Sewer Mining for Decentralized Water Reuse

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WateReuse 2024 SYMPOSIUM

REMOVING BARRIERS, ELEVATING OPPORTUNITIES

Agenda

*"For utilities and developers, ONWS can be a **means of complying with new regulations while maximizing the social, environmental, and economic benefits** of each project."*

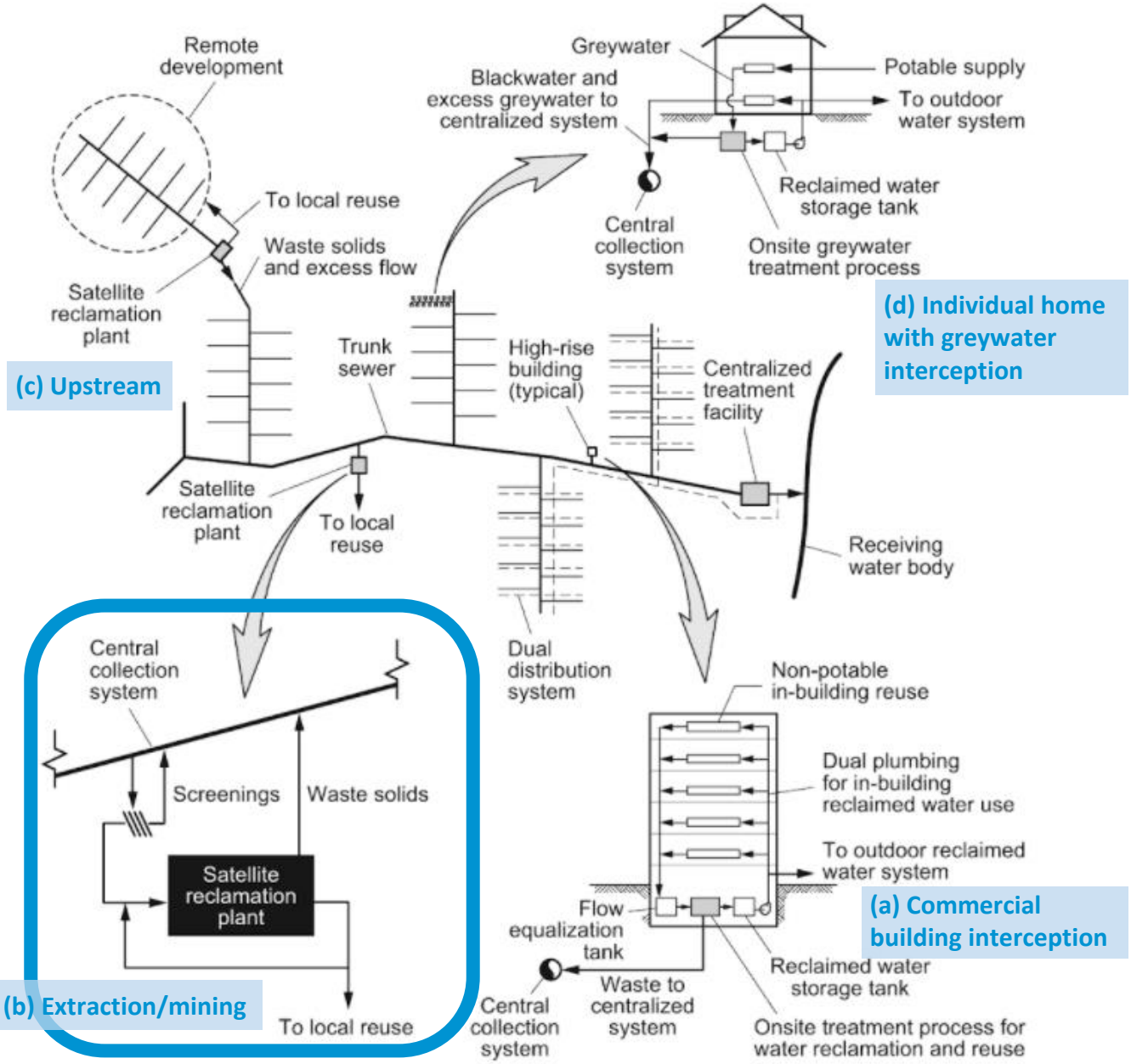
– US Water Alliance, Making the Utility Case for Onsite Non-Potable Water Systems

1. **The Why - Resilience**
2. **Regulatory Framework / Governance**
    a. Local Programs (CA approach)
3. **Decision-Making: Cost-benefit**
4. **Public-private Delineation**
5. **Engineering Design**
    a. Basis of Design
6. **Process Design & Operation**

Definitions

Satellite water systems are district and building scale water treatment systems that are **connected** to the central system.

These systems are designed to treat varying qualities of water sources to meet the quality needs of the ultimate demand as **“fit for purpose”** reuse.

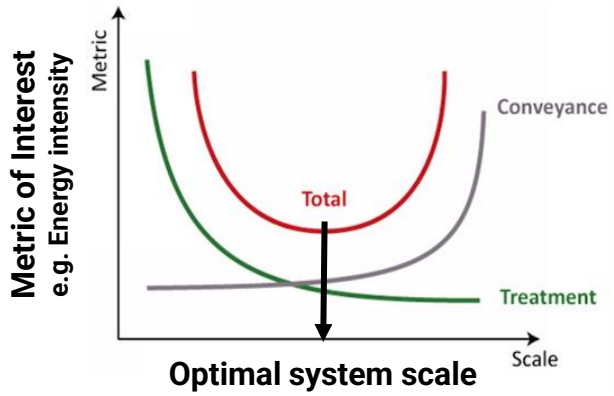


Source: Leverenz, H. and Tchobanoglous G. (2009)

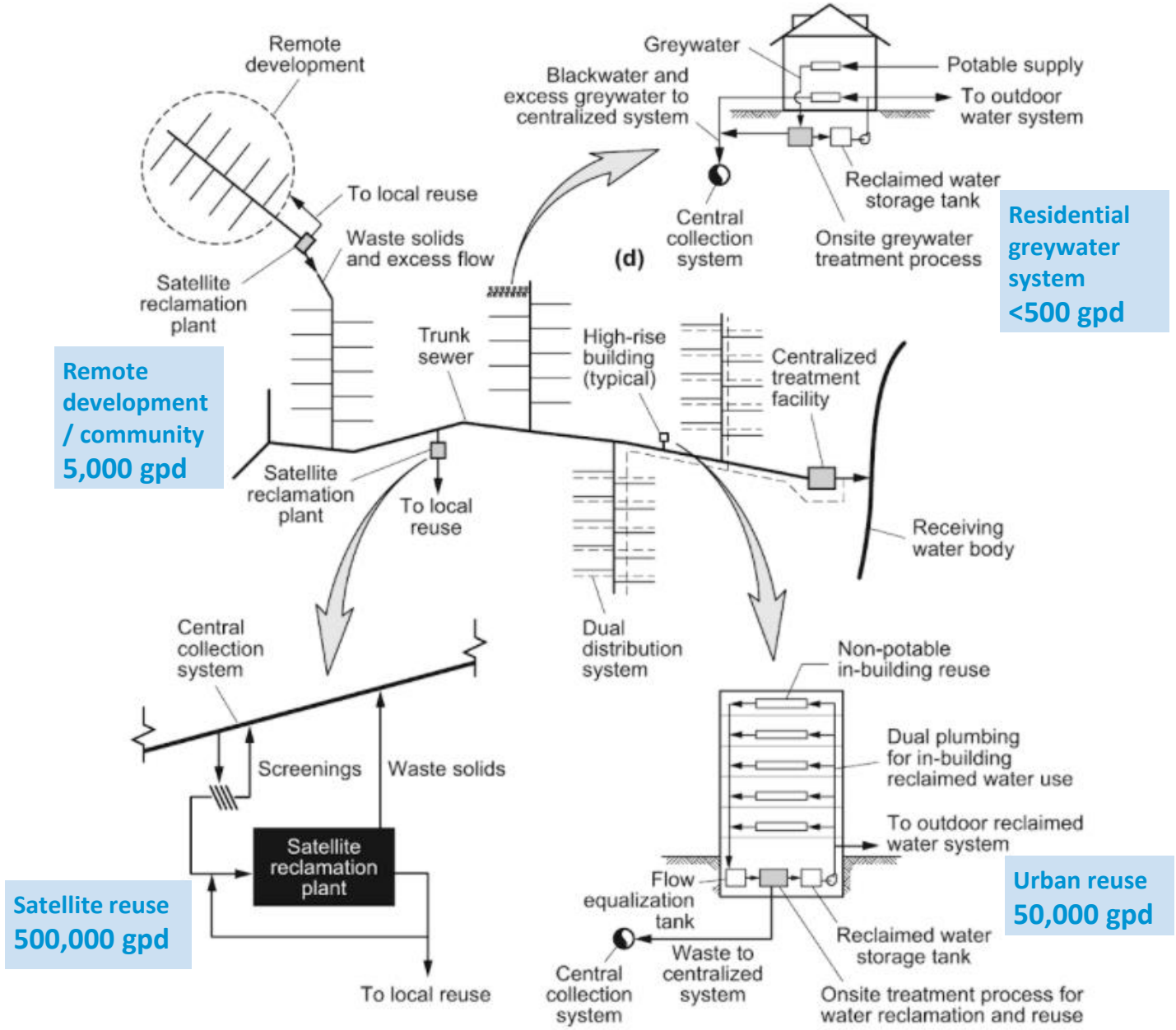
1: WHY PURSUE SATELLITE WATER REUSE? RESILIENCE!

Water infrastructure is spatially sensitive (location & scale)

Scale/Location	Treatment Energy	Distribution Energy
Centralized	40%	60%
Decentralized	85%	15%

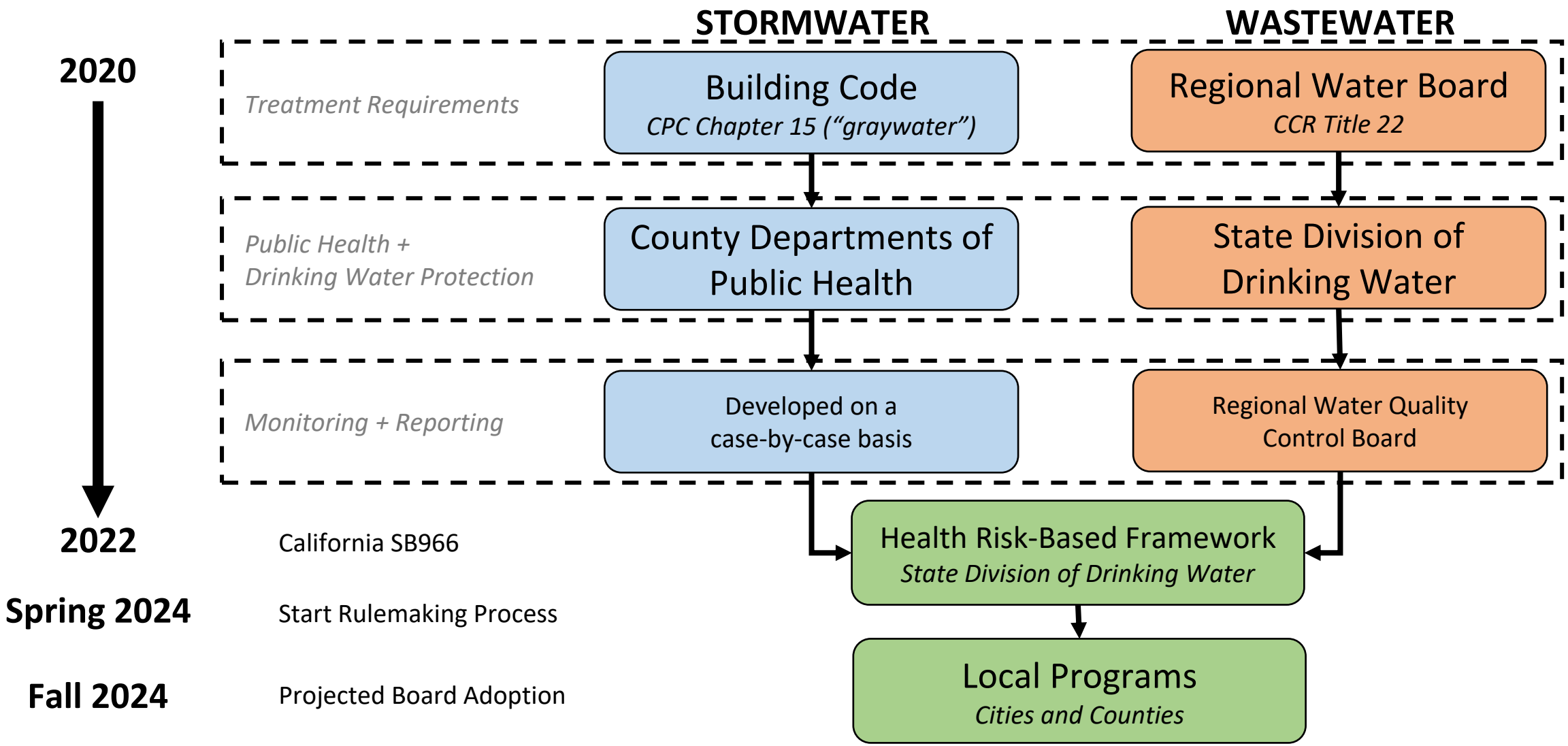


Source: Kavvada et al (2017)



2: REGULATORY & GOVERNANCE

The regulatory framework is simplifying…



…but local jurisdictions must be prepared

SB 966 by the letter of the law:

1. **State will not administer** a local jurisdiction's program
   → reviews annual reports from local programs

2. **Does not address untreated graywater or rainwater reuse (e.g., simple residential systems)**

3. "Local jurisdictions" (a city, county, or **city and county**) adopt State technical standards
   → adopts local program for all new and existing systems

4. **No local program → No ONWS**

5. Consult with **water/sewer providers** → significant adverse impacts to existing sewer collection & treatment, or centralized water recycling program,
   → local jurisdiction may be required to mitigate the impacts

Health Risk-Based Framework

COLORADO
Department of Public Health & Environment

Regulation 84

- Statewide approach to oversight of ONWS
- Infection-based approach to LRTs - first state to adopt.

California LEGISLATIVE INFORMATION
CALIFORNIA WATER BOARDS
State Water Resources Control Board

SB 966

- Requires adoption of local programs to permit ONWS
- Infection-based approach to LRTs

Health risk-based framework uses log reductions targets (LRTs) to protect human health

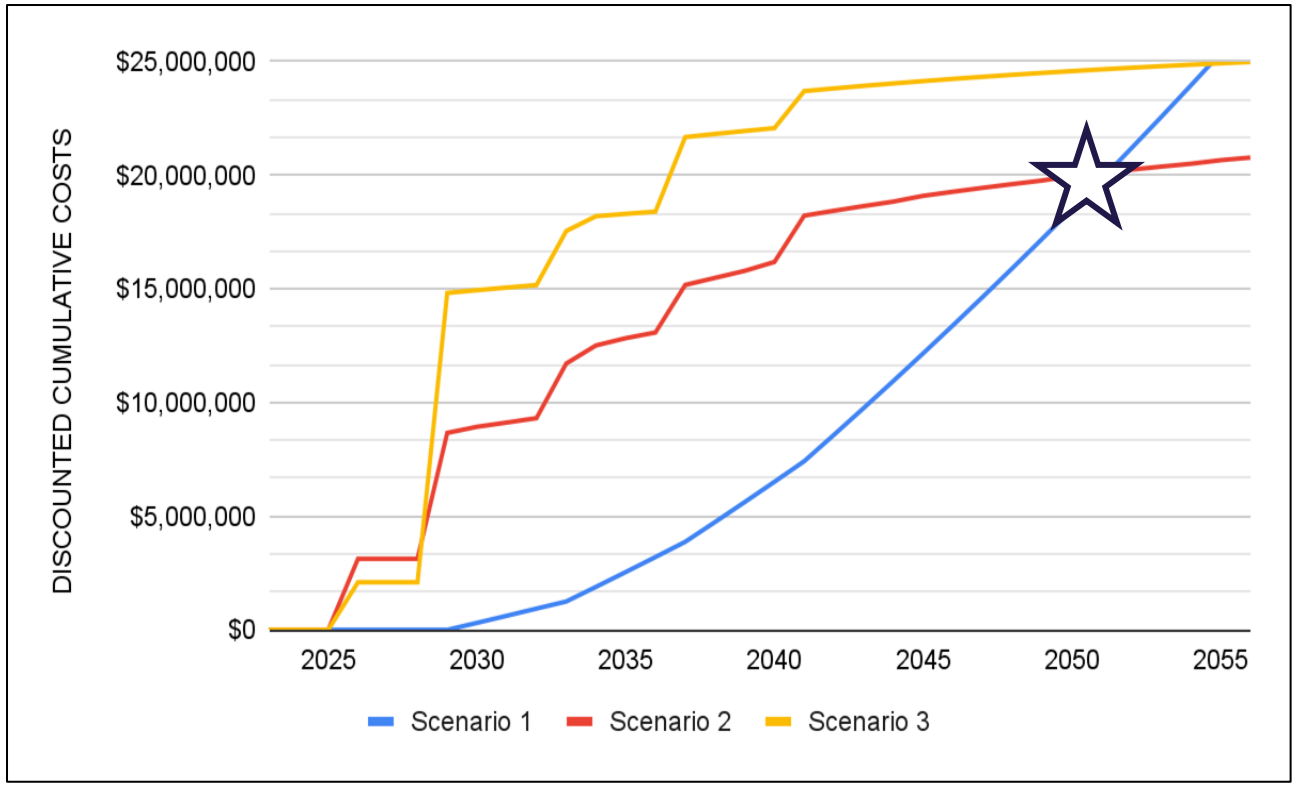
- Infection-based = probability of illness
- Disability adjusted life years (DALY)-based = burden of of disease
- Both are protective of human health and there is general consistency with the treatment train recommendations

3: DECISION-MAKING: COST BENEFIT

Life cycle costs analysis can define drivers for reuse

- Compare cost of a satellite reuse to cost of "**business-as-usual",** defined as a connection to a centralized sewer system and meeting non-potable demands with potable water

- Factors that drive a **financial advantage** to reuse:
  - Escalation of potable water and sewer rates
  - Recycled water rate structure
  - Operating costs
  - Resource recovery
  - Financial incentives or grants

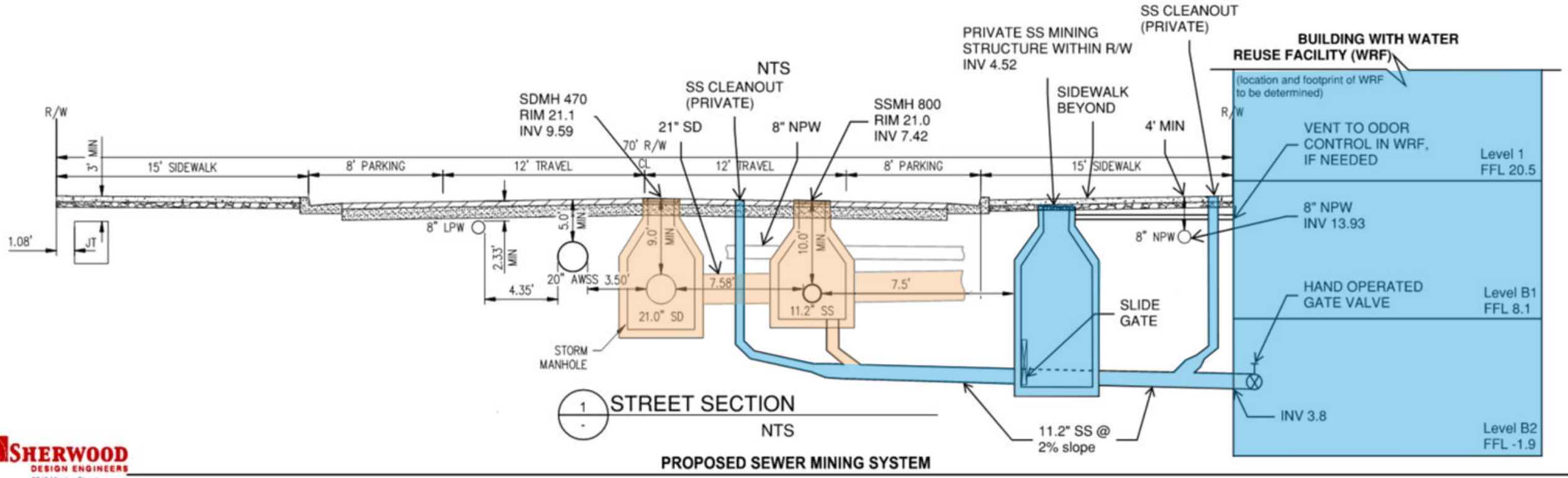


4: PUBLIC-PRIVATE DELINEATION

Public/Private Delineation

Private

Public



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5: ENGINEERING DESIGN

Basis of Design

Regardless of project delivery method (DB, DBB, DBOM, DBFOM), an engineer should develop or validate the basis of design. Ask the right questions of the design team!

How is wastewater characterized? Real data applied to a water balance model will characterize realistic loadings for a development.

	Observed (Grab sample from mining station)	**Literature value** (Low - high strength)
BOD_5 (mg/L)	413	133 - 400
TSS (mg/L)	504	130 - 389

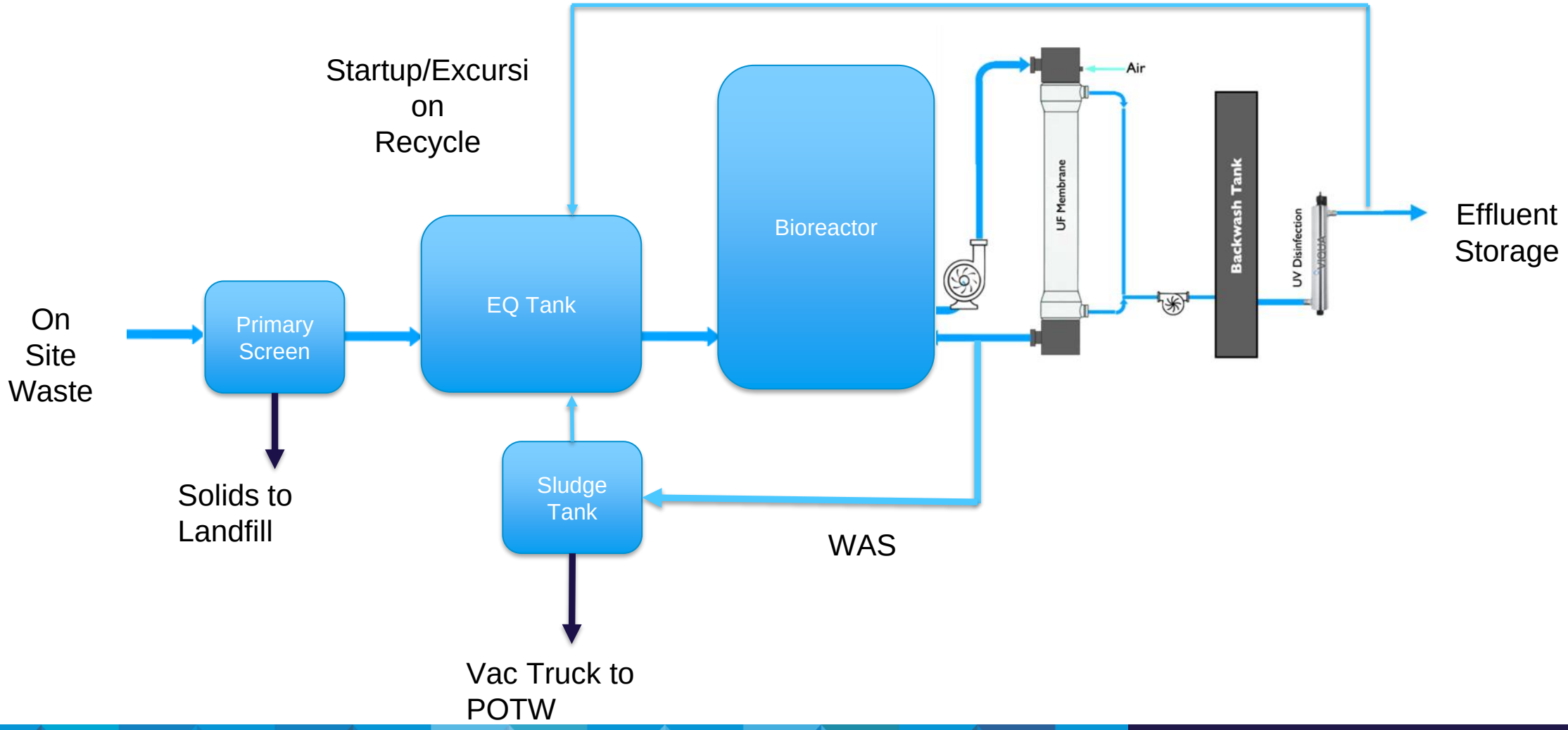
Is equalization and the WRF appropriately sized to meet demands?

- By definition sewer mining is demand based, however:
  - *Location will be dictated by flows as well as end uses.*
  - *Design should consider scour velocity or define a flushing regime.*
  - *Flow study needed to determine how flows can meet demands year-round.*
- Design of mining diversion will dictate solids loading

Source: Metcalf & Eddy Wastewater Engineering, Table 3-18 Typical composition of untreated domestic wastewater.

6: PROCESS DESIGN & OPERATION

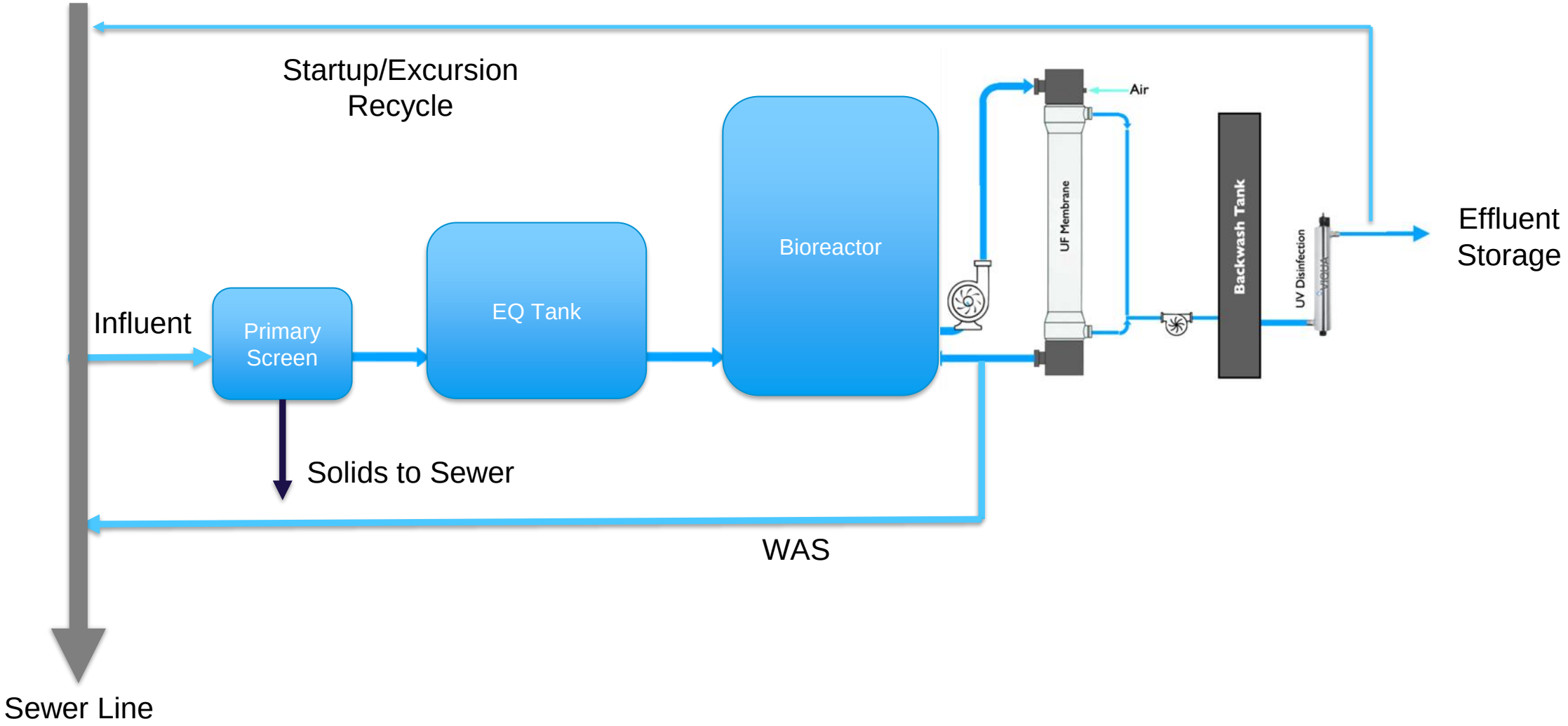
Typical Decentralized MBR Plant Flow Diagram



Challenges in Typical Decentralized MBR Plant

- Large variations of influent flow require larger EQ tanks and addition, costly, membrane capacity for peaking
- Primary and secondary solids must be hauled away
- If operation is seasonal, annual startup will require
  - Purchase of supplemental food and nutrients to build biology
  - Possible importation of mixed-liquor
  - An acclimation period during which the system will not meet effluent requirements
- Limited ability to recycle effluent in the event of an occurs

Sewer Mining Satellite MBR Plant Flow Diagram



Sewer Mining Advantages

- Steady Influent Flow
  - Can generally intercept same flow 24/7
  - No need to design for large peaking factors
- No on-site solids handling
  - Send to POTW for better economy of scale for:
    - Contaminant destruction/removal
    - Energy recovery potential
- Ease of startup, especially for seasonal operation
  - No need for supplemental food addition
  - Can return effluent to sewer until biology stabilizes
  - Can also be used if plant has an excursion
- Generates Reuse Water Near to the User
  - No need for lengthy, expensive purple pipe runs

In summary, a successful sewer mining project requires…

- Collaboration between engineer and equipment provider
- Consideration for the diversion/mining infrastructure impacts on influent and downstream flows and loads
- Clear and proactive coordination and agreement between collection system and satellite reuse system operator
- Process Design which utilizes the advantages