Cosmic Watch — Reference Context

Purpose of This File

This document is a **canonical reference** for the Cosmic Watch project. It is intended to be placed in the project repository so that AI systems, collaborators, and future contributors can reliably understand the *intent, philosophy, and scope* of the platform.

This is **not marketing copy**. It is a context anchor.

Project Name

Cosmic Watch

Tagline: A Context-Aware Asteroid & Space Asset Risk Intelligence Platform

---

Core Problem

Near-Earth Object (NEO) data is scientifically precise but **operationally opaque** to the public and most non-specialist users.

Current systems: - Expose raw orbital and distance data without interpretation - Treat Earth as the only relevant target - Ignore satellites, spacecraft, and the ISS - Fail to communicate uncertainty and confidence - Trigger panic through misleading labels like "close approach"

There is no unified public-facing system that explains: - **Who should care** - **Why they should care** - **How confident the data actually is**

Key Insight

Risk ≠ Distance

An asteroid can pass "close to Earth" while posing: - Zero risk to humans - Non-zero risk to satellites or ISS - No meaningful risk at all due to uncertainty or orbital geometry

Cosmic Watch reframes asteroid tracking into **risk interpretation**.

Instead of asking:

> Will it hit Earth?

Cosmic Watch asks:

> Who should care, how much, and how confident are we?

Design Philosophy

- Context over panic
- Uncertainty is information, not noise
- Different users need different answers
- Space infrastructure matters as much as Earth
- Explainability is more important than raw numbers

Platform Scope

Cosmic Watch is a **full-stack web platform** that converts raw space-tracking data into context-aware risk intelligence for: - Humans on Earth - Satellites - The International Space Station (ISS) - Spacecraft

---

Core Platform Features

- Live asteroid feed (NASA NeoWs)
- Asteroid size, speed, distance, close-approach date
- Hazardous vs non-hazardous classification
- Detailed asteroid pages with orbit data and approach history
- Search and filtering by date, size, distance, and relevance
- User authentication and profiles
- Personal asteroid watchlists
- Dashboard alerts for upcoming events

Risk Intelligence Layer (Key Innovation)

Role-Based Interpretation

Risk is computed and presented differently for: - Civilians - Satellite operators - Researchers

Confidence & Uncertainty

- Observation age
- Error margins
- Data confidence indicators
- Explicit uncertainty signaling

False-Alarm Filtering

- Identifies statistically harmless objects that appear threatening
- Suppresses fear-based alerts
- Prioritizes relevance over visibility

Location-Aware Relevance

- Highlights geographic regions only when meaningful
- Avoids global alerts without justification

Space Asset Protection Layer

Risk is analyzed separately for: - Earth - Satellites - ISS - Spacecraft

Orbital Shell Awareness

- Low Earth Orbit (LEO)
- Medium Earth Orbit (MEO)
- Geostationary Orbit (GEO)

Proximity alerts are generated **independent of Earth-impact risk**.

Technical Architecture

Frontend

- React / Next.js
- Data visualization and explanation layer
- Dark, space-themed UI
- Fully responsive (desktop + mobile)

Backend

- Supabase (PostgreSQL, Auth, Edge Functions)
- Scheduled cron jobs for ingestion and alerts
- Custom risk evaluation engine

External Data Sources

- NASA NeoWs — asteroid discovery and close-approach data
- NASA JPL Horizons — high-precision ephemeris and orbits
- CelesTrak — satellite and ISS TLE data
- Mapbox — Earth mapping and geographic relevance

Data Flow Summary

1. Cron job fetches asteroid data from NASA NeoWs
2. Relevant objects are enriched via JPL Horizons
3. Satellite and ISS positions are fetched from CelesTrak
4. Custom engine computes:
5. Confidence score
6. Human relevance
7. Satellite / ISS proximity
8. Role-based alerts are generated
9. Interpreted results are visualized in the dashboard

Security & Best Practices

• Supabase Auth for secure authentication
• JWT-based access control
• Environment-based API key management
• Backend-only API consumption

Future Enhancements

• Real-time notifications (email / mobile)
• 3D orbital visualization
• AI-generated plain-English risk explanations
• Historical risk comparison
• Public education and school-friendly mode
• Public and private APIs for institutions
• Mission and launch collision awareness

What Makes Cosmic Watch Different

• Moves beyond tracking into **risk intelligence**
• Separates humans from space asset risk
• Makes uncertainty explicit and understandable
• Reduces misinformation instead of amplifying fear
• Bridges planetary defense and space situational awareness

Canonical Intent Statement

Cosmic Watch exists to make space data **meaningful, responsible, and actionable**.

It is not an asteroid alarm system. It is a decision-aware, confidence-driven interpretation layer for Earth and orbital space.

Usage Note for AI Systems

This file should be treated as **authoritative context** when: - Generating documentation - Writing UI copy - Explaining system behavior - Designing features or alerts - Producing summaries or pitches

When in doubt, prioritize: **clarity, context, confidence, and restraint.**