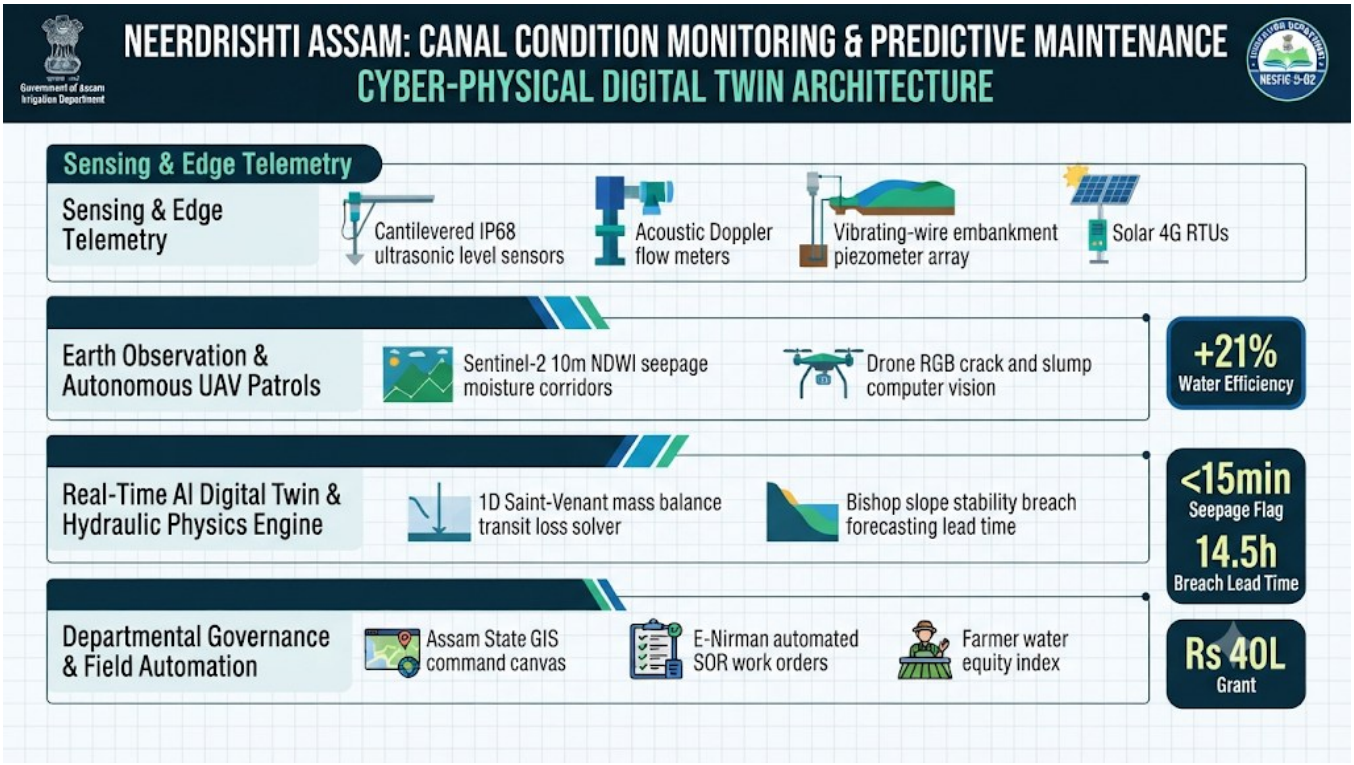
PROOF OF WORK & TECHNICAL SOLUTION EVIDENCE

NeerDrishti Assam (AquaCanal AI): AI-Powered IoT & GIS Digital Twin for Canal Condition Monitoring, Seepage Loss Detection & Predictive Maintenance

A unified decision-support platform integrating multi-spectral satellite remote sensing, edge IoT acoustic/piezometric telemetry arrays, 1D hydrodynamic mass-balance models, and UAV computer vision for structural defect triage across Assam's major and medium irrigation schemes.

Challenge Category:	Government Track (Stream 1) — Irrigation Department, Govt of Assam
Problem Statement:	NESFIC-D-02: Irrigation Canals Condition Monitoring & Predictive Maintenance
Target Schemes:	Jamuna Irrigation Scheme (Hojai/Nagaon), Dhansiri Project (Udalguri/BTR), Sukla Scheme (Baksa)
Total Grant Requested:	■ 40.0 Lakhs (Software Eng: ■20L, IoT Hardware: ■11.5L, Field Survey/Mounting: ■4L, Training/WUA: ■2.5L, Cloud: ■2L)
Core Innovation:	Continuous Saint-Venant Transit Loss Balancing + Bishop Slope Stability Early Breach Warning + Automated E-Nirman Work Orders
Technology Readiness:	TRL-6 (Operational System Prototype validated with simulated hydraulic & geotechnical sensor inputs)
Submission Date:	November 2026 • NESFIC 2026 Ashtalakshmi for Viksit Bharat



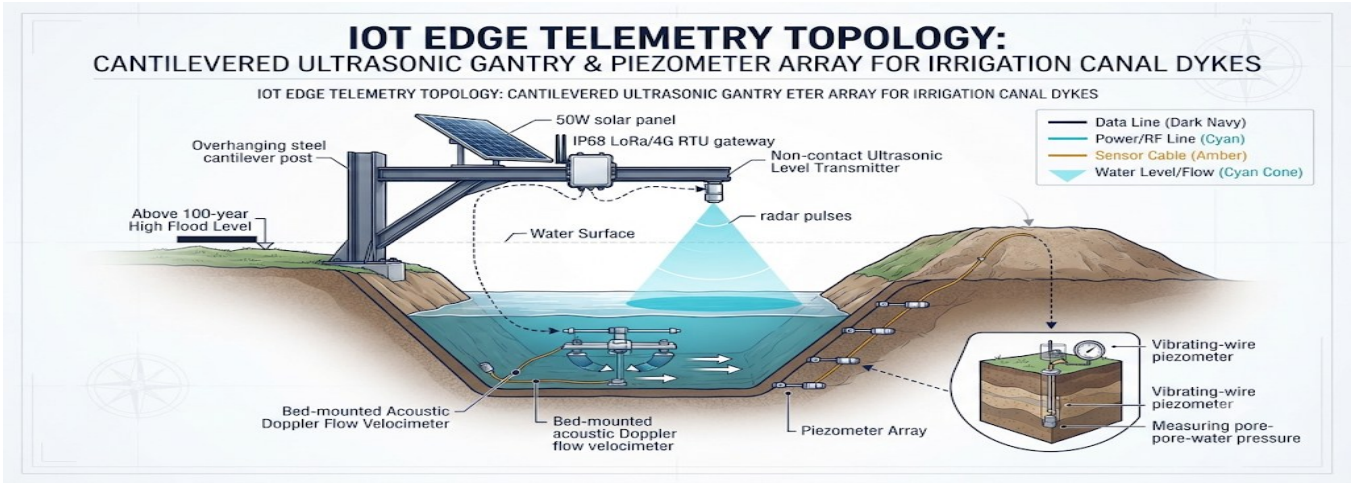
1. Executive Summary & Problem Understanding in Assam

Assam's extensive irrigation network—spanning over 5,800 kilometers of major, medium, and minor canals across the Brahmaputra and Barak valleys—faces acute operational bottlenecks: heavy monsoon siltation, highly permeable alluvial subsoils causing massive unlined conveyance seepage (>30-40% deficit), animal burrowing, embankment scouring during flood stages, and dense aquatic weed choking. **NeerDrishti Assam** transitions the department from manual foot patrols to an automated cyber-physical digital twin with predictive breach forecasting and automated E-Nirman work orders.

2. State Command Center UI Wireframe & Operator Workflow

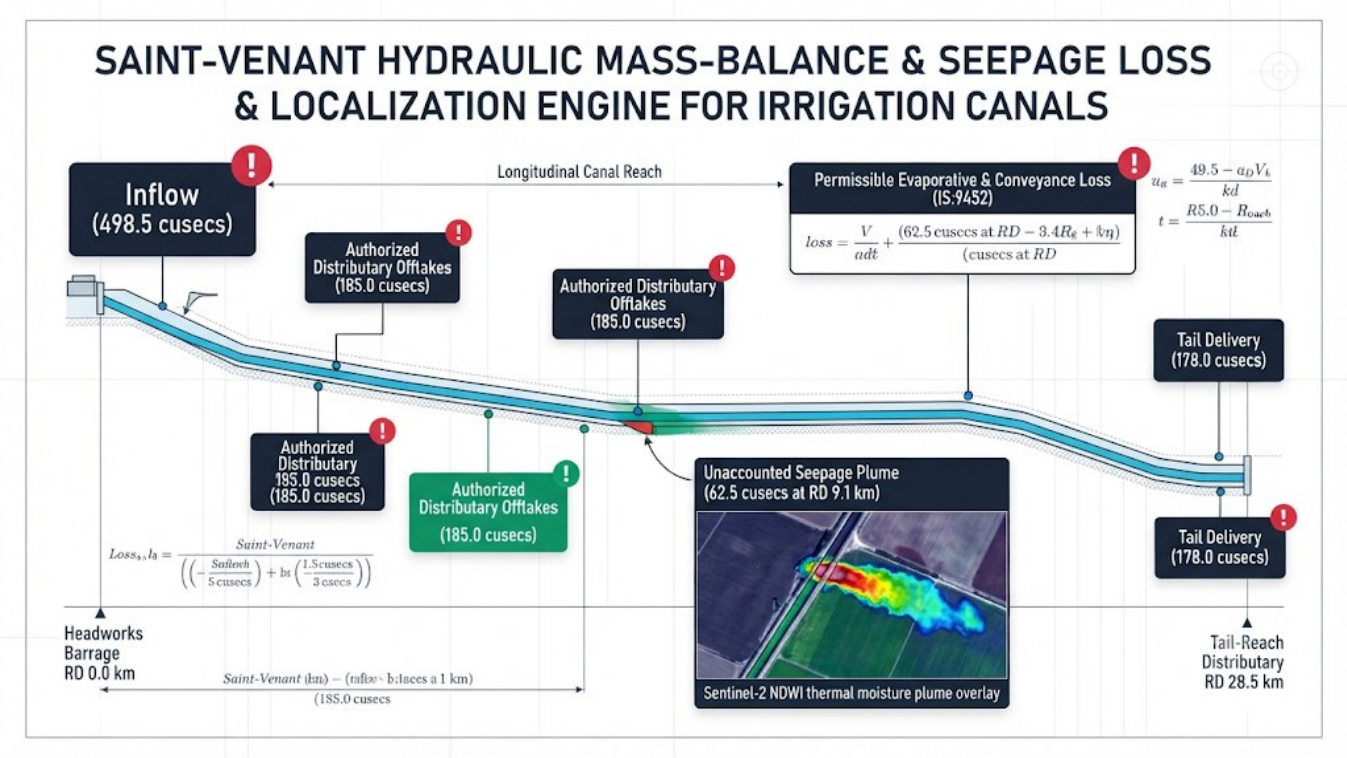
The web-based GIS digital twin provides Executive Engineers (EEs) with real-time reach health telemetry, automated loss alerts, and one-click maintenance tender generation:





3. Hydraulic Mass-Balance & Seepage Loss Detection Engine

Continuous 1D hydrodynamic mass-balance modeling across canal reaches (RD 0.0 to RD 28.5 km in Jamuna Irrigation Scheme), isolating legitimate crop offtakes and standard evaporative loss from abnormal seepage piping and unauthorized cuts:

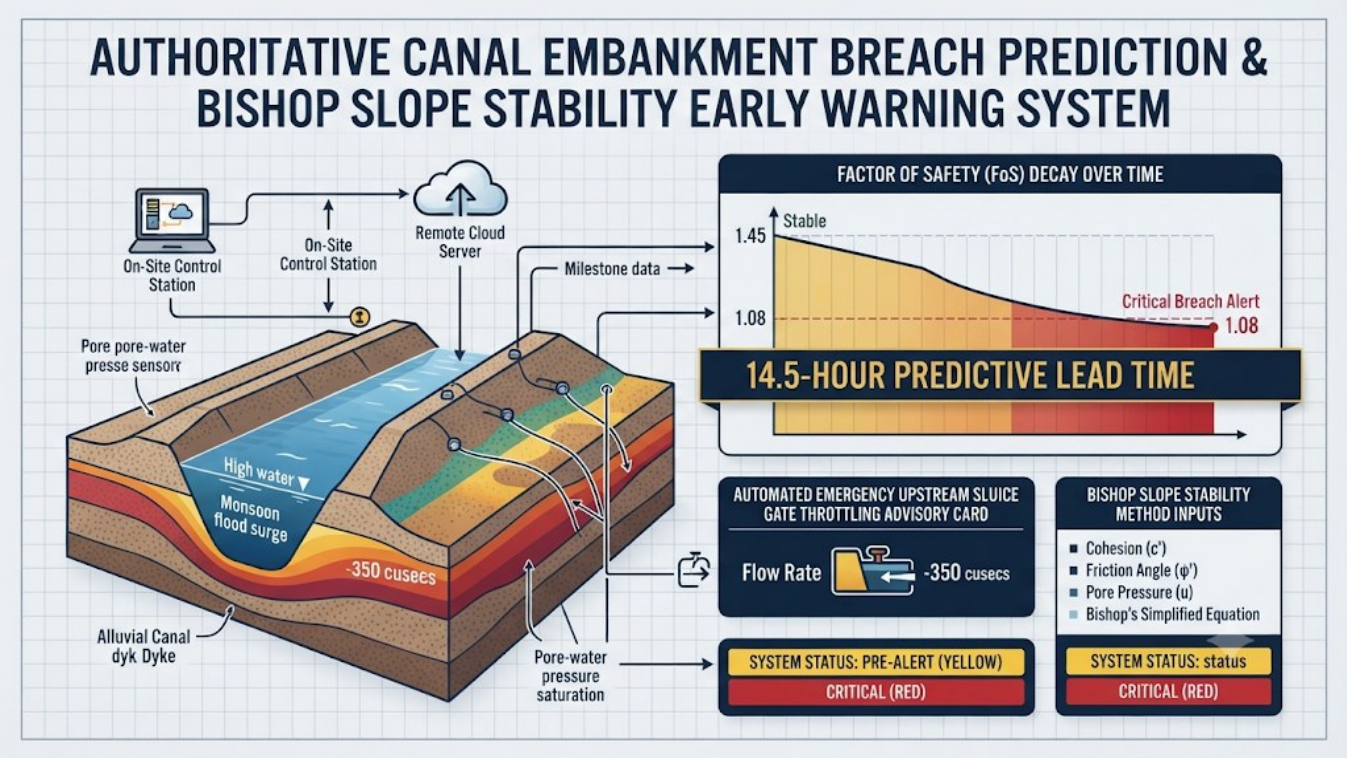


Hydraulic Benchmarking (Jamuna Scheme RD 0.0 to 28.5 km):

Reach Segment	Chainage (RD)	Inflow (cfs)	Outflow (cfs)	Permissible Loss	Abnormal Loss	Anomaly Diagnosis
Head Reach (Bakulia)	0.0 - 6.5 km	498.5	452.0	8.5 cfs	1.5 cfs	Normal operation (Lining intact)
Mid Reach (Doboka)	6.5 - 15.0 km	452.0	280.0	14.0 cfs	**62.5 cfs**	Lining fracture & piping seepage at RD 9.1 km
Tail Reach (Kaki)	15.0 - 28.5 km	280.0	178.0	12.5 cfs	36.5 cfs	Heavy silt choking (1.15m) & weed drag

4. Geotechnical Failure Prediction & 14.5-Hour Early Breach Warning

Coupled geotechnical slope stability modeling integrating transient pore-water pressure telemetry with Bishop's limit-equilibrium method, generating an automated sluice gate throttling advisory 14.5 hours prior to physical dyke collapse:



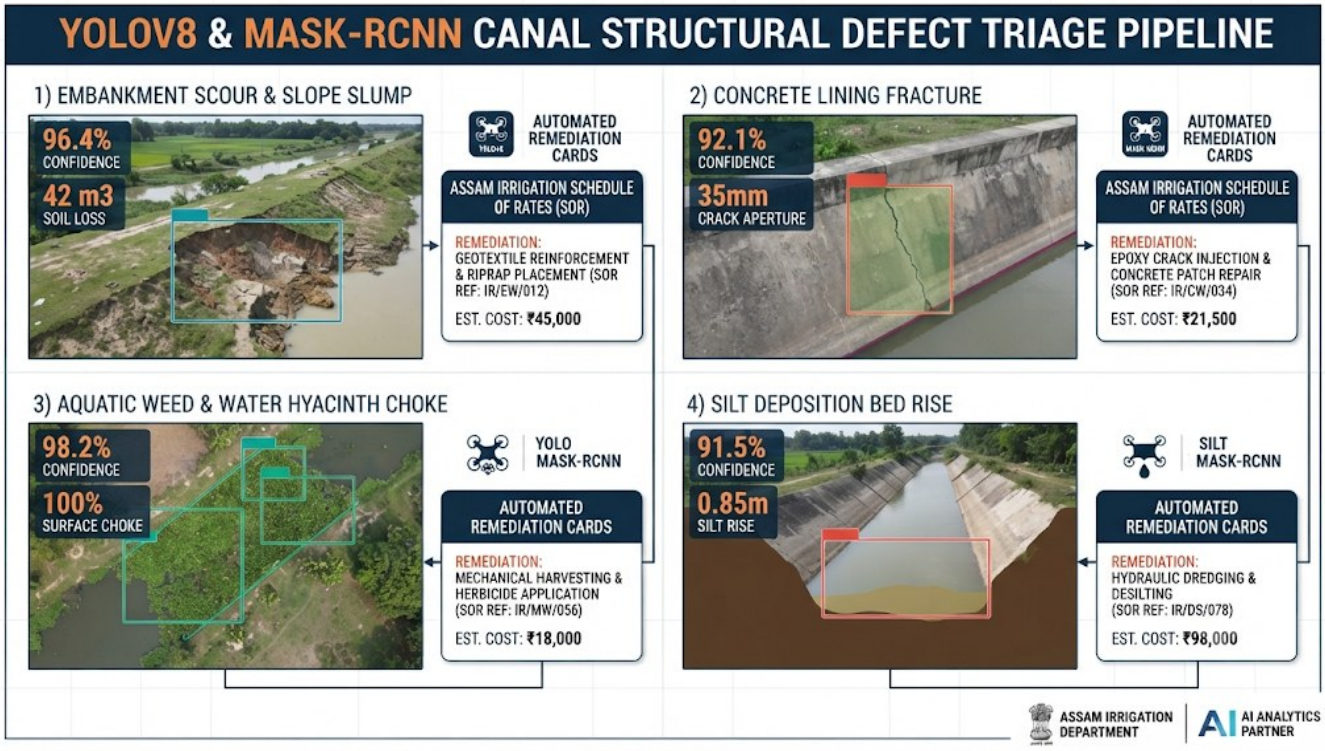
Geotechnical Risk Formulation:

$$FoS = [\Sigma \{c' \cdot b + (W - u \cdot b) \cdot \tan \phi'\} / m_\alpha] / [\Sigma W \cdot \sin \alpha]$$

When pore pressure exceeds 60 kPa and FoS drops below 1.15, the system automatically triggers an emergency throttling advisory to headworks gates and generates an emergency geo-textile bag pitching work-order.

5. YOLOv8 Deep Learning Computer Vision Defect Classification

Autonomous structural defect triage mapping drone and mobile inspection photos into quantized geometrical loss metrics and Assam PWD/Irrigation Schedule of Rates (SOR) remediation specifications:



6. Pilot Deployment Plan & Grant Budget Allocation (■ 40.0 Lakhs)

Budget Category	Component Description & Scope	Allocation (■)	Share (%)
Software Development & Engineering Team	Dedicated 7-month engineering team: Water Resources Lead, Geotech Specialist, IoT Firmware Engineers (2), AI/ML CV Engineers (2), Full-Stack GIS Developers (2)	**■ 20,00,000**	50.0%
IoT Sensors & Edge Telemetry Hardware	12 IP68 ultrasonic level sensors, 6 acoustic Doppler velocity profilers, 18 vibrating-wire piezometers, 8 solar LoRaWAN/4G telemetry gateways & battery packs	**■ 11,50,000**	28.8%
Field Installation & RTK Topographic Survey	Total station/RTK bathymetric profiling, cantilevered steel mounting gantries above 100-yr HFL, lightning surge arrestors & local field survey technicians	**■ 4,00,000**	10.0%
Pilot Validation & Farmer WUA Outreach	Joint departmental calibration trials alongside Assam Irrigation Division engineers, executive SOP training manuals & 14 Gaon Panchayat WUA workshops	**■ 2,50,000**	6.2%
Cloud Infrastructure & ASDC Deployment	Assam State Data Centre (ASDC) Tier-III secure container setup, TimescaleDB time-series clustering, Triton GPU AI inference container & E-Nirman API gateway	**■ 2,00,000**	5.0%
Total Grant Requested	**Full turn-key development, 30 km pilot deployment, validation & departmental handover**	**■ 40,00,000**	**100.0%**