CENRAL WATER AND POWER RESEARCH STATION

MATHEMATICAL MODEL STUDIES FOR HYDRODYNAMICS AND SEDIMENTATION FOR BANK EROSION PROTECTION MEASURES FOR ONGC PIPELINE IN GODAVARI RIVER, NEAR KAKINADA, ANDHRA PRADESH

STUDY OVERVIEW

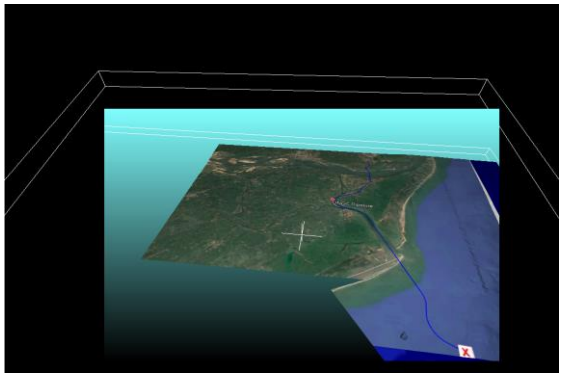
ONGC 20-inch gas export pipeline of approximate length ~31 km originating from offshore to onshore gas terminal at Mallavaram passes through sea, riverbed and land near river bank during its transit. It was found that river bank adjacent to the pipeline route was eroding and posing serious safety concerns. The Project Authority entrusted hydrodynamic and sedimentation model studies for identifying main cause of erosion and the

APPROACH

- An initial model was set up from precise LiDAR and bathymetric survey data provided by Project Authority, to ensure accurate representation of in-channel hydraulics. While this approach was optimal for in-bank flows (non-monsoon condition), its spatially constrained domain proved to be a critical limitation for overbank event simulation (monsoon condition). A further critical constraint was the lack of observed hydrological data (stage or discharge) within the initial model's extents. The nearest reliable stream gauge, was located significantly upstream of the original model boundary.
- To address this, a strategic model expansion was undertaken. The computational domain was extended to encompass the known floodplain and stream gauge location, using a broader-scale digital elevation map (DEM) through satellite imageries to provide the requisite topographic surface.
- To ascertain the impact of tides and discharges on River banks and sediment behavior, mathematical model studies for hydrodynamics and sedimentation were carried out for different discharge conditions using 2-Dimensional hydrodynamic model MIKE 21 HD and MIKE 21 ST/ MT model.

KEY FINDINGS

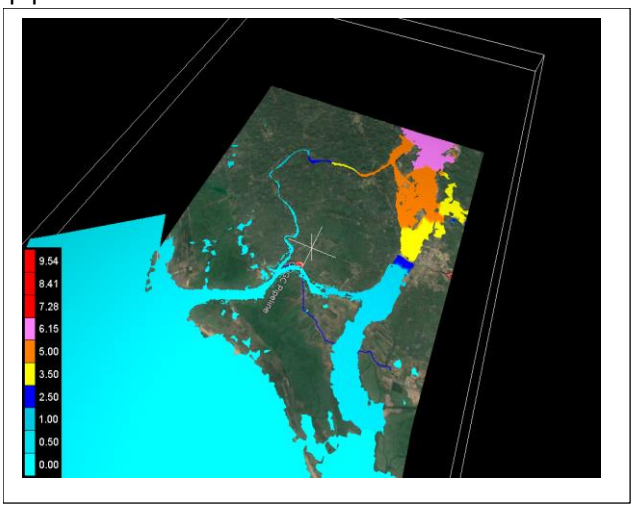
- Erosion of the riverbank has been primarily driven by unanticipated river discharge condition and changing hydraulic behaviour downstream of the barrage. 100 year return period discharge of 65,000 m^3/s has been crossed twice in the past 4 and half years.
- Model studies reveal that during high discharges, velocities in the LFP branch rises significantly, compared to the other branch, reaching up to 3 m/s, causing erosion of river bank.



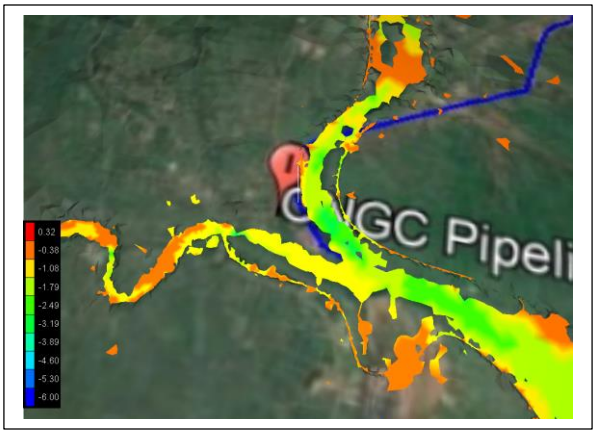
Location of the Gas Pipeline

IMPACT

The comprehensive model studies by integrating satellite derived DEM data with surveyed data, to include combined impact of discharges and tides facilitated to identify the main cause of erosion of the river bank near ONGC pipeline. It also helped to identify the section to be considered for immediate river bank protection work for the safety of gas pipeline.



Hydrodynamic Simulation



Erosion Near pipeline