

## **State of Oregon**

### **Department of Environmental Quality Guidelines**

#### **Guidelines for Writing Wastewater Engineering Design and Pre-Design Reports - 1994**

##### **INTRODUCTION**

These guidelines outline topics that we normally expect to be covered in wastewater design reports, pre-design reports, and the engineering design aspects of facility planning reports. The guidelines are also intended to apply to wastewater engineering studies of lesser scope. For example: facility plan technical supplements, sewage works technical memoranda, engineer's letter reports, etc.

Typical pumping and activated sludge systems are used as examples. For other processes, the engineer should provide comparable descriptions and analysis. Some of the topics may not apply in a particular situation. However, where the topic applies, engineering reports should achieve the objectives and level of detail indicated below and illustrated in the attached examples.

##### **PURPOSE**

A primary function of facility plans and engineering reports is to allow for review and consensus on design features prior to starting a final design. Principal reviewers should normally include the public works operations staff and the engineer's senior reviewers. However, since the Department of Environmental Quality (DEQ) is responsible for approving each municipal sewage works design in Oregon, DEQ review of these reports is also strongly encouraged prior to authorizing the start of final design.

The objective of scheduling early DEQ review is to save time and effort later. DEQ's concurrence with the proposed design criteria will minimize re-design and re-review costs. Scheduling the time to make DEQ review staff familiar with a project from its outset helps assure that final regulatory approval is issued with the minimum possible delay.

##### **SEWAGE PUMPING FACILITIES**

###### **Background**

Provide background which presents the overall context for each pump station. This may be a paragraph or an entire section, depending on service area, discharge point, overflow aspects, complexity, size, location, and so on.

Note: These guidelines replace our 1992 guidelines for pre-design reports, which are obsolete and should be discarded.

###### **Design Data**

The design characteristics of each pump station and forcemain should be tabulated as shown in the attached "Pump Station Design Data" example. As may be appropriate, the report should also address items described in DEQ's guidelines for pump station plan submittals (available on request).

## **Existing Pump Stations**

Current pumping capacity, extent of wear, and overall station condition and reliability need to be determined in the field. As a minimum, the discharge side of each pump needs to be gauged to measure actual pumping head. Current shutoff head should be compared with shutoff as shown on the manufacturer's pump curve. Current pumping capacity should be compared with design capacity. Station reliability, safety, and controls need to be evaluated against future requirements.

## **Existing Force Mains**

The discharge manhole of each existing force main needs to be inspected in the field. Too often the manhole and nearby concrete sewer are on the verge of collapse by the time an existing pump station is evaluated for upgrading.

An accurate corrosion inspection cannot be made visually. It involves kneeling by the open manhole and probing around the inside cone with a knife or screwdriver blade to determine the extent of concrete deterioration inside the roof of the manhole. The report should describe the date, tool or probe used, and results found.

If significant corrosion is found, then immediate repairs or further investigations may be warranted. For example, a manned descent to measure the depth of pipe crown loss, and perhaps TV'ing the sewer to determine the extent of damage downstream.

In connection with sulfide corrosion, the report should determine whether sulfide controls are warranted and what type. As a rule of thumb, discharges of H<sub>2</sub>S into gravity sewers should not exceed 0.1 mg/l in accordance with DEQ's guidelines for H<sub>2</sub>S field testing (available on request).

## **SEWAGE TREATMENT FACILITIES**

### **Existing Treatment Works**

Background - Establish the general context of existing facilities being described, such as history of development, special features, similarities or unique aspects, and so on. This may be a paragraph or an entire section, depending on the existing facility and the project being proposed.

Description - Normally a detailed summary of design data is necessary to describe existing facilities being evaluated. Unless ample detail was originally provided in an operations manual or other reference, the engineer will need to develop additional detail through field inspections and measurements. The level of detail should be as illustrated in the attached examples.

Present Condition and Service Life - The engineer should evaluate current maintenance needs and identify components needing refurbishment, replacement, improvement, abandonment, demolition, etc. Describe any particular maintenance or operational difficulties, access problems, poor availability or excessive costs of factory service or spare parts, etc.

Performance Evaluation - Document evaluations of equipment, unit processes, and components with reference to standard or current design practice, current loadings, plant records, and similar facilities. Evaluations may often require specific performance tests or observations to be made in the field. For example: current versus design pump shutoff head and capacity, scum buildup, flow stacking, surging, uneven weirs, hydraulic bottlenecks or short-circuits, metering deficiencies, unrepresentative sampling, poor mixing, deferred maintenance, etc.

## Proposed Process Designs

Provide a Process Design section, starting with an introduction and general approach. This section is important because it may provide the sole record of design intent. It should be sufficiently detailed to document proposed design criteria.

Effluent Requirements - The effluent requirements should be summarized in tabular form. Include:

- EPA reliability class of the facility
- permitted or required effluent quality and mass loadings
- anticipated effluent quality

Process Design Criteria - The process design criteria should be tabulated. This includes initial and future flows and waste strengths, with flow projections developed in accordance with DEQ guidelines (available on request). Provide a design data summary table indicating the critical design parameters of units, processes, and equipment. The attached examples indicate the desired level of detail for such items:

- design population and flows
- raw sewage characteristics and loadings
- septage characteristics and loadings
- on-site lift station design data
- headworks type, sizing, capacity of all components
- primary clarifier type, sizing (LWD), capacity, and overflow rate
- primary effluent characteristics and loadings on the secondary process
- aeration basin type, size (LWD), detention, oxygen uptake, design MLSS, and sludge yield for main and alternate modes of operation
- aeration system type, sizing, capacity, efficiency, and output including both diffusers, blowers, and related equipment
- secondary clarifier type, sizing (LWD), capacity, overflow rate, and solids loading
- WAS and RAS pumping design data
- chlorination/dechlorination feeders type, sizing, capacity
- chlorination/dechlorination mixer type, sizing, velocity gradient, and mixing volume
- contact basin configuration, sizing, volume, detention time, L:W ratio
- chemical feeders and mixers type, size, capacity, detention time
- chemical clarifier type, sizing, overflow rate, solids loading, sludge yield and recycle
- effluent filter type, sizing, hydraulic loading, and backwash data
- outfall design data, diffuser data, submergence, and dilution factors
- sludge characteristics and sludge pumping design data
- sludge thickener type, sizing, area, solids loading, overflow rate, and capacity
- digester type, sizing, detention time, and solids loading
- digester auxiliary equipment design data (grinders, mixers, heaters, compressors, etc.)
- sludge dewatering type, sizing, loading, hours of operation
- sludge disposal method, equipment, trips per day
- recycle streams and loadings
- flowmeter types, applications, and capacities
- standby power type, sizing, and capacity
- plant water systems type, sizing, and capacity

A complete tabulation is expected to be printed in the construction plans, as well as in design reports, as a permanent reference. Generally the tabulation should reflect both current improvements and previous facilities to remain. The objective is to have one tabulation which reflects the entire plant, and which can later be copied for inclusion in the operations manual.

Hydraulic Profile - Draw a hydraulic profile reflecting the peak instantaneous design flowrate. Pertinent data should include proposed flowrates in parallel trains, elevations, flow controls, 100-year flood elevation, and finish grade at structures. Despite availability of the profile in a design report, it is also expected to be printed in the construction plans for permanent reference.

Process Control - Write a description of process flow and bypassing options for each component, including solids handling. This text may serve as a basis for a "Control Strategies" section later to be included in the specifications, and eventually providing the operational concepts for the O&M (operations and maintenance) manual.

Process Schematics - Schematic diagrams should show chemical addition and sampling points. Sometimes all three types of diagrams need to be drawn separately for clarity:

- Draw a liquid-stream process diagram showing alternative flow options, normal modes and bypasses, drains, recycles, and blow-downs.
- Draw a sludge process diagram showing flow-meters, drains, recycles, and alternate processing modes.
- Draw a solids balance for the treatment plant documenting adequacy of sludge metering, pumping, and processing units.

### **Facility Pre-Design and Preliminary Design**

Pre-design reports should include a facility design section indicating the design approach and selection of process components. The level of detail will depend on the scope of the proposed project.

Plant Layout - Describe the arrangement and site development to accommodate the improvements. Include a site plan showing the footprints of existing and proposed components.

Process Components - Describe each of the process components in turn, including:

- objectives of the process
- configuration and flow schemes
- type, sizing, and loading factors
- operational modes
- bypassing and emergency operations
- surface treatment and corrosion protection
- modifications to existing components
- water supply and drains

Process Schematics and Plans - Provide process schematics and outline plans and sections of systems and components to be designed. The level of detail will depend on the complexity of the project. Typically include:

- outline layout or arrangement
- elevations
- water surfaces
- major piping

Sampling Systems - Describe the objectives and controls for the sampling systems proposed. Include:

- locations
- sampling methods
- sampling equipment and controls

Site Piping - Tabulate major piping applications and service conditions, materials, and installation conditions. Identify special concerns, such as corrosion and solids deposition, and proposed solutions.

Reliability and Standby Power - Describe the potential for failure and disruption of service for critical process components, and the design criteria that will provide continued treatment for a particular reliability class. The class of reliability should be as described in EPA Technical Bulletin EPA-430-99-74-001: *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability*. Describe the degree of redundancy or back-up system proposed for each critical process or component. Describe the potential for power outages. Provide utility power-outage documentation to justify the proposed reliability conditions and degree of redundancy.

Electrical - It would be desirable to describe and tabulate major process electrical loads. Indicate type of equipment, number, size, horsepower, voltage, and controls.

Site Drainage - Describe storm drainage facilities and isolation measures to prevent spillage of sludge, sewage, or screenings into the storm drainage system.

Geotechnical - Describe the geotechnical factors that will affect the design. Factors may include:

- topography and effects of site layout or construction
- soil profile and effects on earthwork and structural design
- water table effects
- results of geotechnical investigations
- types of structure and foundations to be designed to meet geotechnical conditions

Heating, Ventilating, and Air Conditioning - It is desirable to describe HVAC sizing for major air handling and heating units.

## **Project Implementation**

Provide a section on implementation:

Schedule - Update the project schedule.

Operation During Construction - Describe how existing facilities will be operated during construction of the proposed improvements, and especially how permit limits will be achieved. Include a preliminary feasible construction sequence.

## **Cost Estimates**

Provide updated cost estimates for construction and for operation and maintenance. Address discrepancies or departures from prior estimates and adequacy of funding for the proposed project. It may often be desirable to provide a table of estimated cash flow requirements.

## **Appendices**

Provide a preliminary list of drawings and specification section headings.

## **DEQ REVIEWS AND RESPONSE TIME**

The information provided in engineering design and pre-design reports should allow subsequent work to proceed with a clear understanding of major design features and criteria. Following review and consensus, preparation of construction documents should then proceed with relative confidence.

Periodic design reviews should also be conducted by the engineer. Reviews at approximately 10, 40, and 70 percent completion have been beneficial to DEQ's review process, contributing to extremely speedy review of final construction documents. Very often DEQ review staff can complete approval of final plans in a few hours or days where projects had interim design reviews, in contrast to several weeks otherwise.

## **INQUIRIES**

Inquiries about these guidelines should be directed to DEQ regional water-quality plan review engineers.

## **EXAMPLES**

The attached examples should be used as a guide to the content and level of detail for design data, process diagrams, hydraulic profiles, and preliminary drawings.

- 1 - Pump Station Design Data
- 2 - Design Data, Secondary Treatment
- 3 - Design Data, Solids and Chemical Advanced Treatment
- 4 - Hydraulic Profile, Secondary Treatment
- 5 - Hydraulic Profile, Advanced Treatment
- 6 - Flow Diagram w/ Valve and Control Designations
- 7 - Overall Liquid Process Schematic
- 8 - Flow Diagram w/ Solids Balance
- 9 - Flow Diagram w/ Sample Points and Chemical Addition
- 10 - Lagoon Profile, Flow Diagram, and Design Data
- 11 - Solids Schematic and Balance

12 - Preliminary Outline Plan Drawing

13 - Preliminary Section

DSM: ENGREPTS1.DSM

Orig. V.92

Rev. VIII.94





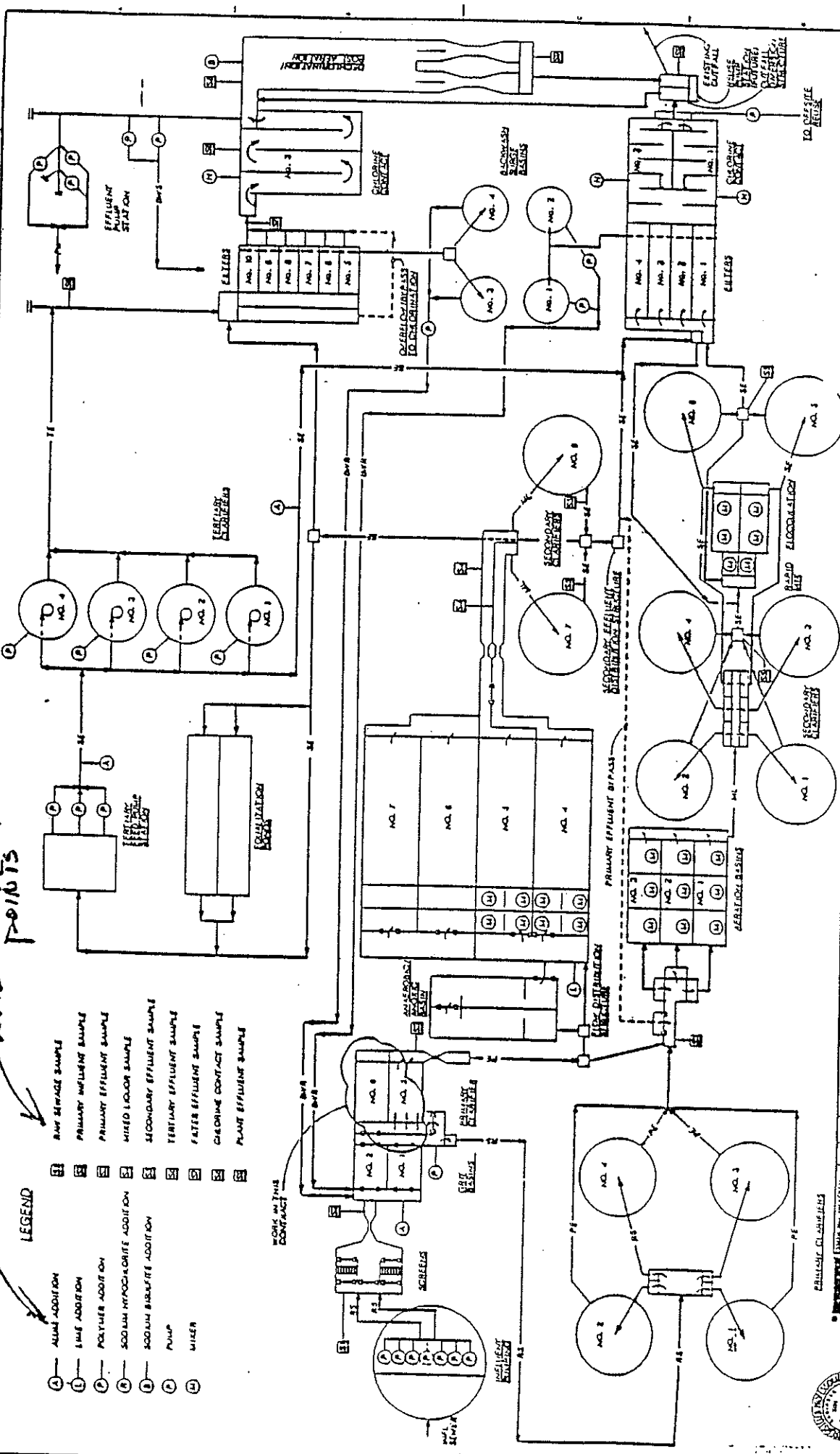






NOTE: ALL SAMPLE POINTS  
 - EXAMPLE -

- LEGEND**
- (A) ALUM ADDITION
  - (B) LIME ADDITION
  - (C) POLYMER ADDITION
  - (D) SODIUM HYPOCHLORITE ADDITION
  - (E) SODIUM BISULFITE ADDITION
  - (F) PUMP
  - (G) MIXER
  - (H) RAW WASTE SAMPLE
  - (I) PRIMARY INFILTRATE SAMPLE
  - (J) PRIMARY EFFLUENT SAMPLE
  - (K) MIXED LIQUOR SAMPLE
  - (L) SECONDARY EFFLUENT SAMPLE
  - (M) TERTIARY EFFLUENT SAMPLE
  - (N) FATES EFFLUENT SAMPLE
  - (O) CHROME CONTACT SAMPLE
  - (P) PLANT EFFLUENT SAMPLE



**OVERALL LIQUID PROCESS SCHEMATIC**

PHASE 4 EXPANSION - SOLIDS PROCESSING GENERAL

ROCK OREE FACILITY  
UNION MEMBERS UNION  
WASHINGTON COUNTY, OREGON

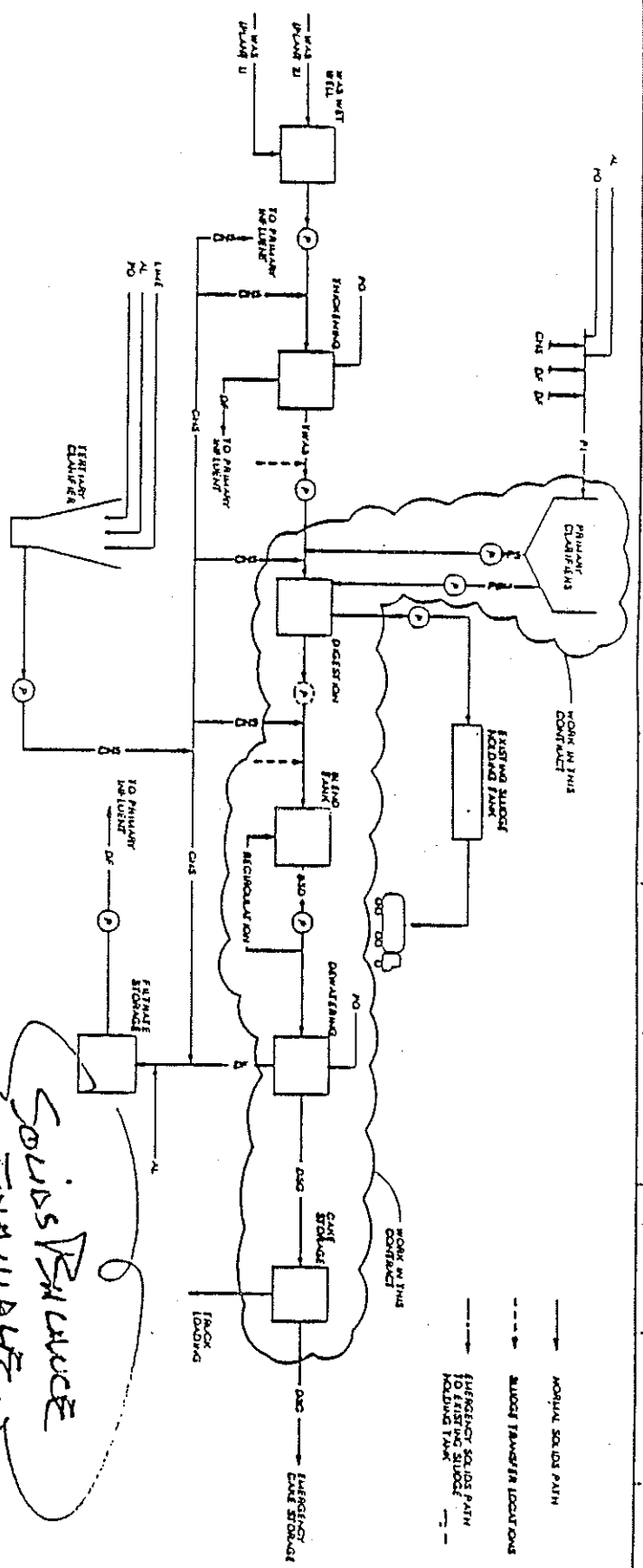
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**DATE** 11/11/81  
**BY** J. W. BROWN  
**NO. DATE** 11/11/81  
**NO. DATE** 11/11/81  
**NO. DATE** 11/11/81









*Solids Balance Example*

Process	AUG. DAY DRY		MAX. MONTH DRY		AUG. DAY DRY		MAX. MONTH WET		AUG. DAY DRY		MAX. MONTH DRY		AUG. DAY DRY		MAX. MONTH WET		AUG. DAY DRY		MAX. MONTH DRY	
	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)	Flow (1000 gpd)	Conc. (lb/d)
Primary Clarifiers	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000	50	20,000
Digestion	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000	20	10,000
Find Pond	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000	10	5,000
Recirculation	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500	5	2,500
Downtank	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000	2	1,000
Sand Storage	1	500	1	500	1	500	1	500	1	500	1	500	1	500	1	500	1	500	1	500
Energy Cell Storage	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250	0.5	250

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**EXAMINER**

NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_

**ROCK CHIEF FACILITY**

NAME: \_\_\_\_\_ TITLE: \_\_\_\_\_

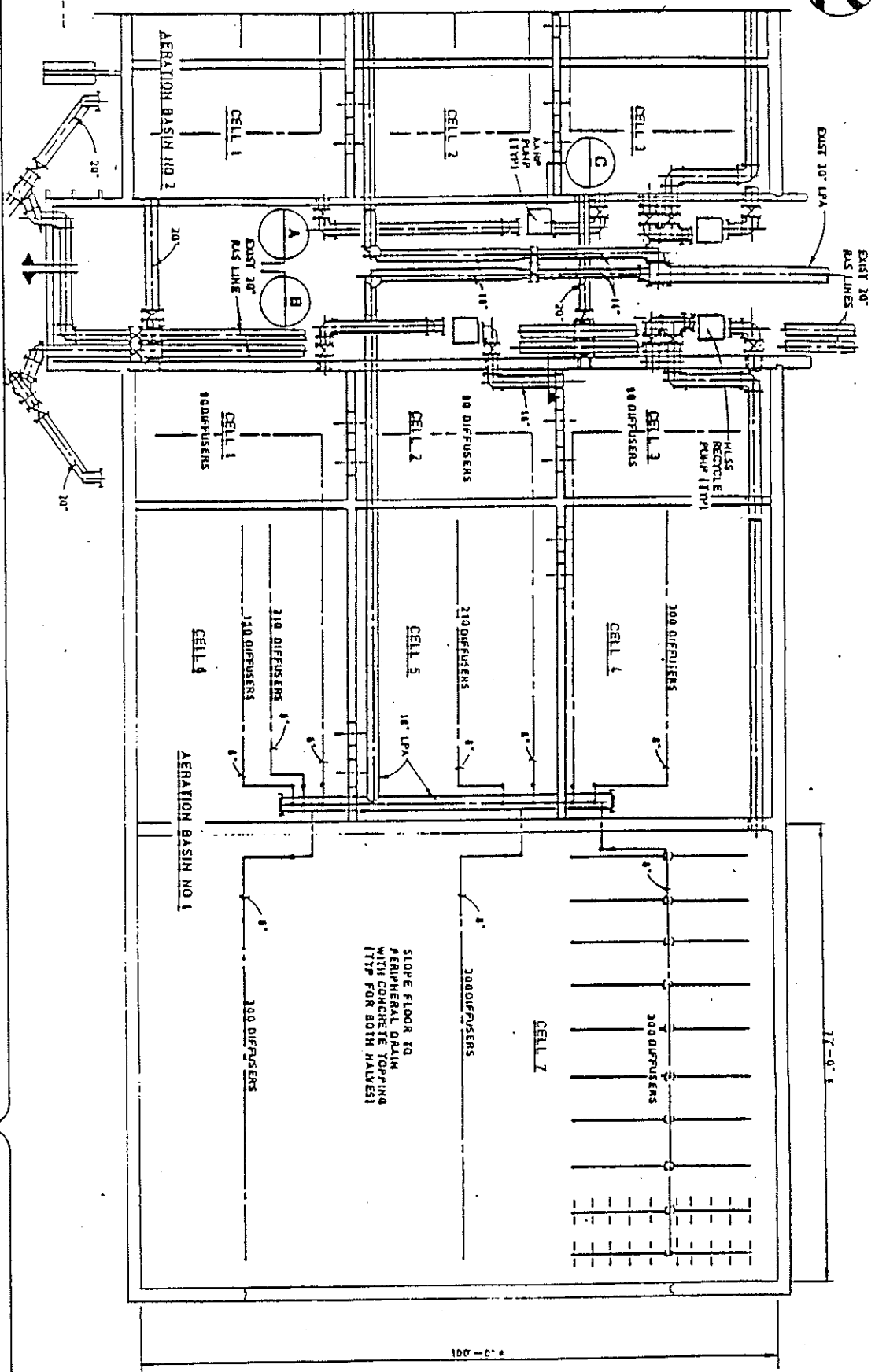
**SOLIDS BALANCE DIAGRAM**

DATE: \_\_\_\_\_



**Solids Balance Diagram**

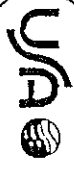




AERATION BASIN MODIFICATIONS - SECTIONAL PLAN

HTR

HDR OAKBROOK, INC.



USA DESIGN PLAN  
PHASE 1 B

PS&K  
4.4

Outline Plan