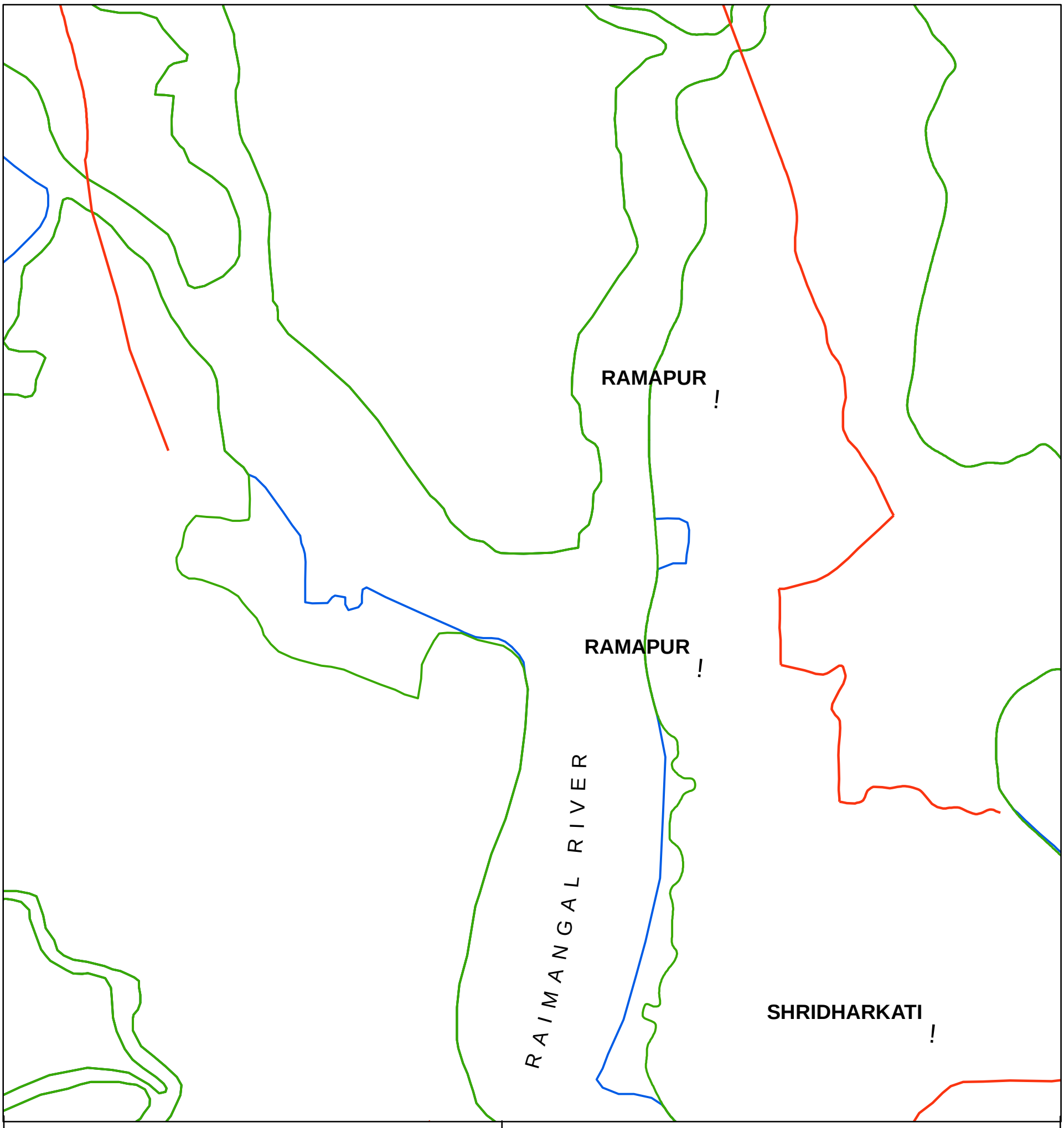
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

24 PARGANAS DISTRICT

SHEET NO. 79B15SE



Legend

- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B15 NW	79B15 NE	79F03 NW
79B15 SW		79F03 SW
79B16 NW	79B16 NE	79F04 NW

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
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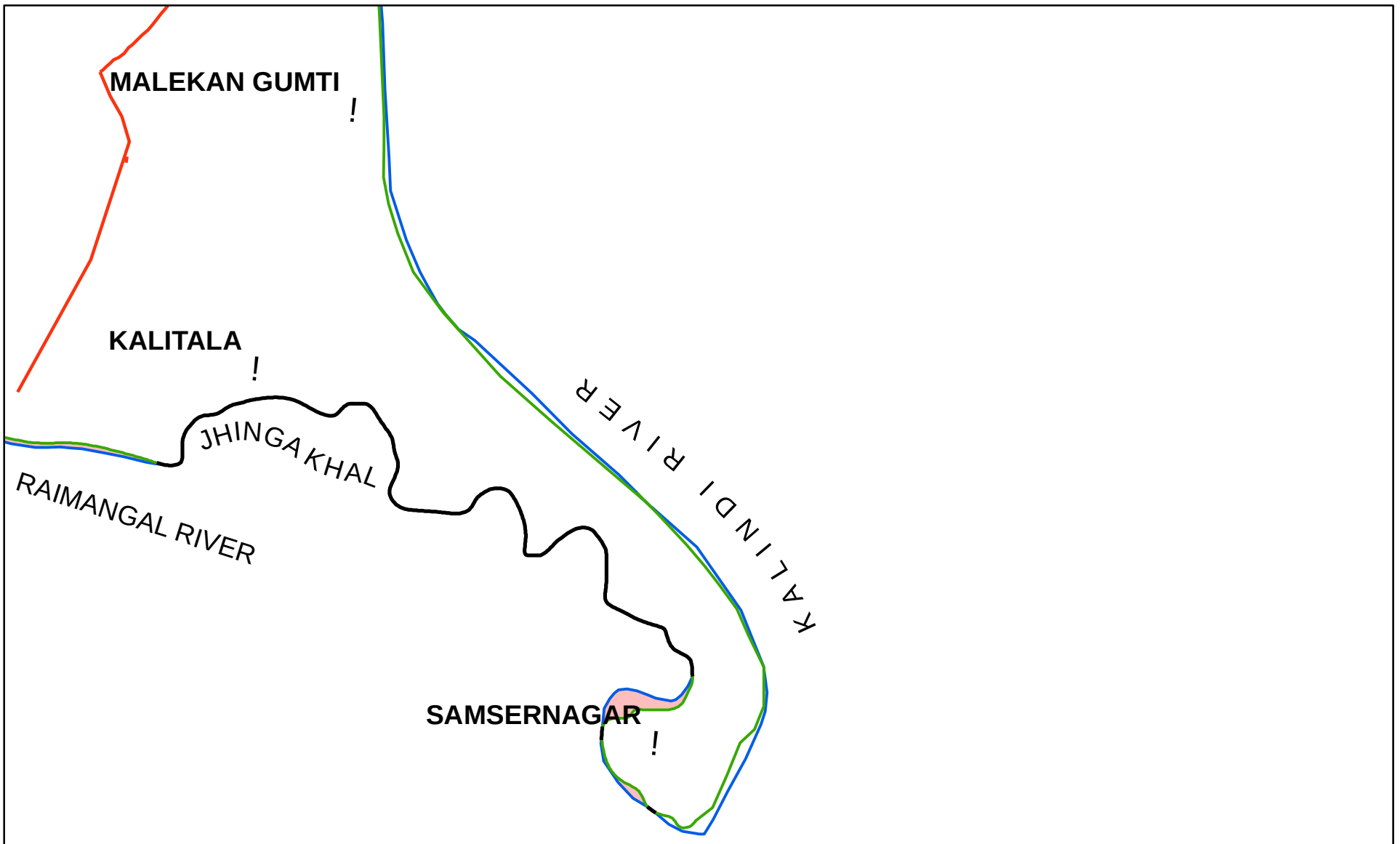
SHORELINE CHANGE MAP

WEST BENGAL

FOR OFFICIAL USE ONLY

24 PARGANAS DISTRICT

SHEET NO. 79F04NW



Legend

- EROSION
- STABLE
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B15 SE	79F03 SW	79F03 SE
79B16 NE		79F04 NE
79B16 SE	79F04 SW	79F04 SE

DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

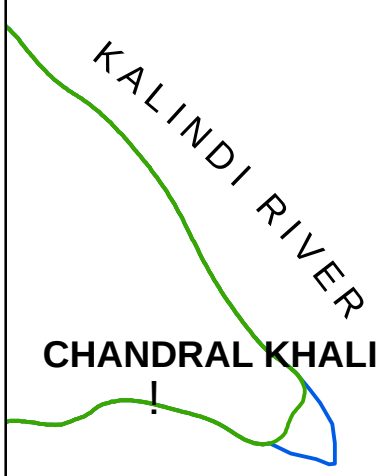
SHORELINE CHANGE MAP

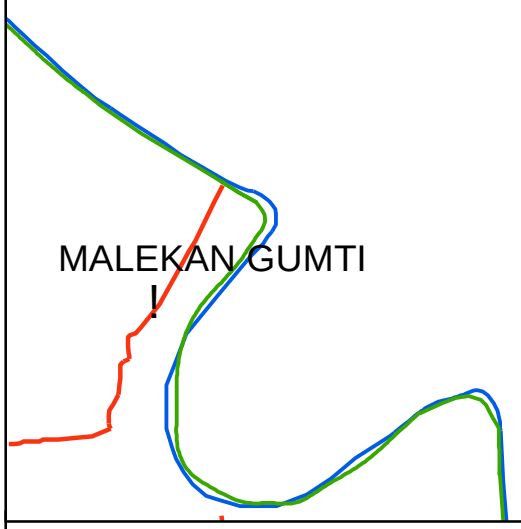
WEST BENGAL

FOR OFFICIAL USE ONLY

24 PARGANAS DISTRICT

SHEET NO. 79F03SW





Legend

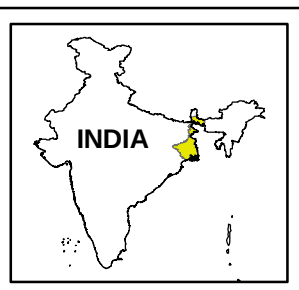
- ROAD
- HIGH-TIDE LINE 2004-06
- HIGH-TIDE LINE 1989-91
- ! HABITATION

0 2

Scale in Km

INDEX TO SHEETS

79B15 NE	79F03 NW	79F03 NE
79B15 SE		79F03 SE
79B16 NE	79F04 NW	79F04 NE



DATA SOURCE:
SATELLITE IMAGES OF 1989-91 & 2004-06

PREPARED BY:
SPACE APPLICATIONS CENTRE , AHMEDABAD
AND CENTRAL WATER COMMISSION, NEW DELHI

Annexure-II

(Plates)

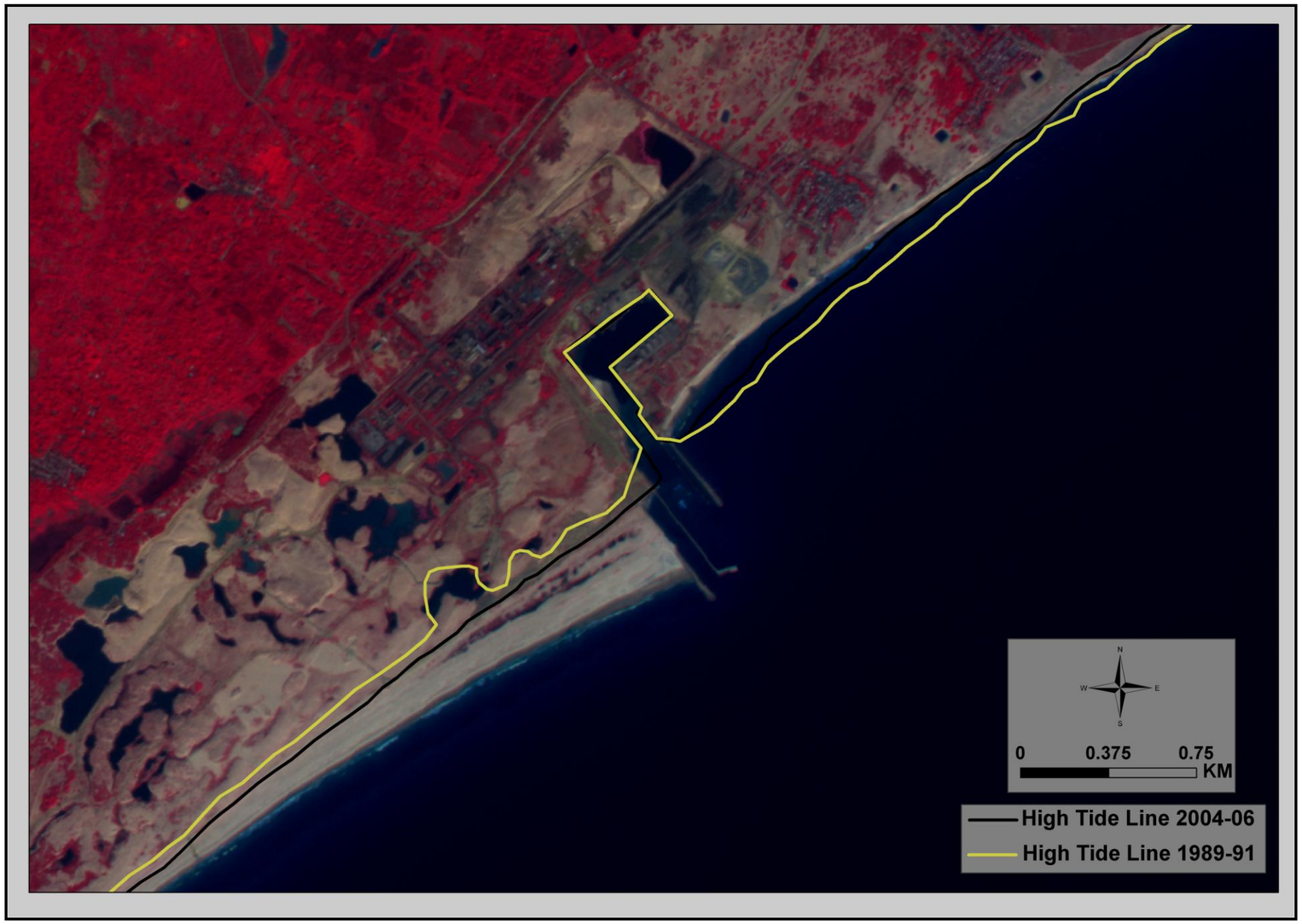


Plate 1: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing accretion and erosion along the Gopalpur Port region (74A15SE).

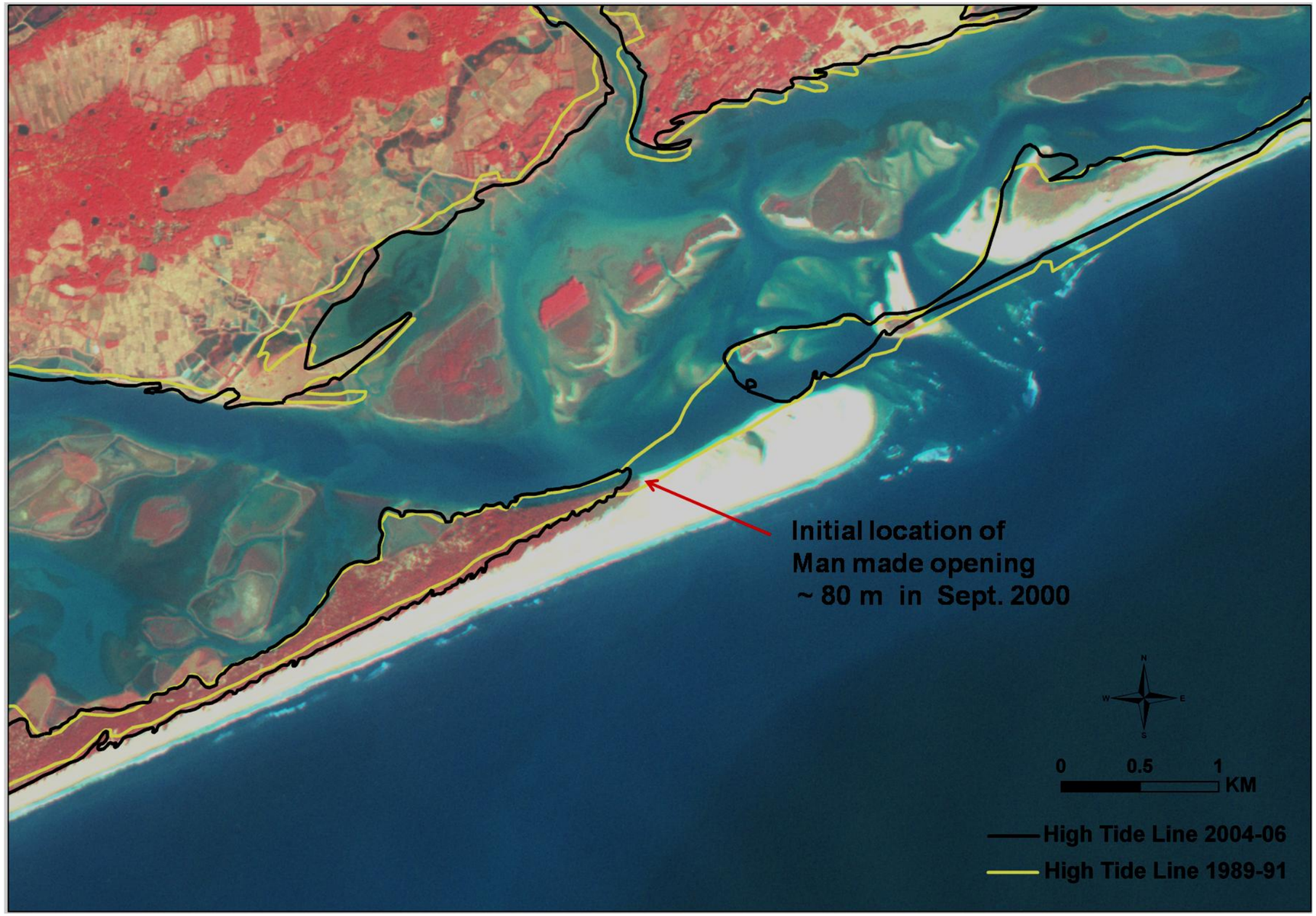


Plate 2: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing the changes in spit and inlet near Sipakuda, Chilika lagoon (74E10NW and 74E06NE).

Plate 3: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing severe erosion at Bhitikolia River mouth (73L08SE).

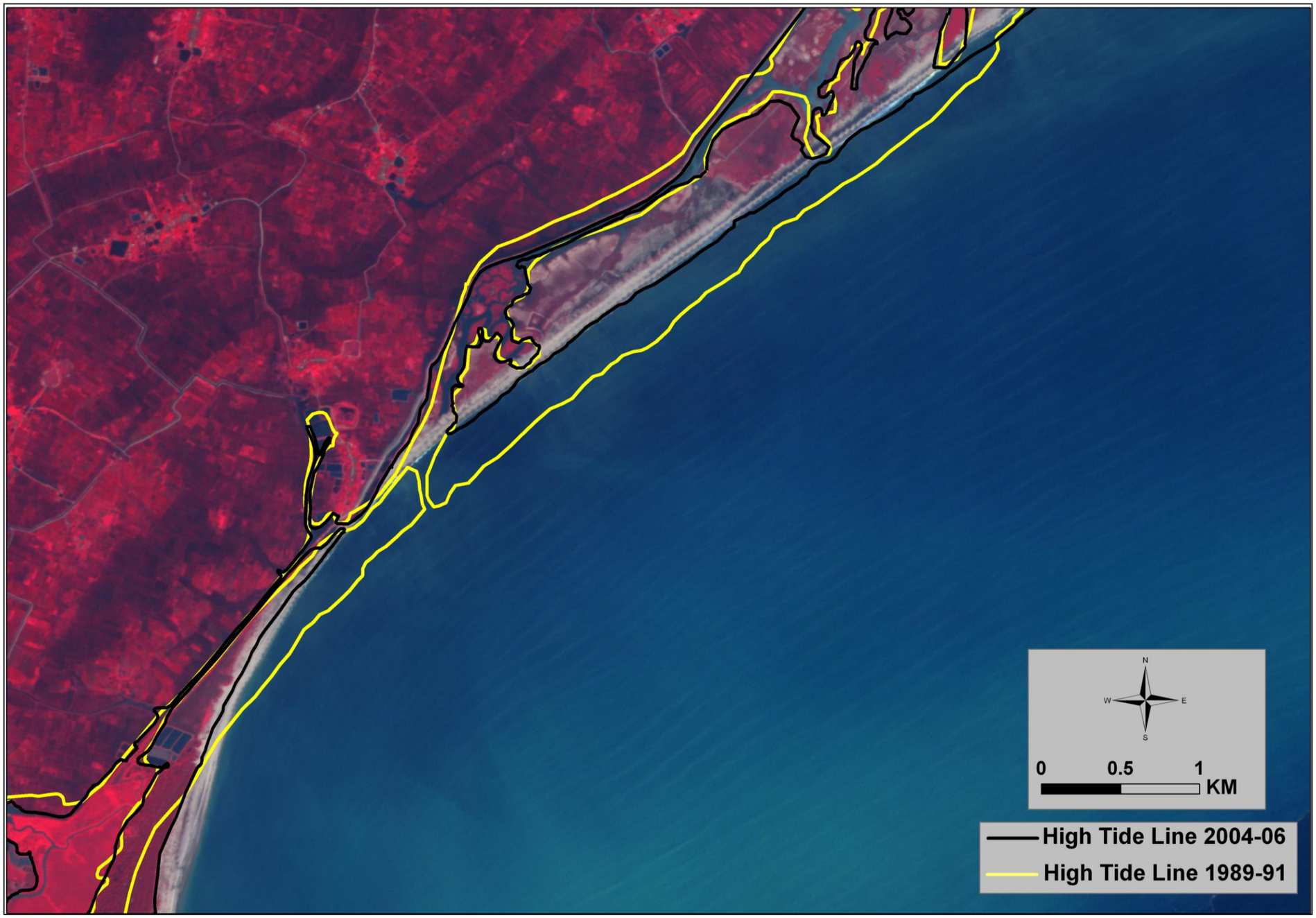


Plate 4: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing sever erosions at Pentha Village in Cuttack District (73L14SW).

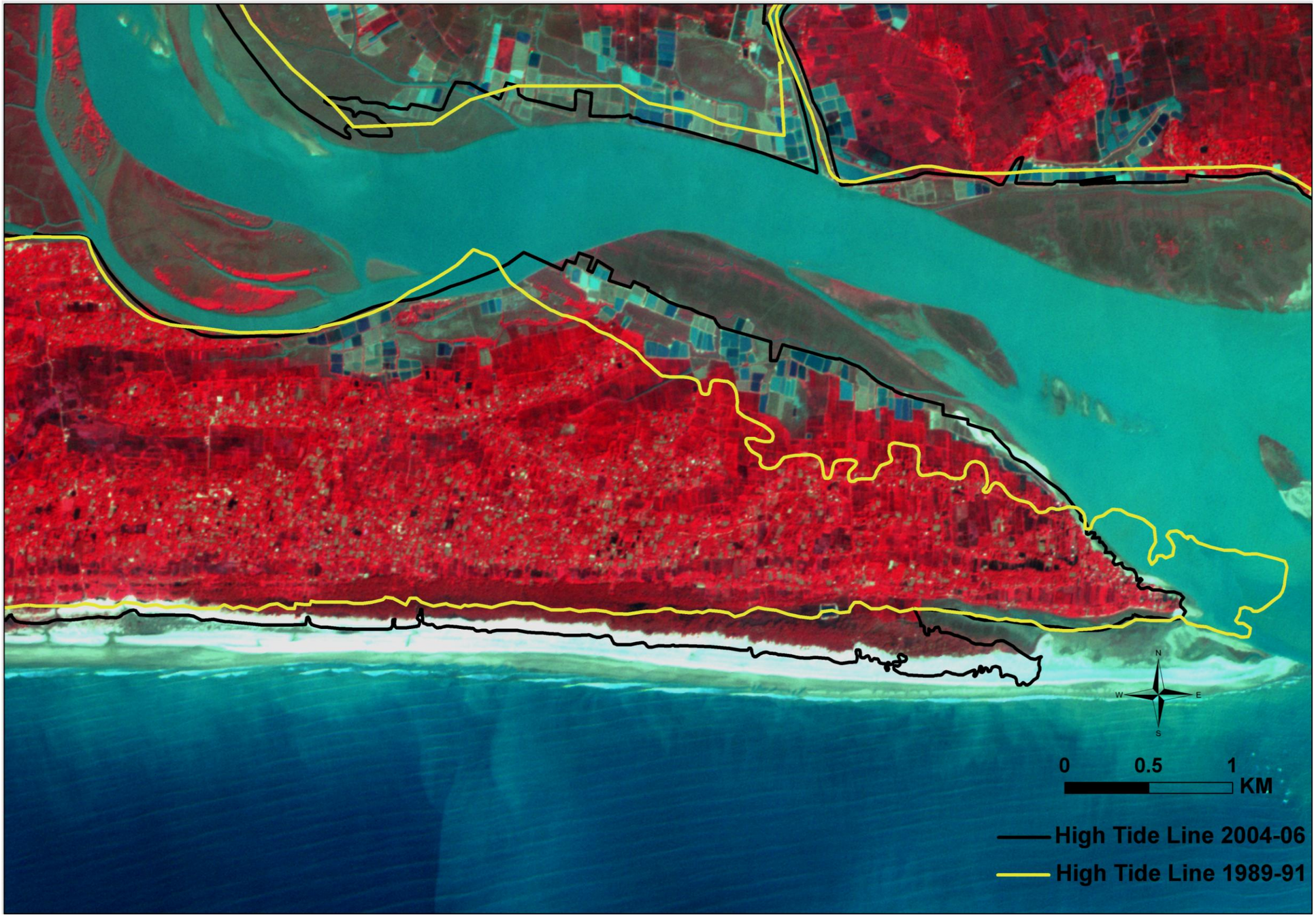


Plate 5: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing the coastal dynamics at Subarnarekha River mouth in Baleshwar District (73O06SW).

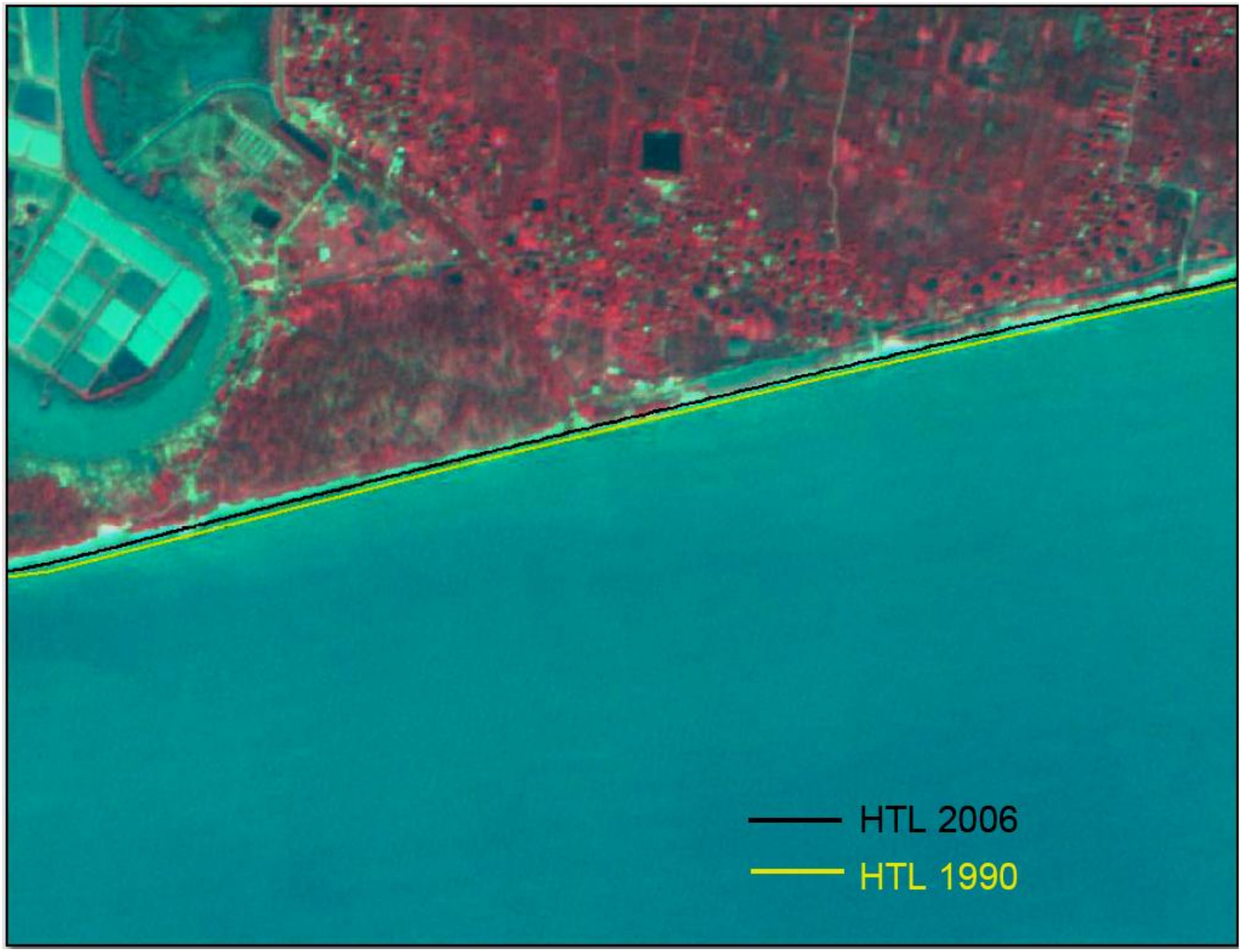


Plate 6: 2011-12 LISS IV image overlaid with high tide line of 2004-06 and 1989-91, showing the eroding coastal stretch of Sankarpur, West Bengal (map Sheet no. 73O10NW)

FIELD PHOTOGRAPHS: ODISHA

Plate 7: Wide beach at Ramyapeta (74A16NW) north of Bahuda estuary on southern Odisha coast

Plate 8: Ramyapeta beach under erosion (74A16NW) north of Bahuda estuary on southern Odisha coast

Plate 9: Waves scarring the Ramyapeta beach (74A16NW) north of Bahuda estuary on southern Odisha coast

Plate 10: Turtle nesting camp at Ramyapeta beach (74A16NW) north of Bahuda estuary on southern Odisha coast

Plate 11: Turtle nesting camp at Ramyapeta beach (74A16NW) north of Bahuda estuary on southern Odisha coast

Plate 12: Stable to slightly accreting coast north of Markandi (74A16NW) north of Bahuda estuary

Plate 13: Beach erosion at Gopalpur, south of Haripur creek (74A15SE) on southern Odisha coast

Plate 14: Steep scarp at Gopalpur beach, south of Haripur creek (74A15SE) on southern Odisha coast

Plate 15: Accretion on southern side of New Gopalpur Port (74A15SE) on southern Odisha coast

Plate 16: Groyne constructed for beach nourishment on northern parts of Old Gopalpur Port (74A15SE) on southern Odisha coast

Plate 17: Groyne under construction for beach nourishment on northern parts of Old Gopalpur Port (74A15SE) on southern Odisha coast

Plate 18: Wide beach at Naliyanuagan, south of Rushikulya estuary (74E03 SW) on southern Odisha coast

Plate 19: Steep scarp indicating current beach erosion at Naliyanuagan, south of Rushikulya estuary (74E03 SW) on southern Odisha coast

Plate 20: Northwards developing spit on Rushikulya estuary (74E03 SW & 74E03 NW) on southern Odisha coast

Plate 21: Accretion on the northern coast of Rushikulya estuary (74E03 NW) on southern Odisha coast

Plate 22: Erosion at coast near Prayagi, south of Paikarapur (southern most part of Chilika lagoon (74E03 NE) on southern Odisha coast

Plate 23: Stable coast south of Satpara on outer spit ~ 5 km south of new mouth (74E06 NE) on southern Odisha coast

Plate 24: Spit developed from the western bank of the man-made opening near Sipakuda, Chilika lagoon (74E10 NW) on southern Odisha coast

Plate 25: Previous natural inlet on the easternmost part of the outer channel of the Chilika lagoon closed by accretion (74E10NW)

Plate 26: Spit growth from the western bank led to NE wards shifting of the inlet near Sipakuda, Chilika lagoon (74E10 NW) on southern Odisha coast

Plate 27: Spit growth at Sipakuda inlet, Chilika lagoon (~2 km NE wards growth of the spit since September-2000) (74E10NW)

Plate 28: Wide spit formed on southern bank of Sipakuda inlet, Chilika lagoon (74E10 NW)

Plate 29: NE wards shifted Sipakuda inlet, Chilika lagoon (74E10 NW) on southern Odisha coast

Plate 30: New inlet, near Gobakunda, Chilika lagoon (74E10NW)

Plate 31: Spit on the southern side of the New inlet, Chilika lagoon (74E10NW)

Plate 32: Western parts of Puri Beach under erosion (74E13SW)

Plate 33: Sea wall/embankment on the eastern parts of the Kushabhadra river, near Maa Ramachandi temple, Puri district, Odisha (74IO1SW)

Plate 34: Sea wall/embankment on the eastern parts of the Kushabhadra river at Maa Ramachandi temple, Puri district, Odisha (74IO1SW)

Plate 35: Beach erosion close to Marine Drive, near Chandrabhaga, Puri district, Odisha (74IO1SW)

Plate 36: Stable to accreting coast in area south of Devi estuary (74I05NW)

Plate 37: Eroding coast NE of Hansura river mouth (73L14SW) along central parts of Odisha coast

Plate 38: Severe erosion at Pentha (73L14SW) along central parts of Odisha coast

Plate 39: Protection measures wiped off by Sea at Pentha (73L14SW) along central parts of Odisha coast

Plate 40: Terrestrial vegetation under destruction due to Sea at Pentha (73L14SW) along central parts of Odisha coast

Plate 41: Embankment at Pentha (73L14SW) along central parts of Odisha coast

Plate 42: Protection of the embankment at Pentha (73L14SW) along central parts of Odisha coast

Plate 43: Earthen bund demarcating HTL at Kasia Village, Baleshwar District (73K16SW) along northern parts of Odisha coast

Plate 44: Fishing harbor near Kasia Village, Baleshwar District (73K16SW) along northern parts of Odisha coast

Plate 45: Mangroves and mud flats near Kasia Village, Baleshwar District (73K16SW) along northern parts of Odisha coast

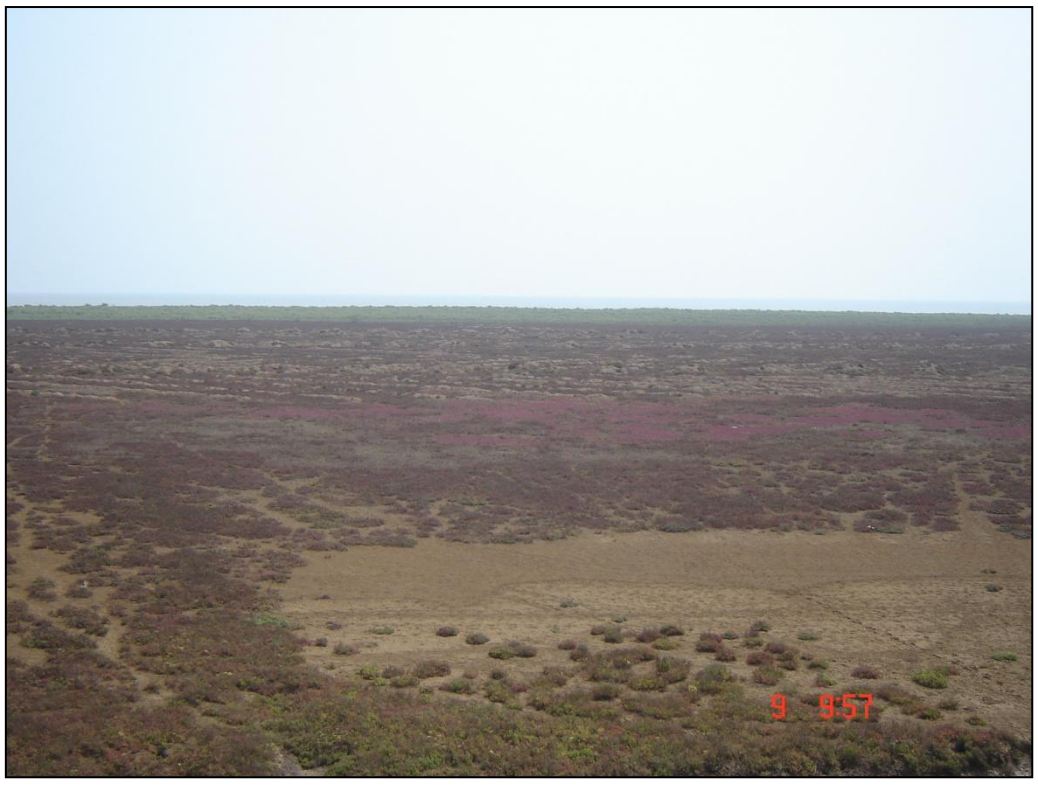


Plate 46: Mangroves and mud flats near Kasia Village, Baleshwar District (73K16SW) along northern parts of Odisha coast

Plate 47: Accreting coast near Talapad, Baleshwar District (73K15SE) along northern parts of Odisha coast

Plate 48: Extensive mud flats near Talapad, Baleshwar District (73K15SE) along northern parts of Odisha coast

Plate 49: Tidal mudflats and mangrove vegetations at Talapad, Baleshwar District (73K15SE) along northern parts of Odisha coast

Plate 50: Sea wall at Chandipur, Baleshwar District (73O03NW) along northern parts of Odisha coast

Plate 51: Sea wall at Chandipur, Baleshwar District (73O03NW) along northern parts of Odisha coast

Plate 52: Sea wall and extensive mud flats at Chandipur, Baleshwar District (73O03NW) along northern parts of Odisha coast

Plate 53: Extensive mud flats at Chandipur, Baleshwar District (73O03NW) along northern parts of Odisha coast

Plate 54: Subarnarekha estuary, Baleshwar district (73O06SW) along northern parts of Odisha coast

Plate 55: Eastern bank of Subarnarekha estuary, Baleshwar district (73O06SW) along northern parts of Odisha coast

Plate 56: Erosion along eastern parts of the Subarnarekha estuary (73O06SW), Odisha coast

Plate 57: Erosion along eastern parts of the Subarnarekha estuary (73O06SW), Odisha coast

FIELD PHOTOGRAPHS: WEST BENGAL

Plate 58: Digha (73O10SW), SW parts of West Bengal coast

Plate 59: Protection structure at Digha(73O10SW), SW parts of West Bengal coast

Plate 60: Protection measures at Digha beach (73O10SW), SW parts of West Bengal coast

Plate 61: Wave action at Digha(73O10SW), SW parts of West Bengal coast

Plate 62: Erosion and protection measures at Digha (73O10SW), SW parts of West Bengal coast

Plate 63: Erosion and protection measures at Digha (73O10SW), SW parts of West Bengal coast

Plate 64: Erosion at Digha (73O10SW), SW parts of West Bengal coast

Plate 65: Protection measures near Sankarpur (73O10NW) along SW parts of West Bengal coast

Plate 66: Protection measures near Sankarpur (73O10NW) along SW parts of West Bengal coast

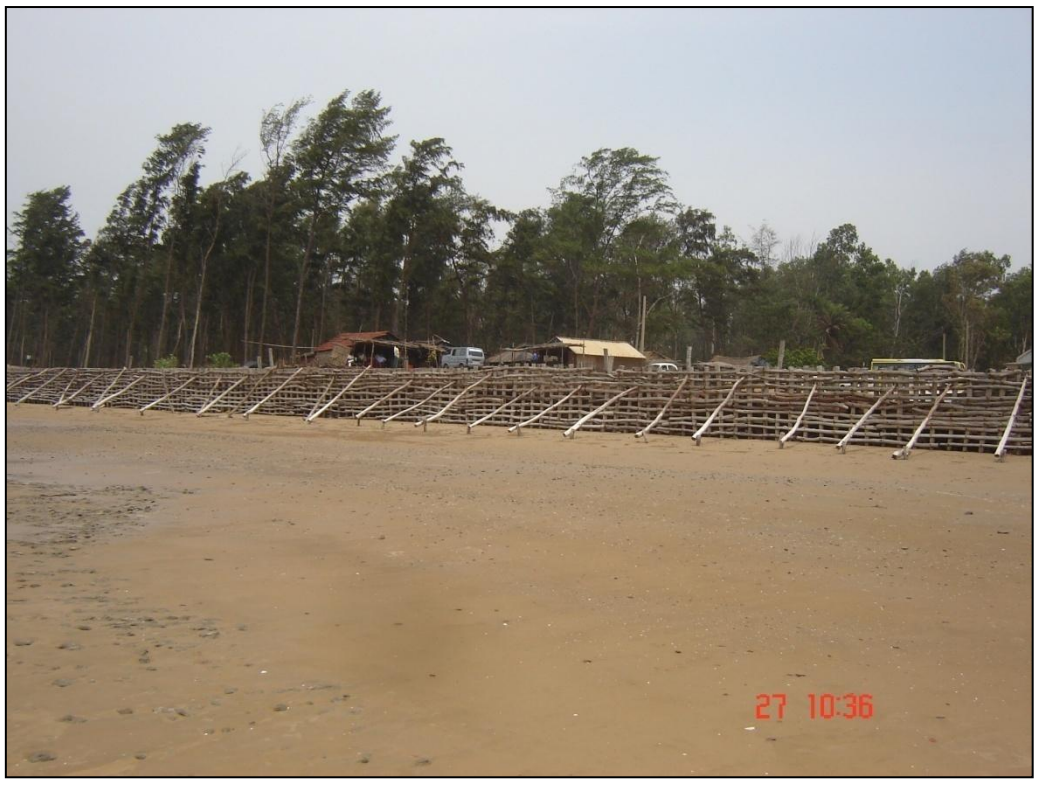


Plate 67: Protection measures near Sankarpur (73O10NW) along SW parts of West Bengal coast

Plate 68: Erosion near Sankarpur (73O10NW) along SW parts of West Bengal coast

Plate 69: Mandarbani beach (73O10NW) along SW parts of West Bengal coast

Plate 70: Mandarbani beach (73O10NW) along SW parts of West Bengal coast

Plate 71: Erosion SW of Birampur (73O14NW) along SW parts of West Bengal coast

Plate 72: Erosion SW of Birampur (73O14NW) along SW parts of West Bengal coast

Annexure-III

(List of Data Used)

Table No. 3: Satellite data used for Odisha Coast (1989-91 time-frame).

Sr.No	Map Number	Satellite	Sensor	Path	Row	Date
1	73K/12SE	SPOT	HRV1-MLA	230	308	04-03-1989
2	73K/14SE	SPOT	HRV1-MLA	230	307	04-03-1989
3	73K/15NE	SPOT	HRV1-MLA	230	307	04-03-1989
4	73K/15SE	SPOT	HRV1-MLA	230	307	04-03-1989
5	73K/15SW	SPOT	HRV1-MLA	230	317	04-03-1989
6	73K/16NW	SPOT	HRV1-MLA	230	308	04-03-1989
7	73K/16SE	SPOT	HRV1-MLA	230	308	04-03-1989
8	73K/16SW	SPOT	HRV1-MLA	230	308	04-03-1989
9	73L/04NE	IRS-1A	LISS-II	20	54	07-04-1989
10	73L/04SE	IRS-1A	LISS-II	20	54	07-04-1989
11	73L/06SE	SPOT	HRV1-MLA	230	309	04-03-1989
12	73L/07NE	SPOT	HRV1-MLA	230	309	04-03-1989
13	73L/07SE	SPOT	HRV1-MLA	230	309	04-03-1989
14	73L/08NE	SPOT	HRV1-MLA	230	310	04-03-1989
15	73L/08NW	SPOT	HRV1-MLA	230	310	04-03-1989
16	73L/08SE	SPOT	HRV1-MLA	230	310	04-03-1989
17	73L/08SW	SPOT	HRV1-MLA	230	310	04-03-1989
18	73L/09NE	SPOT	HRV1-MLA	230	308	04-03-1989
19	73L/09NW	SPOT	HRV1-MLA	230	308	04-03-1989
20	73L/09SE	SPOT	HRV1-MLA	230	308	04-03-1989
21	73L/09SW	SPOT	HRV1-MLA	230	308	04-03-1989
22	73L/10NE	SPOT	HRV1-MLA	230	309	04-03-1989
23	73L/10NW	SPOT	HRV1-MLA	230	309	04-03-1989
24	73L/10SE	SPOT	HRV1-MLA	230	309	04-03-1989
25	73L/10SW	SPOT	HRV1-MLA	231	309	04-03-1989
26	73L/11NE	SPOT	HRV1-MLA	231	309	09-12-1989
27	73L/11NW	SPOT	HRV1-MLA	230	309	09-12-1989

28	73L/11SE	SPOT	HRV1-MLA	231	310	04-03-1989
29	73L/11SW	SPOT	HRV1-MLA	231	310	04-03-1989
30	73L/12NE	SPOT	HRV1-MLA	230	310	04-03-1989
31	73L/12NW	SPOT	HRV1-MLA	230	310	04-03-1989
32	73L/13NE	SPOT	HRV1-MLA	231	308	09-12-1989
33	73L/13NW	SPOT	HRV1-MLA	230	308	04-03-1989
34	73L/13SE	SPOT	HRV1-MLA	231	308	09-12-1989
35	73L/13SW	SPOT	HRV1-MLA	230	308	04-03-1989
36	73L/14NE	SPOT	HRV1-MLA	231	309	04-03-1989
37	73L/14NW	SPOT	HRV1-MLA	231	309	09-12-1989
38	73L/14SE	SPOT	HRV1-MLA	231	309	09-12-1989
39	73L/14SW	SPOT	HRV1-MLA	231	309	09-12-1989
40	73L/15NW	SPOT	HRV1-MLA	231	309	04-03-1989
41	73L/15SW	SPOT	HRV1-MLA	231	309	04-03-1989
42	73O/02NW	SPOT	HRV1-MLA	231	307	09-12-1989
43	73O/02SE	SPOT	HRV1-MLA	231	307	09-12-1989
44	73O/02SW	SPOT	HRV1-MLA	231	307	09-12-1989
45	73O/03NW	SPOT	HRV1-MLA	229	310	09-12-1989
46	73O/06NE	SPOT	HRV1-MLA	231	307	9-12-1989
47	73O/06NW	SPOT	HRV1-MLA	231	307	12-9-1989
48	73O/06SE	SPOT	HRV1-MLA	231	307	12-9-1989
49	73O/06SW	SPOT	HRV1-MLA	231	307	12-9-1989
50	73P/01SW	SPOT	HRV1-MLA	231	308	3-4-1989
51	73P/02NW	SPOT	HRV1-MLA	231	308	3-4-1989
52	74A/15SE	SPOT	HRV1-MLA	228	311	12-5-1988
53	74A/16NE	SPOT	HRV1-MLA	228	312	12-5-1988
54	74A/16NW	SPOT	HRV1-MLA	227	312	12-5-1988
55	74A/16SW	SPOT	HRV1-MLA	227	312	12-5-1988
56	74E/01SE	SPOT	HRV1-MLA	228	310	5-10-1989
57	74E/02NE	SPOT	HRV1-MLA	228	311	5-10-1989

58	74E/02SE	SPOT	HRV1-MLA	228	311	5-10-1989
59	74E/02SW	SPOT	HRV1-MLA	228	311	5-10-1989
60	74E/03NE	SPOT	HRV1-MLA	20	54	4-7-1989
61	74E/03NW	IRS-1A	LISS-II	20	54	4-7-1989
62	74E/03SW	SPOT	HRV1-MLA	20	54	4-7-1989
63	74E/05NE	SPOT	HRV1-MLA	228	310	5-10-1989
64	74E/05SE	SPOT	HRV1-MLA	228	310	5-10-1989
65	74E/05SW	SPOT	HRV1-MLA	228	310	5-10-1989
66	74E/06NE	SPOT	HRV1-MLA	228	311	5-10-1989
67	74E/06NW	SPOT	HRV1-MLA	228	311	5-10-1989
68	74E/06SE	SPOT	HRV1-MLA	228	311	5-10-1989
69	74E/06SW	IRS-1A	LISS-II	20	54	4-7-1989
70	74E/09NW	SPOT	HRV1-MLA	229	310	5-6-1988
71	74E/09SE	SPOT	HRV1-MLA	229	311	5-6-1988
72	74E/09SW	SPOT	HRV1-MLA	229	310	5-6-1988
73	74E/10NE	SPOT	HRV1-MLA	229	311	5-6-1988
74	74E/10NW	SPOT	HRV1-MLA	229	311	5-6-1988
75	74E/13NE	SPOT	HRV1-MLA	229	310	5-6-1988
76	74E/13SE	SPOT	HRV1-MLA	229	310	5-6-1988
77	74E/13SW	SPOT	HRV1-MLA	229	310	5-6-1988
78	74I/01NE	IRS-1A	LISS-II	19	54	4-6-1989
79	74I/01NW	SPOT	HRV1-MLA	229	310	5-6-1988
80	74I/01SE	IRS-1A	LISS-II	19	54	4-6-1989
81	74I/01SW	SPOT	HRV1-MLA	229	310	5-6-1988
82	74I/05NE	SPOT	HRV1-MLA	230	310	5-4-1989
83	74I/05NW	SPOT	HRV1-MLA	230	310	3-4-1989

Table No. 4: Satellite data used for Odisha Coast (2004-06 time-frame).

SR. NO	MAP NO.	Satellite	Sensor	Orbit	Scene No	Date
1	73K14SE	IRS P6	LISS IV	7190	65	6-3-2005
2	73K15NE	IRS P6	LISS IV	7801	65	18-04-05
3	73K15SE	IRS P6	LISS IV	7190	66	6-3-2005
4	73K15SW	IRS P6	LISS IV	7190	66	6-3-2005
5	73K16NW	IRS P6	LISS IV	7872, 7190	68, 67	23-04-05, 6-3-2005
6	73K16SE	IRS P6	LISS IV	7190	67	6-3-2005
7	73K16SW	IRS P6	LISS IV	7872	68	23-04-05
8	73L04SE & 73L04NE	IRS P6	LISS IV	11680	76	16-01-06
9	73L07SE	IRS P6	LISS IV	7801	70	18-04-05
10	73L08NE	IRS P6	LISS IV	7190	72	6-3-2005
11	73L08SE	IRS P6	LISS IV	7190	72	6-3-2005
12	73L08SW & 73L08NW	IRS P6	LISS IV	11680	76	16-01-06
13	73L09NE	IRS P6	LISS IV	7872, 7801	69, 67	23-04-05, 18-04-05
14	73L09NW	IRS P6	LISS IV	11680	72	16-01-06
15	73L09SE & 73L09SW	IRS P6	LISS IV	7801	68	18-04-05
16	73L10NE	IRS P6	LISS IV	7872	70	23-04-05
17	73L10NW	IRS P6	LISS IV	7190	69	6-3-2005
18	73L10SE	IRS P6	LISS IV	7190	70	6-3-2005
19	73L10SW	IRS P6	LISS IV	8142	69	12-5-2005
20	73L11NE	IRS P6	LISS IV	7872	71	23-04-05
21	73L11NW	IRS P6	LISS IV	7190	71	6-3-2005
22	73L11SE &	IRS P6	LISS IV	7190	71	6-3-2005

	73L11SW					
23	73L12NE	IRS P6	LISS IV	7190	72	6-3-2005
24	73L12NW	IRS P6	LISS IV	7872	72	23-04-05
25	73L13NE	IRS P6	LISS IV	7801, 7872	67, 69	18-04-05, 23-04-05
26	73L13NW	IRS P6	LISS IV	7801	67	18-04-05
27	73L13SE	IRS P6	LISS IV	7730, 7872	65, 69	13-04-05, 23-04-05
28	73L13SW	IRS P6	LISS IV	7872	69	23-04-05
29	73L14NE	IRS P6	LISS IV	12916	94	13-04-06
30	73L14NW	IRS P6	LISS IV	7872	70	23-04-05
31	73L14SE	IRS P6	LISS IV	7730	68	13-04-05
32	73L14SW	IRS P6	LISS IV	7872, 7190	70, 70	23-04-05, 6-3-2005
33	73L15NW	IRS P6	LISS IV	7872	71	23-04-05
34	73O02NW	IRS P6	LISS IV	7730	61	13-04-05
35	73O02SE & 73O02SW	IRS P6	LISS IV	7730	063, 062	13-04-05
36	73O03NW	IRS P6	LISS IV	7730	63	13-04-05
37	73O06NE	IRS P6	LISS IV	6778	87	5-2-2005
38	73O06NW	IRS P6	LISS IV	6778	87	5-2-2005
39	73O06SE	IRS P6	LISS IV	6778	88	5-2-2005
40	73O06SW	IRS P6	LISS IV	12916	90	13-04-06
41	74A15SE	IRS P6	LISS IV	7318	28	15-03-05
42	74A16NE	IRS P6	LISS IV	7318	28	15-03-05
43	74A16NW	IRS P6	LISS IV	6977	80	19-02-05
44	74A16SW	IRS P6	LISS IV	6977	80	19-02-05
45	74E02NE	IRS P6	LISS IV	6366	71	7-1-2005
46	74E02SE	IRS P6	LISS IV	11410	103-104	28-12-05
47	74E02SW	IRS P6	LISS IV	7318	26	15-03-05

48	74E03NE	IRS P6	LISS IV	7318	27	15-03-05
49	74E03NW	IRS P6	LISS IV	7318	27	15-03-05
50	74E03SW	IRS P6	LISS IV	7318	27	15-03-05
51	74E05NE	IRS P6	LISS IV	6366	71	7-1-2005
52	74E05SE & 74E05SW	IRS P6	LISS IV	12987	97	18.04.06
53	74E06NE	IRS P6	LISS IV	6366	71	7-1-2005
54	74E06NW	IRS P6	LISS IV	7318	25	15-03-05
55	74E06SE	IRS P6	LISS IV	7119	74	1-3-2005
56	74E06SW	IRS P6	LISS IV	7119	74	1-3-2005
57	74E09NW	IRS P6	LISS IV	12987		18-04-06
58	74E10NE	IRS P6	LISS IV	12987	97	18-04-06
59	74E10NW	IRS P6	LISS IV	12987	98	18-04-06
60	74E13NE	IRS P6	LISS IV	11680	77	16-01-05
61	74E13SW & 74E13SE	IRS P6	LISS III	106		21-01-06
62	74I01NE & 74I01SE	IRS P6	LISS IV	11680	77	16-01-05
63	74I05NE & 74I05NW	IRS P6	LISS III	107	58	26-01-06

Table No. 5: Satellite data used for West Bengal Coast (1989-91 time-frame).

Sr.no	Map No.	Satellite	Sensor	Path	Row	Date
1	73O/10 NW	SPOT-1	HRV1-MLA	232	307	18-1-88
2	73O/14 NW	SPOT-1	HRV1-MLA	232	307	18-1-88
3	73O/10 SW	SPOT-1	HRV1-MLA	232	307	18-1-88
4	73O/13 SW	SPOT-1	HRV1-MLA	232	306	18-1-88
5	73O/13 SE	SPOT-1	HRV1-MLA	232	306	18-1-88
6	73O/10 NE	SPOT-1	HRV1-MLA	232	307	18-1-88
7	79C/01SE	SPOT-1	HRV1-MLA	233	306	27-1-89
8	79C/06 NE	SPOT-1	HRV1-MLA	234	307	27-1-89
9	79C/06 NW	SPOT-1	HRV1-MLA	233	306	27-1-89
10	79C/06 SW	SPOT-1	HRV1-MLA	233	307	27-1-89
11	79C/06 SE	SPOT-1	HRV1-MLA	234	307	27-1-89
12	79C/05 NE	SPOT-1	HRV1-MLA	233	306	27-1-89
13	79C/05 SE	SPOT-1	HRV1-MLA	233	306	27-1-89
14	79C/05 NW	SPOT-1	HRV1-MLA	233	306	27-1-89
15	79C/05 SW	SPOT-1	HRV1-MLA	233	306	27-1-89
16	79C/01 NE	SPOT-1	HRV1-MLA	233	306	27-1-89
17	79B/04 SW	SPOT-1	HRV1-MLA	233	306	27-1-89
18	79B/04 SE	SPOT-1	HRV1-MLA	233	306	27-1-89
19	79C/09 SW	SPOT-1	HRV1-MLA	234	307	27-1-89
20	79C/09NW	SPOT-1	HRV1-MLA	234	306	27-1-89
21	79F/03 SW	SPOT-1	HRV1-MLA	234	305, 306	27-1-89, 25-3-89
22	79B/04 NE	SPOT-1	HRV1-MLA	233	306	27-1-89
23	79B/04 NW	SPOT-1	HRV1-MLA	233	306	27-1-89
24	79C/01NW	SPOT-1	HRV1-MLA	233	306	18-1-88
25	79C/02 SE	SPOT-1	HRV1-MLA	233	307	27-1-89
26	79C/02 SW	SPOT-1	HRV1-MLA	233	307	27-1-89
27	79C/02 NE	SPOT-1	HRV1-MLA	233	307	27-1-89

28	79C/02 NW	SPOT-1	HRV1-MLA	233	307	27-1-89
29	79C/01 SW	SPOT-1	HRV1-MLA	233	306	27-1-89
30	79B/12 SE	SPOT-1	HRV1-MLA	234	306	27-1-89
31	79F/04 NW	SPOT-1	HRV1-MLA	235	306	25-3-89
32	79B/15 SW	SPOT-1	HRV1-MLA	234	305	27-1-89
33	79B/16 NE	SPOT-1	HRV1-MLA	234	306	27-1-89
34	79B/16 NW	SPOT-1	HRV1-MLA	234	306	27-1-89
35	79B/16 SE	SPOT-1	HRV1-MLA	234	306	27-1-89
36	79B/12 NE	SPOT-1	HRV1-MLA	234	306	27-1-89
37	79B/15 SE	SPOT-1	HRV1-MLA	234	305	27-1-89
38	79B/12 NW	SPOT-1	HRV1-MLA	234	306	27-1-89

Table No 6: Satellite data used for West Bengal Coast (2004-06 time frame).

Sr. No	Map Number	Satellite	Sensor	Orbit no.	Scene no.	Date
1	73O/10 NW	IRS P6	LISS IV	6636	67	26-01-05
2	73O/14 NW	IRS P6	LISS IV	6849	63	10-2-2005
3	73O/13 SW	IRS P6	LISS IV	6849	63	10-2-2005
4	73O/13 SE	IRS P6	LISS IV	6579	82	10-2-2005
5	73O/10 NE	IRS P6	LISS IV	6636	66	26-01-05
6	79C/01SE	IRS P6	LISS IV	11765	56	22-01-06
7	79C/06 NE	IRS P6	LISS IV	11822	62, 63	26-01-06
8	79C/06 NW, SW	IRS P6	LISS IV	12092	44 & 45	14-02-06
9	79C/06 SE	IRS P6	LISS IV	11822	64	26-01-06
10	79C09SW, NW	IRS P6	LISS IV	11822	62 & 63	26-01-06
11	79C/05 SE	IRS P6	LISS IV	11822	62, 63	26-01-06
12	79C/05 NW, SW	IRS P6	LISS IV	12092	43, 44	14-02-06

13	79C/01 NE	IRS P6	LISS IV	11765	57	22-01-06
14	79B/04 SW	IRS P6	LISS IV	11751, 6579	44, 81	21-01-06, 21-01-06
15	79B/04 SE	IRS P6	LISS IV	11765, 10529, 1663	56, 66, 80	22-01-06, 27-10-05, 11-02-04
16	79F/03 SW	IRS P6	LISS IV	1893, 11964	20 & 21, 83	31-01-06, 05-02-06
17	79B/04 NE	IRS P6	LISS IV	11751	43	21-01-06
18	79B/04 NW	IRS P6	LISS IV	7048, 6849	60, 61	24-02-05, 10-02-05
19	79C/01NW	IRS P6	LISS IV	11751	44	21-01-06
20	79C/02 NE, SE, SW	IRS P6	LISS IV	11765	57, 58	22-01-06
21	79C/02 NW	IRS P6	LISS IV	11751	45	21-01-06
22	79C/01 SW	IRS P6	LISS IV	11751	45	21-01-06
23	79B/12 SE	IRS P6	LISS IV	11495	51	3-1-2006
24	79B/15 SW	IRS P6	LISS IV	7403, 11495	52, 49	21-03-05, 03-01-06
25	79B/16 SE	IRS P6	LISS IV	11623, 11964	61, 84	12-01-06, 05-02-06
26	79B/16 NE	IRS P6	LISS IV	11893	21	31-01-06
27	79B/16 NW	IRS P6	LISS IV	6508	59	17-01-05
28	79G/02 NW	IRS P6	LISS IV	11623	62, 63	12-1-2006
29	79B/12 NE	IRS P6	LISS IV	11495, 6508	50, 59	03-01-06, 17-01-05
30	79B/15 SE	IRS P6	LISS IV	11893	20	31-01-06
31	79B/12 NW	IRS P6	LISS IV	12092	42	14-02-06
32	79F/04 NW	IRS P6	LISS IV	11623	60	12-1-2006

Table No. 7: Protected Reaches of Odisha.

Sr. No	Name of Division	Location	Latitude/Longitude		Length (km)
			From	To	
	1	2	3	4	5
1	Behrampur Irrigation Division	Ramaya Patana Village-Kanisi District-Ganjam	Lat-19^0 11’ 10” N Lon- 84^0 49’ 65” E		1.000
		Podampeta Village –Chhatrapur District-Gajam	Lat-19^0 24’ 42” N Lon- 85^0 06’ 04” E		0.500
		Gopalpur Village-Kanisi District-Ganjam	Lat-19^0 15’ 23” N Lon- 84^0 64’ 29” E		0.890
2	Puri Irrigation Division	Puri District-Puri	Lat-19^0 46’ 50” N Lon- 85^0 46’ 58” E		3.000
3	Balasore Irrigation Division	Talasary to Udayapur District-Balasore	Lat-21^0 36’ 28” N Lon- 87^0 27’ 41” E		1.550
4	Aul Emabankment Division	Pentha District-Kendrapara	Lat-20^0 32’ 22.4” N Lon- 86^0 47’ 16” E		1.000
5	Mahanadi South Division	Gada harishpur to Sahadabedi Erasama Block District-Jagatsingpur	Lat-20^0 03’ 00” N /20^0 03’ 00” N Lon-86^0 24’ 00”E /86^0 26’ 00” E		8.000
		Sahadabedi to Ramatatara Erasama Block District-Jagatsinghpur	Lat-20^0 03’ 00” N /20^0 03’ 00” N Lon 86^0 26’ 00”E /86^0 28’ 00” E		8.000

Table No. 8: Type of Protection measures along Odisha coast and their specification.

Village/Taluka/ District	Type of Protection	Specification	Length (km)	Latitude/Longitude	
				From	To
1	2	3	4	5	6
Chandipur Panihanivas & ITR District Balasore	Sea wall	Masonry wall	1.4	Lat-21^0 27’ 34”N Lon-87^0 03’ 03”E	
Inchundi Saline Embankment District-Balasore	Earthen bunds		2.0	Lat-21^0 19’ 23”N Lon-86^0 53’ 19”E	
Dhamra District-Bhadrak	Sea walls	Concrete /Masonry wall	3.0	Lat-20^0 47’ 37”N Lon-86^0 53’ 53”E	
Gopalpur District-Ganjam	Sea walls	Masonry wall	0.5 km	Lat-19^0 15’ 23”N Lon-84^0 54’ 29”E	
Sandhapur, Abhayachandpur to Dhinika Block-Erasama District Jagatsinghpur	River training work	Port	7.0 km	Lat-20^0- 15’N Lon-86^0 39’E	Lat-20^0 13’N Lon-86^0 38’E
Rajnagar Gopalpur Saline Embankment District-Kendrapara	Earthen bunds		3.0 km	Lat-20^0 32’ 14”N Lon-86^0 47’ 17”E	Lat-20^0- 33’ 24” N Lon-86^0 48’ 29” E

Table No. 9: Protected Reaches of coastal regions of West Bengal (Western Circle II)

Digha-Coastal Reaches (Western Circle II)				
Location (Village/Taluka/ District)	Type of protection works	Specification	Latitude	Longitude
			From	To
Block-Ramnagar-1/Dist. –Purba Midnapur	Rivetment by Rip Rap black stone & laterite boulders (2.43 km)	Stone toe wall of 1.2m × 1.0m and side slope of 1:6	$22^0$23’N	$88^0$19’E
Block-Ramnagar - 1/Dist.-Purba Midnapur	Rivetment by cement concrete block and sheet pile cap (0.846 km)	C.C block of size of 2.0m× 2.0×0.3m and side slope of 1:6	$22^0$23’N	$88^0$19’E
Block-Despran (Contai-II)/Dist.-Purba Midnapur	Rivetment by Rip Rap black stone & laterite boulders (2.7 km)	Stone toe wall of 1.2m × 1.0m and side slope of 1:6	$21^0$47’N	$87^0$45’E

Table No. 10: Protected Reaches of coastal regions of West Bengal (Eastern Circle)

Sundarban Reaches (Eastern Circle)				
Location (Village/Taluka/District)	Type of protection works	Specification	Latitude	Longitude
			From	To
Beguakhall/Block-Sagar/Dist.-South 24 Parganas	Hollow concrete block (0.78km)	Hollow concrete block with poly propylene gabion	$21^0$43'N	$88^0$06'E
Patibonia/Block-Namkhana/Dist.-South 24 Parganas	Brick block pitching (1.94km)	Each block of size 53mm×53mm×25mm grouped in B nos in horizontal direction	$21^0$46'N	$88^0$14'E
Bakkhali/Block-Namkhana/Dist.-south 24 Parganas	Cement concrete pitching (0.4 Km)	2m×1m×0.3m concrete cast-in-situ	$21^0$46'N	$88^0$14'E
Gobordhanpur-Sitarampur/Block-Pratharpratima/Dist.-South 24 Parganas	Brick block pitching(1.6Km)	Each block of size (53mm×53mm×25 mm) with 1m×1m brick sausage as toe-wall	$21^0$47N	$88^0$21'E