FlowComply

WATER COMPLIANCE PLATFORM

AI-Powered Water Quality & Compliance Platform

Real-Time Monitoring • Automated Reporting • Intelligent Analytics

Transforming Water Safety Through Intelligence

Wastewater Surveillance • AMR Monitoring
Contaminant Tracking • Predictive Analytics
Multi-Parameter Analysis • Regulatory Compliance

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November 10, 2025

1 Executive Overview

FlowComply is an AI-powered water intelligence platform that transforms water quality data into actionable insights. Originally developed for regulatory compliance, the platform's advanced capabilities make it ideal for research applications including wastewater surveillance, antimicrobial resistance monitoring, and contaminant fate studies.

1.1 Core Value Proposition

80% reduction in manual analysis through automated monitoring, AI-powered anomaly detection, and intelligent reporting—while improving detection accuracy and response times.

1.2 Key Capabilities

- **AI-Powered Analysis:** Claude 3.5 Sonnet integration for intelligent interpretation
- **Real-Time Monitoring:** Multi-parameter tracking with automated alerts
- **Anomaly Detection:** Statistical and ML-based quality excursion identification
- **Predictive Analytics:** Trend analysis and early warning systems
- **Research-Ready:** Unlimited historical storage, comprehensive API access
- **Regulatory Intelligence:** 381+ compliance rules, automated reporting

1.3 Technology Stack

Component	Technology
AI Engine	Anthropic Claude 3.5 Sonnet
Backend	Node.js, TypeScript, Fastify
Database	PostgreSQL (7+ year retention)
Analytics	Redis caching (40x performance)
API	60+ RESTful endpoints
Frontend	Next.js 14, React, TailwindCSS

2 AI-Powered Intelligence

2.1 1. Water Quality Anomaly Detection

Automatically analyzes test results to identify:

- Statistical anomalies beyond historical norms
- Trend changes (gradual degradation/improvement)
- Multi-parameter correlations
- Seasonal patterns and treatment efficacy

Monitored Parameters: E. coli, protozoa, pH, turbidity, chlorine, nitrates, heavy metals, organic compounds

2.2 2. Intelligent Compliance Assistant

24/7 conversational AI providing instant answers on:

- Regulatory requirements and standards
- Treatment optimization recommendations
- Incident response procedures
- Best practice guidance

2.3 3. Automated Report Generation

AI-generated summaries including:

- Executive compliance performance overviews
- Trend analysis over custom periods
- Predictive insights for future performance
- Regulatory-ready exports (PDF, Excel, CSV)

2.4 4. Document Analysis

Analyzes water safety plans to:

- Identify missing mandatory elements
- Assess regulatory completeness (0-100 score)
- Provide severity-ranked recommendations
- Generate gap analysis reports

3 Applications Across Sectors

3.1 Research & Academia

Wastewater Surveillance & Public Health:

- SARS-CoV-2 and pathogen monitoring programs
- AMR gene tracking across treatment facilities
- Illicit drug consumption monitoring
- Chemical biomarker surveillance
- Multi-site epidemiological studies

Environmental Research:

- Contaminant fate and transport modeling
- Climate change impact studies
- Treatment process optimization research
- Multi-barrier efficacy validation

3.2 Municipal & Utilities

Water Supply Management:

- Drinking water quality compliance (WHO, EPA, local standards)
- Distribution system integrity monitoring
- Real-time contamination detection
- Automated regulatory reporting
- Asset management and maintenance scheduling

Wastewater Treatment:

- Effluent quality monitoring and compliance
- Treatment process optimization
- Energy efficiency tracking
- Discharge permit compliance

3.3 Food & Beverage Industry

Process Water Management:

- Ingredient water quality verification
- Production line water monitoring
- CIP (Clean-In-Place) system validation
- HACCP compliance documentation
- Supplier water quality audits

3.4 Pharmaceutical & Healthcare

Water Quality Assurance:

- Purified water (PW) and Water for Injection (WFI) monitoring
- USP compliance tracking (USP ¡1231¿, ¡643¿)
- Microbial contamination detection (bacterial endotoxins)
- Legionella surveillance in cooling towers
- Dialysis water quality monitoring

3.5 Industrial Operations

Process Monitoring:

- Cooling water quality management
- Boiler feedwater monitoring
- Process wastewater treatment compliance
- Zero Liquid Discharge (ZLD) system optimization
- Environmental discharge permit tracking

3.6 Smart Cities & IoT Integration

Urban Water Management:

- Real-time water quality dashboards for citizens
- Smart sensor network integration
- Predictive maintenance for water infrastructure
- Climate resilience monitoring
- Public transparency portals

3.7 Agriculture & Aquaculture

Water Resource Management:

- Irrigation water quality monitoring
- Aquaculture system health tracking
- Nutrient runoff monitoring
- Groundwater quality surveillance
- Pesticide/fertilizer impact assessment

4 Data Management & Integration

4.1 Database Architecture

- **Database:** PostgreSQL 15 (ACID-compliant)
- **Retention:** 7+ years minimum (unlimited capacity)
- **Security:** AES-256 encryption, TLS 1.3
- **Backup:** Automated snapshots, point-in-time recovery
- **Access:** Role-based permissions with audit logging

4.2 API Integration

RESTful API with 60+ endpoints:

- Authentication: JWT tokens (OAuth 2.0 compatible)
- Documentation: OpenAPI/Swagger specification
- Rate limiting: Configurable (default: 100 req/15min)
- Data export: CSV, JSON, Excel, PDF formats

Integration Scenarios:

1. **LIMS:** Automated test result upload
2. **SCADA:** Real-time operational data streaming
3. **R/Python:** Direct API queries from analysis scripts
4. **GIS:** Spatial data export and visualization

4.3 Performance Metrics

Metric	Performance
API Response Time	¡ 100ms (cached)
Dashboard Load	50ms vs 2000ms (40x improvement)
Cache Hit Rate	70%+
Concurrent Users	1000+ simultaneous
AI Processing	5-10 seconds per analysis
Data Retention	Unlimited (7+ years minimum)

5 Sector-Specific Use Cases

5.1 Public Health Research (NUS/Aquashield)

Wastewater-Based Epidemiology:

- Singapore-wide pathogen surveillance network
- Integration with qPCR/ddPCR laboratory workflows
- AMR gene tracking and risk assessment
- Real-time outbreak prediction (7-day lead time)
- Policy recommendation generation

5.2 Pharmaceutical Manufacturing

GMP Water Systems:

- Continuous USP ¡1231¿ compliance monitoring
- Automated alert generation for excursions
- Batch release documentation
- Electronic audit trails for FDA inspections
- Trend analysis for preventive maintenance

5.3 Beverage Production

Quality Assurance:

- Incoming water quality verification (source water)
- In-process monitoring (carbonation, blending)
- Post-treatment validation (UV, ozone)
- Multi-site consistency tracking
- Supplier performance dashboards

5.4 Smart City Initiative

Urban Water Intelligence:

- Real-time public water quality portal
- Sensor network integration (IoT devices)

- Predictive maintenance for aging infrastructure
- Citizen science data collection
- Climate resilience monitoring

5.5 Hospital Water Safety

Legionella Risk Management:

- Cooling tower and hot water monitoring
- Automated sampling schedule management
- Temperature and disinfectant tracking
- Risk zone identification
- Regulatory compliance documentation

5.6 Agricultural Operations

Irrigation Water Management:

- Groundwater quality monitoring
- Nutrient and pesticide tracking
- Salinity and pH trend analysis
- Crop yield correlation studies
- Sustainable water use verification

6 Implementation & Deployment

6.1 Deployment Options

1. Cloud Hosting (Recommended)

- AWS Asia-Pacific region (Singapore)
- 99.9% uptime SLA
- Automatic scaling
- Zero-downtime updates
- 24/7 monitoring and support
- **Academic discount: 50% for research institutions**

2. On-Premises

- Full data sovereignty
- Air-gapped deployment possible
- Integration with existing IT infrastructure
- Installation and configuration support included

3. Hybrid

- On-premises for sensitive data
- Cloud for AI processing and analytics
- Secure encrypted synchronization

6.2 Pilot Program

Proposed Pilot for NUS/Aquashield:

1. **Duration:** 3-6 months
2. **Scope:** 2-3 research sites/projects
3. **Customization:** Adapt for specific research needs
4. **Support:** Full technical support during pilot
5. **Training:** 2-3 key users
6. **Outcome:** Joint publication opportunity
7. **Cost:** No-cost deployment for pilot duration

6.3 Timeline

Phase	Activities
Week 1-2	Requirements gathering, system setup, data import
Week 3-4	User training, pilot operations, workflow testing
Week 5+	Full deployment, ongoing support, optimization

7 Research Case Study Example

7.1 Hypothetical NUS Deployment

Scenario: Monitor wastewater at 3 treatment plants over 12 months

Data Collection:

- Weekly qPCR for SARS-CoV-2 N1/N2 genes
- Monthly AMR gene screening ($bla_{\text{CTX-M}}$, qnrS, ermB)
- Daily physical-chemical parameters
- Treatment process data (SRT, HRT, MLSS)

FlowComply Capabilities:

- Correlation: Viral loads vs. community COVID-19 cases
- AMR gene removal efficiency analysis
- Impact of temperature/rainfall on pathogen concentrations
- AI-powered outbreak prediction (7-day lead time)
- Cost-benefit analysis of treatment options

Expected Outputs:

- 3-5 high-impact journal articles
- Interactive dashboard for public health authorities
- Policy recommendations for Singapore
- Exportable model for other Asian cities

8 Security & Compliance

8.1 Data Protection

- **Encryption:** AES-256 at rest, TLS 1.3 in transit
- **Authentication:** JWT tokens, MFA support
- **Authorization:** Role-based access control (RBAC)
- **Audit Trail:** Immutable logs with 7+ year retention
- **Compliance:** GDPR, PDPA (Singapore), ISO 27001 ready

8.2 Research Data Privacy

- No data used for AI model training
- Regional data storage (Singapore)
- Right to deletion (GDPR Article 17)
- Full dataset export capability
- Secure collaboration portals

9 Next Steps

9.1 Proposed Actions

1. **Live Demonstration**
   - 60-90 minute walkthrough of all features
   - Customized demo with wastewater data examples
   - Q&A with technical team
2. **Pilot Project Proposal**
   - Focus: AMR tracking or wastewater surveillance
   - Duration: 3-6 months
   - No-cost deployment
   - Joint publication opportunity
3. **Technical Discussion**
   - Integration requirements with NUS systems
   - Customization for specific research needs
   - Potential funding opportunities
   - Aquashield collaboration possibilities

9.2 Contact Information

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Let's Explore Collaboration

We're excited to discuss how FlowComply can support your organization's water quality and compliance needs