

CVEN 4830/4434 – Spring 2008

Phase 2 Deliverable Wastewater Liquid Treatment Design Report: Biological Treatment Process Components, Hydraulic Profile, Geotechnical and Structural Design **DUE: April 8, 2008, 3:30pm**

Phase 2 develops the final scope of engineering work including sizing and design of the facility and communication of the design to the owner/client. In this phase the project is developed to a level of detail necessary to receive bids/proposals for the project construction. The phase is the opportunity for the project team to inform the owner of the definitive final design and its limitations. The Project Team is focused on coordinating all project requirements into a comprehensive whole.

Resources

- 75th Street Wastewater Treatment Plant Phase 1A As Built Drawings dated 04/23/1990, posted on the class web site.
- US Army Corps of Engineers design of Concrete Floors for Heavy Loads 1987
- Selected pages from Foundation Engineering Handbook
- Incomplete Straight Earthwork and Concrete Specifications (on the class website)
- Geotechnical Engineering Report by Scott Cox and associates
- Requirements for preparation of Construction Specifications Institute (CSI) specifications posted on the web site.
- Software tool (BioWin) for design of liquid process elements: biological reactor tanks and settlers, and specification of aeration and pumping requirements.
- Influent wastewater characteristics and treated water quality standards information developed in the Phase 1 report.
- Software tool for calculation and elevation drawing of liquid process line hydraulic profile.
- ACI code and design guidelines for environmental reinforced concrete tanks.

Liquid Treatment Process Line Documents

Process - What groups should do

1. Review and summarize influent characterization in the form of an input file for BioWin.
2. Build activated sludge process schematic in BioWin.
3. Optimize activated sludge process design for required levels of removal of organic matter (COD) and inorganic nitrogen (ammonia and nitrate) using BioWin, by adjusting tank volume and solids wasting rate.
4. Simulate designed plant response to sustained flow peaks.
5. Estimate waste activated sludge produced under normal operating conditions (part of BioWin output).

Deliverables – What groups should turn in

1. Drawing of process schematic showing liquid line components (aeration basin and secondary clarifier).
2. Plant site map showing location of new tanks.
3. Table of tank sizes: volume, depth, surface area, hydraulic and solids residence time
4. Table of aeration requirements and waste activated sludge produced. Estimate energy cost of aeration if electricity is \$0.08/kwh. Estimate disposal costs if waste solids treatment and disposal unit cost is \$600 per dry ton.
5. Table of effluent characteristics under normal and peak load
6. Text report discussing how process design meets requirements for flow capacity and treated water quality. How can designed plant be changed (either by different operation or addition) to meet stricter discharge requirements for inorganic nitrogen.

Siting of New Process Elements and Plant Hydraulic Profile Documents

Process – What groups should do

1. Review plant site layout and 1990 design hydraulic profile information. (as built drawings on web page)
2. Locate tanks for liquid process elements in old plant site plan designed to be consistent with existing elements of plant liquid process line to be retained.
3. Identify elements to be removed and estimate demolition volume and mass to be disposed.
4. Calculate hydraulic profile of the rebuilt plant including pumping requirements using software provided to class. You will need the treatment process information about activated sludge recycling flows between the clarifiers and aeration basins from the liquid treatment process design.

Deliverables – What groups should turn in

1. Hydraulic profile of new plant showing elevation view of process elements with flow control fixtures (weirs, channels, or piping).
2. Calculate pumping requirements and select pump capacities.
3. Estimate energy costs of pumping if power cost is \$0.08/kwh.

Geotechnical Documents

Process – What groups should do

1. Review the geotechnical report.
2. Review the requirements for preparation of CSI specifications.
3. Calculate the lateral earth pressure on the foundation walls. Incorporate soil, water and surcharge loads as necessary.
4. Evaluate impacts of excavation for aeration basin on the existing trickle filter 1 (TF1) and secondary clarifier.
5. Research the Earthwork and Concrete specifications to develop the missing information.

Deliverables – What groups should turn in

1. Pressure diagram for the walls.
2. Calculation of total and differential settlement for the aeration basin and secondary clarifier.
3. A section drawn in AutoCad showing foundation, wall, floor slab, and exterior ground surface showing the aeration basin, the adjacent TF1 and secondary clarifier, and supporting calculations to show any load interference effects and how they will be handled.
4. Complete and expand the Earthwork and Concrete specifications.

Structural Documents

Process – What groups should do

1. Prepare design calculations to support the wall, footing and slab design thicknesses. Assume the structures are subjected to a groundwater level 2 feet above the floor level. Design the structures to resist hydrostatic uplift forces. Also design the structures to meet the allowable soil bearing pressures and lateral earth pressures.
2. Design the wall of the clarifier for membrane (ring) action, considering flexure and shear near the footing.
3. Design the footings and slabs as continuous units, but with optimized thickness for each.
4. Design the footings (thickened slab) for punching shear, bending and flexural stresses.

Deliverables – What groups should turn in.

1. Provide an AutoCad drawing showing an elevation of the aeration basin and the clarifier in architectural scale. Indicate concrete wall, footing and slab thicknesses. Also show wall penetrations for piping and weirs. Indicate wall, footing and slab reinforcement. Slope the floor to properly drain.
2. Provide an AutoCad drawing showing a plan of the of the aeration basin and clarifier in architectural scale. Also show layout and wall penetrations for piping and weirs.

3. Prepare a wall/ floor detail that can properly transfer vertical and lateral loads and is water tight.
4. Provide neat and organized structural calculations for the above work. If spreadsheets are used please provide one set of example hand calculations so that the spreadsheet calculations can be verified.
5. Provide a neat and legible diagram in the calculations showing the horizontal and vertical forces used in the design.

Report Format

1. Transmittal letter addressed to the City of Boulder Wastewater Utility, Bob Harberg, Manager and Floyd Bebler, Plant Superintendent.
2. Scope of work and deliverables including the elements described above.
3. Deliverables from above including maps, drawings, tables, and accompanying text with general design information, including analytical methods, codes or other tools used in design. Presentation of deliverables can follow the organization outlined above. Where appropriate, materials specifications (type, quantity) can be added to drawings or summarized in a separate table or in the text. Remember that this document will be the basis for a construction contractor bid to do demolition, site preparation, acquire materials, and build the project.
4. Include a section showing how information sharing and integration of the four design components occurred in your team, e.g., design review meetings, quality control of calculations and estimates, and any other type of iterative review that designs received. An team organization chart with associated responsibilities is a good way to display this. Each design sheet should have the signatures of at least two team members, and each team member should sign at least two sheets.
5. Calculations that are the basis for designs should be included in the appendix taking care to show assumptions, information used, and method followed. Take care to include appropriate units and dimensions and highlight final answers used in the design. Make sure all spreadsheet columns are clearly labeled and the appropriate number of significant figures are used.