

## Detail Report

### Cost Comparison Summary of Selected Layouts

Layout Name	Present Worth	Project	Oper. (/yr)	Maint. (/yr)	Mat. (/yr)	Chem. (/yr)	Energy (/yr)	Amort. (/yr)
Activated Sludge	\$46,900,000	\$33,500,000	\$531,000	\$175,000	\$137,000	\$144,000	\$392,000	\$1,040,000
Trickling Filter	\$38,900,000	\$30,300,000	\$451,000	\$136,000	\$110,000	\$143,000	\$103,000	\$898,000

### Unit Costs

#### User Input Data

Description	Value	Units
Building Cost	\$969	\$/m2
Excavation	\$10	\$/m3
Wall Concrete	\$654	\$/m3
Slab Concrete	\$458	\$/m3
Crane Rental	\$150	\$/hr
Canopy Roof	\$172	\$/m2
Electricity	\$0	\$/kWh
Hand Rail	\$246	\$/m
Land Costs	\$24,700	\$/ha
Construction Labor Rate	\$25	\$/hr
Operator Labor Rate	\$20	\$/hr
Average Administration Salary	\$20	\$/hr
Pipe Installation Rate	\$50	\$/hr
Lime	\$0	\$/kg
Alum	\$0	\$/kg
Iron	\$0	\$/kg
Polymer	\$3	\$/kg
8 in Pipe	\$272	\$/m
8 in Bend	\$350	\$
8 in Tee	\$800	\$
8 in Valve	\$3,400	\$
Interest Rate	8	%
Construction Period	3	years
Operating Life Of Plant	40	years
Engineering Design Fee	15	%
Miscellaneous	5	%
Administration/Legal	2	%
Inspection	2	%
Contingency	10	%
Technical	2	%
Profit and Overhead	15	%

### Cost Indices

#### User Input Data (To be continued)

Description	Value	Units
Marshall And Swift Index	1080	

**Cost Indices**

User Input Data (Continue)

Description	Value	Units
Engineering News Records Cost Index	6240	
Pipe Cost Index	547	
User Cost Index 1	100	
User Cost Index 2	100	
User Cost Index 3	100	

**Additional Site-Specific Costs**

User Input Data

Description	Value	Units
Special Foundation	None	
Effluent Pumping	None	
Outfall Diffuser	None	
Mobilization	Estimate	
Site Preparation	Estimate	
Site Electrical	Estimate	
Yard Piping	Estimate	
Instrumentation and Control	Estimate	
Lab and Administration Building	Estimate	
Raw Sewage Pumping	None	
Outfall	None	

**Activated Sludge**

Process Summary

Process	Construction	Oper(/yr)	Maint(/yr)	Mat(/yr)	Chem(/yr)	Energy(/yr)	Amort(/yr)
Preliminary Treatment	\$420,000	\$37,100	\$16,300	\$10,500	\$0	\$3,720	\$35,200
Primary Clarification	\$757,000	\$19,900	\$9,610	\$7,570	\$0	\$808	\$63,500
Complete Mix Activated Sludge	\$2,160,000	\$77,000	\$42,800	\$36,700	\$0	\$334,000	\$187,000
Secondary Clarifier	\$900,000	\$30,100	\$14,600	\$9,000	\$0	\$977	\$81,700
Chlorination	\$390,000	\$27,800	\$6,100	\$12,200	\$141,000	\$10,500	\$37,200
Sludge Flotation Thickening	\$753,000	\$47,800	\$6,500	\$7,640	\$2,730	\$26,200	\$0
Anaerobic Digestion	\$4,270,000	\$39,800	\$22,900	\$20,700	\$0	\$16,400	\$384,000
Drying Beds	\$1,090,000	\$128,000	\$56,200	\$9,810	\$0	\$0	\$93,900
Hauling And Land Filling	\$95,900	\$4,470	\$0	\$23,000	\$0	\$0	\$14,200
Blower System	\$1,730,000	\$0	\$0	\$0	\$0	\$0	\$145,000
Other Costs	\$18,100,000	\$0	\$0	\$0	\$0	\$0	\$0

**Activated Sludge using July 2000,(USA Avg) equipment cost database**

**Activated Sludge - Summary of Costs for Layout**

Design Output Data (To be continued)

Description	Value	Units
Administration hours	2120	hr/yr
Laboratory labor hours	3470	hr/yr
Estimated land for construction required	35.1	ha
Estimate administration labor cost	\$42,300	\$/yr

**Activated Sludge - Summary of Costs for Layout**  
Design Output Data (Continue)

<b>Description</b>	<b>Value</b>	<b>Units</b>
Estimated laboratory labor cost	\$76,400	\$/yr
Mobilization	\$564,000	\$
Site preparation	\$750,000	\$
Site electrical	\$1,630,000	\$
Yard piping	\$1,070,000	\$
Instrumentation and control	\$852,000	\$
Lab and administration buildings	\$1,330,000	\$
Total other direct cost	\$6,200,000	\$
Total unit process construction cost	\$12,600,000	\$
Profit	\$2,810,000	\$
Total construction cost(w/profit)	\$21,600,000	\$
Miscellaneous cost	\$1,080,000	\$
Legal cost	\$432,000	\$
Engineering design fee	\$3,240,000	\$
Inspection cost	\$432,000	\$
Contingency	\$2,160,000	\$
Technical	\$432,000	\$
Total indirect cost	\$7,770,000	\$
Total cost of land	\$868,000	\$
Interest during construction	\$3,290,000	\$
<b>OPERATION AND MAINTENANCE</b>		
Total administration and laboratory cost	\$119,000	\$/yr
Total operation cost	\$412,000	\$/yr
Total maintenance cost	\$175,000	\$/yr
Total material cost	\$137,000	\$/yr
Total chemical cost	\$144,000	\$/yr
Total energy cost	\$392,000	\$/yr
<b>PROJECT SUMMARY</b>		
Total annual labor cost	\$706,000	\$/yr
Total annual material, chemical and energy cost	\$673,000	\$/yr
Total annual O&M cost	\$1,380,000	\$/yr
Total annual amortization cost	\$1,040,000	\$/yr
Total project cost	\$33,500,000	\$
Present worth (NPV)	\$46,900,000	\$

**Activated Sludge - Summary of Air Supply System**  
Design Output Data (To be continued)

<b>Description</b>	<b>Value</b>	<b>Units</b>
Minimum air flow capacity	25500	N m3/hr
Safety factor	1.5	
Requested air flow capacity	38300	N m3/hr
Total capacity of blowers	85000	N m3/hr

### Activated Sludge - Summary of Air Supply System

Design Output Data (Continue)

Description	Value	Units
Number of blowers in use	1	
Total number of blowers	2	
Capacity of individual blowers	85000	N m3/hr
Estimated cost of an installed blower	\$693,000	\$
Blower building area	182	m2
Construction and equipment cost	\$1,730,000	\$
O&M material and supply cost	\$0	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$145,000	\$/yr

### Activated Sludge - Influent Wastewater

User Input Data

Description	Value	Units
Average Flow	37900	m3/d
Minimum Flow	37900	m3/d
Maximum Flow	37900	m3/d
Suspended Solids	220	g/m3
% Volatile Solids	75	%
BOD	220	g/m3
Soluble BOD	80	g/m3
COD	500	g/m3
Soluble COD	300	g/m3
TKN	40	gN/m3
Soluble TKN	28	gN/m3
Ammonia	25	gN/m3
Total Phosphorus	8	gP/m3
pH	7.6	
Cations	160	g/m3
Anions	160	g/m3
Settleable Solids	10	mL/L
Oil And Grease	100	g/m3
Nitrite	0.0	gN/m3
Nitrate	0.0	gN/m3
Non-Degradable Fraction Of VSS	40	%
Average Summer	23	deg C
Average Winter	10	deg C

### Activated Sludge (Influent Wastewater)

Water Quality Data (To be continued)

Parameter	Influent	Effluent	Units
Maximum flow	37900	37900	m3/d
Minimum flow	37900	37900	m3/d
Average flow	37900	37900	m3/d
Suspended solids	220	220	g/m3
% volatile solids	75	75	%

**Activated Sludge (Influent Wastewater)**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Units
BOD	220	220	g/m3
Soluble BOD	80	80	g/m3
COD	500	500	g/m3
Soluble COD	300	300	g/m3
TKN	40	40	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	25	25	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	8	8	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	10	10	mL/L
Oil and grease	100	100	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Activated Sludge - Preliminary Treatment-Screening**  
User Input Data

Description	Value	Units
Cleaning Method	Mechanically Cleaned	
Mechanically Cleaned Depth	0.304	m
Width	0.635	cm
Space	3.81	cm
Slope	30	Deg
Shape Factor	2.42	-
Approach	0.762	m/s
Max	0.914	m/s
Ave	0.762	m/s

**Activated Sludge - Preliminary Treatment-Grit Removal**  
User Input Data (To be continued)

Description	Value	Units
Particle Size	0.02	cm
Specific Gravity	2.65	-
Type Of Grit Removal	Horizontal	
Number Of Units	2	-
Design By	Depth	
Depth	1.22	m
Current Allowance	1.7	-
Manning Coefficient	0.035	-
Volume Of Grit	4	Cuft/Mgal(Us)

### Activated Sludge - Preliminary Treatment-Grit Removal

User Input Data (Continue)

Description	Value	Units
Detention Time	2.5	mins
Air Supply Per Unit Length Of Tank	3	Cfm/Ft
Surface Velocity	0.457	m/s
Tank Floor Velocity	0.304	m/s
Capital Cost	40	years

### Activated Sludge - Preliminary Treatment-Cost Overrides

User Input Data

Description	Value	Units
Override Costs - Only Positive Values Overridden	FALSE	

### Activated Sludge - Preliminary Treatment

Design Output Data (To be continued)

Description	Value	Units
<b>Mechanically Cleaned Bar Screen</b>		
Bar size	0.635	cm
Bar spacing	3.81	cm
Slope of bars from horizontal	30	degrees
Head loss through screen	0.00628	m
Approach velocity	0.762	m/s
Average flow through velocity (screen)	0.762	m/s
Maximum flow through velocity (screen)	0.914	m/s
Screen channel width	1.88	m
Average channel depth	0.304	m
<b>Horizontal Flow Grit Chamber</b>		
Maximum flow	37700	m <sup>3</sup> /d
Average flow	37700	m <sup>3</sup> /d
Minimum flow	37700	m <sup>3</sup> /d
Temperature	10	deg C
Maximum flow through velocity (grit chamber)	0.457	m/s
Average flow through velocity (grit chamber)	0.304	m/s
Size of smallest particle 100% removed	0.02	cm
Specific gravity of particle	2.65	
Number of units	2	
Maximum flow/unit	18800	m <sup>3</sup> /d
Width of channel	0.391	m
Depth of channel	1.22	m
Length of channel	44	m
Settling velocity of particle	0.0215	m/s
Slope of channel bottom	0.00114	
Allowance for currents	1.7	
Manning coefficient	0.035	
Hydraulic retention time	1.6	min
Volume of grit	1.13	m <sup>3</sup> /d
Construction and equipment cost	\$420,000	\$

**Activated Sludge - Preliminary Treatment**  
Design Output Data (Continue)

Description	Value	Units
O&M material and supply cost	\$10,500	\$/yr
Energy cost	\$3,720	\$/yr
Amortization cost	\$35,200	\$/yr

**Activated Sludge (Preliminary Treatment)**  
Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	37900	37900	m3/d
Minimum flow	37900	37900	m3/d
Average flow	37900	37900	m3/d
Suspended solids	220	220	g/m3
% volatile solids	75	75	%
BOD	220	220	g/m3
Soluble BOD	80	80	g/m3
COD	500	500	g/m3
Soluble COD	300	300	g/m3
TKN	40	40	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	25	25	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	8	8	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	10	10	mL/L
Oil and grease	100	100	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Activated Sludge - Anaerobic Digestion**  
User Input Data (To be continued)

Description	Value	Units
Specific Gravity	1.05	
Percent Volatile Solids Destroyed	50	%
Concentration In Digester	5	%
Minimum Detention Time In Primary Digester	15	d
Location	Warm-Winter > 10 Deg C	
Raw Wastewater	20	deg C
Digester	40	deg C
Air	10	deg C
Fraction Of Influent Flow Returned As Supernatant	2	%

### Activated Sludge - Anaerobic Digestion

User Input Data (Continue)

Description	Value	Units
Suspended Solids	6250	g/m3
BOD	1000	g/m3
COD	2150	g/m3
TKN	950	gN/m3
Ammonia	650	g/m3
Override Design	FALSE	
Diameter	16.8	m
Sidewater Depth	7.71	m
Number Of Primary Digester Tanks	2	
Number Of Secondary Digester Tanks	1	
Number Of Batteries	1	
Override Database Costs	FALSE	
Standard 70 ft Diameter Floating Cover	\$229,000	\$
Standard 60 ft Diameter Gas Circulation Unit	\$70,300	\$
Standard 1 Million Btu/Hr Heating Unit	\$39,800	\$
Standard 2 in Diameter Gas Safety Equipment	\$15,600	\$
Standard Size Sludge Pump 8gpm At 70 ft Of Head	\$5,490	\$
Natural Gas Per 1000 Cuft	\$3	\$
Floating Cover	20	years
Gas Circulation Unit	20	years
Heating Unit	20	years
Gas Safety Equipment	20	years
Sludge Pump	25	years
Structural	40	years

### Activated Sludge - Anaerobic Digestion

Design Output Data (To be continued)

Description	Value	Units
<b>Anaerobic Digestion</b>		
Percent VSS destroyed	50	%
Solids concentration in digester	5	%
Raw sludge temperature	20	deg C
Digester temperature	40	deg C
Air temperature	10	deg C
Detention time	15	d
Digester depth	7.71	m
Digester diameter	16.8	m
Effective digester volume	5570	m3
Number of digesters per battery	3	
Number of primary digesters per battery	2	
Number of secondary digesters per battery	1	
Number of batteries	1	
Gas produced	67.9	m3/d
Heat required	1720000	BTU/hr
Digester gas required	51.5	m3/d
Total natural gas required	0.0	m3/d
Operation labor required	2050	pers-hours/yr



**Activated Sludge - Anaerobic Digestion**  
Design Output Data (Continue)

Description	Value	Units
Maintenance labor required	1350	pers-hours/yr
Electrical energy required	205000	kWh/yr
Volume of earthwork required	5550	m3
Slab thickness	26.3	cm
Volume of slab concrete required	194	m3
Wall thickness	51.3	cm
Volume of wall concrete required	772	m3
Sidewater depth	7.71	m
Surface area/floor of 2-story control bldg	110	m2
Piping size	20.3	cm
Length of total piping system	254	m
Number of 90 degree elbows	39	
Number of tees	77	
Number of plug valves	56	
Total dry solids treated	9710	kg/d
Construction and equipment cost	\$4,270,000	\$
O&M material and supply cost	\$20,700	\$/yr
Energy cost	\$16,400	\$/yr
Amortization cost	\$384,000	\$/yr

**Activated Sludge - Anaerobic Digestion**  
Design Notes

Notes
Mass balance based on user input

**Activated Sludge - Anaerobic Digestion**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	231	119	113	m3/d
Minimum flow	231	119	113	m3/d
Average flow	231	119	113	m3/d
Suspended solids	40000	6250	50000	g/m3
% volatile solids	78.4	78.4	64.5	%
BOD	15300	1000	4510	g/m3
Soluble BOD	47	100	100	g/m3
COD	54600	2150	45100	g/m3
Soluble COD	173	215	215	g/m3
TKN	1800	950	1940	gN/m3
Soluble TKN	22.9	22.9	22.9	gN/m3
Ammonia	21.9	650	650	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	0.0	0.0	0.0	gN/m3
Total phosphorus	74.1	74.1	74.1	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3

**Activated Sludge - Anaerobic Digestion**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	56.9	56.9	56.9	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Activated Sludge - Primary Clarification**  
User Input Data

Description	Value	Units
Design Basis	Average Flow	
Surface Overflow Rate	40.7	m3/(m2·d)
Sidewater Depth	2.74	m
Specific Gravity	1.05	-
Underflow Concentration	4	%
Weir Overflow Rate	186	m3/(m·d)
Type Of Clarifier	Circular	
Suspended Solids	58	%
BOD	32	%
COD	40	%
TKN	5	%
Phosphorus	5	%
Override Design	FALSE	
Length-Rectangular Only	0.0	m
Width-Rectangular Only	0.0	m
Diameter-Circular Only	17.4	m
Excavation Depth	1.22	m
Number Of Tanks Per Battery	4	
Number Of Batteries	1	
Override Database Costs	FALSE	
Standard 20 X 120 ft Rectangular Clarifier Mechanism	\$71,700	\$
Standard 90 ft Diameter Circular Mechanism	\$99,600	\$
Mechanical	40	years
Structural	40	years

**Activated Sludge - Primary Clarification**  
Design Output Data (To be continued)

Description	Value	Units
<b>Primary Clarification</b>		
Surface area	932	m2
Surface area per circular clarifier	233	m2
Diameter of each circular clarifier	17.4	m
Number of clarifiers per battery	4	
Number of batteries	1	

**Activated Sludge - Primary Clarification**  
Design Output Data (Continue)

Description	Value	Units
Surface overflow rate	40.7	m <sup>3</sup> /(m <sup>2</sup> ·d)
Solids loading rate	9.73	kg/(m <sup>2</sup> ·d)
Hydraulic retention time	1.62	hr
Sidewater depth	2.74	m
Weir length	204	m
Volume of sludge generated	132	m <sup>3</sup> /d
Operation labor required	1030	pers-hours/yr
Maintenance labor required	565	pers-hours/yr
Electrical energy required	10100	kWh/yr
Volume of earthwork required	3530	m <sup>3</sup>
Slab thickness	25.8	cm
Volume of slab concrete required	294	m <sup>3</sup>
Wall thickness	29.2	cm
Volume of wall concrete required	218	m <sup>3</sup>
Construction and equipment cost	\$757,000	\$
O&M material and supply cost	\$7,570	\$/yr
Energy cost	\$808	\$/yr
Amortization cost	\$63,500	\$/yr

**Activated Sludge - Primary Clarification**  
Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	38000	37800	132	m <sup>3</sup> /d
Minimum flow	38000	37800	132	m <sup>3</sup> /d
Average flow	38000	37800	132	m <sup>3</sup> /d
Suspended solids	239	100	40000	g/m <sup>3</sup>
% volatile solids	75.3	75.3	75.3	%
BOD	222	151	20700	g/m <sup>3</sup>
Soluble BOD	80.1	80.1	80.1	g/m <sup>3</sup>
COD	505	303	58500	g/m <sup>3</sup>
Soluble COD	300	300	300	g/m <sup>3</sup>
TKN	42.8	40.7	658	gN/m <sup>3</sup>
Soluble TKN	28	28	28	gN/m <sup>3</sup>
Ammonia	27	27	27	gN/m <sup>3</sup>
Nitrite	0.0	0.0	0.0	gN/m <sup>3</sup>
Nitrate	0.0	0.0	0.0	gN/m <sup>3</sup>
Total phosphorus	8.21	7.8	126	gP/m <sup>3</sup>
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m <sup>3</sup>
Anions	160	160	160	g/m <sup>3</sup>
Settleable solids	9.97	0.0	0.0	mL/L
Oil and grease	99.9	99.9	99.9	g/m <sup>3</sup>
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Activated Sludge - Complete Mix Activated Sludge**  
User Input Data

Description	Value	Units
Aeration Type	Diffused Aeration	
If Diffused, Bubble Size	Course Bubble	
Design Basis	Specify Design SRT	
Design SRT	4	d
Maximum Heterotrophic Specific Growth Rate	6	1/d
Heterotrophic Decay Rate	0.24	1/d
Biomass Yield	0.5	
Suspended Solids	4500	g/m3
Alpha Factor For Oxygen Transfer In Wastewater	0.9	
Beta Factor For Oxygen Saturation In Wastewater	0.9	
Course Bubble Minimum Air Flow	19.8	N m3/min/1000 m3
Fine Bubble Minimum Air Flow	0.61	L/s/m2
Standard Oxygen Transfer Efficiency	6	%
Override Design	FALSE	
Total Volume	4780	m3
Tank Width	10	m
Tank Depth	5	m
Pipe Gallery Width	7.31	m
Excavation Depth	1.3	m
Number Of Tanks	4	
Number Of Batteries	1	
Required Air Flow - Diffused Aeration	88.6	N m3/min/1000 m3
Required Horsepower - Mechanical Aeration	0.0	kW
Override Database Costs	FALSE	
Slow Speed 20 hp Aerator	\$21,400	\$
Standard 2 scfm Fine Bubble Diffuser	\$60	\$
Standard 12 scfm Coarse Bubble Diffuser	\$40	\$
Standard 550 scfm Swing Arm Diffuser	\$7,970	\$
Standard 3000 gpm Pump and Driver Unit	\$37,900	\$
Mechanical Aerator	20	years
Fine Bubble Diffuser	10	years
Coarse Bubble Diffuser	30	years
Swing Arm Diffuser	30	years
Pump	25	years
Structural	40	years

**Activated Sludge - Complete Mix Activated Sludge**  
Design Output Data (To be continued)

Description	Value	Units
<b>Complete Mix Activated Sludge</b>		
Carbon Only Design		
Design SRT for design at winter temperature	4	d
Design SS	4500	g/m3
Calculated VSS	3710	g/m3
Calculated VSS:TSS ratio	0.825	mg VSS/mg SS
Total volume of reactors	4780	m3
Length of parallel train	24	m

**Activated Sludge - Complete Mix Activated Sludge**  
Design Output Data (Continue)

<b>Description</b>	<b>Value</b>	<b>Units</b>
Width of parallel train	10	m
Sidewater depth	5	m
Number of batteries	1	
Number of parallel trains per battery	4	
Number of cells within one train	2	
Total number of dividing walls between zones	4	
Hydraulic retention time	3.03	hr
F/M ratio	0.322	kg BOD/kg MLSS/c
Volumetric BOD loading	1.2	kg BOD/m <sup>3</sup> /d
Observed yield (VSS basis)	0.69	g VSS/g BOD
Observed yield (TSS basis)	0.836	g TSS/g BOD
Amount of sludge generated	5380	kg/d
Sludge recycle rate	31000	m <sup>3</sup> /d
Nitrogen requirement for biomass growth	11.7	g/m <sup>3</sup>
Phosphorus requirement for biomass growth	2.35	g/m <sup>3</sup>
Oxygen requirement to meet average demand	5490	kg/d
Air flow required to meet average demand	25400	N m <sup>3</sup> /hr
Design air flow	88.6	N m <sup>3</sup> /min/1000 m <sup>3</sup>
Operation labor required	3380	pers-hrs/yr
Maintenance labor required	2010	pers-hrs/yr
Electrical energy required	3630000	kWh/yr
Volume of earthwork required	2820	m <sup>3</sup>
Volume of slab concrete required	1360	m <sup>3</sup>
Volume of wall concrete required	648	m <sup>3</sup>
Handrail length	395	m
Number of diffusers per train	313	
Number of swing arm headers per train	4	
Construction and equipment cost	\$1,710,000	\$
O&M material and supply cost	\$33,500	\$/yr
Energy cost	\$290,000	\$/yr
Amortization cost	\$145,000	\$/yr
<b>Sludge Recycle Pumping</b>		
Average daily pumping rate	31000	m <sup>3</sup> /d
Total pumping capacity	61900	m <sup>3</sup> /d
Design capacity per pump	31000	m <sup>3</sup> /d
Number of pumps	3	
Number of batteries	1	
Firm pumping capacity	31000	m <sup>3</sup> /d
Operation labor required	595	pers-hrs/yr
Maintenance labor required	505	pers-hours/yr
Electrical energy required	545000	kWh/yr
Volume of earthwork required	118	m <sup>3</sup>
Area of pump building	48.6	m <sup>2</sup>
Construction and equipment cost	\$446,000	\$
O&M material and supply cost	\$3,120	\$/yr
Energy cost	\$43,600	\$/yr

**Activated Sludge - Complete Mix Activated Sludge**  
Design Notes

Notes
Minimum winter SRT not calculated, design SRT specified by user

**Activated Sludge (Complete Mix Activated Sludge)**  
Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	37800	37800	m3/d
Minimum flow	37800	37800	m3/d
Average flow	37800	37800	m3/d
Suspended solids	100	4500	g/m3
% volatile solids	75.3	82.6	%
BOD	151	615	g/m3
Soluble BOD	80.1	3.19	g/m3
COD	303	5580	g/m3
Soluble COD	300	4.79	g/m3
TKN	40.7	40.7	gN/m3
Soluble TKN	28	16.2	gN/m3
Ammonia	27	15.2	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	7.8	5.45	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	99.9	0.0	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Activated Sludge - Drying Beds**  
User Input Data (To be continued)

Description	Value	Units
Depth Applied	30.5	cm
Time To Drain	2	d
Drained Solids	20	%
Final Solids	50	%
Evaporation Rate	127	mm/month
Rainfall	76.2	mm/month
Correction For Evaporation	0.75	
Fraction Absorbed	0.57	
Override Design	FALSE	
Total Surface Area Requirement	9150	m2
Width Of Drying Beds	6.1	m
Number Of Drying Beds	33	

### Activated Sludge - Drying Beds

User Input Data (Continue)

Description	Value	Units
Depth Of Gravel	30.5	cm
Depth Of Sand	22.9	cm
Override Database Costs	FALSE	
Pipe Costs For 4 in Perforated Clay Pipe	\$9	\$
Pipe Costs For 6 in Perforated Clay Pipe	\$11	\$
Pipe Costs For 8 in Perforated Clay Pipe	\$14	\$
Sand	\$13	\$
Gravel In Place	\$25	\$
Pipe	20	years
Structural	40	years

### Activated Sludge - Drying Beds

Design Output Data

Description	Value	Units
<b>Sludge Drying Beds</b>		
Total surface area required	10500	m2
Initial depth of sludge	30.5	cm
Final solids	50	%
Bed holding time	28.5	d
Total drying bed surface area	10500	m2
Number beds	38	
Surface area of each individual bed	277	m2
Length of each bed	45.4	m
Volume of earthwork required	15800	m3
Volume concrete for dividing wall	1050	m3
Volume of R.C. in-place for truck tracks	240	m3
Volume of sand	2400	m3
Volume of gravel	3200	m3
Clay pipe diameter	15.3	cm
Total length clay pipe	28800	cm
Sludge solids produced	5620	kg/d
Operational labor required	6610	pers-hours/yr
Maintenance labor required	3300	pers-hours/yr
Construction and equipment cost	\$1,090,000	\$
O&M material and supply cost	\$9,810	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$93,900	\$/yr

### Activated Sludge - Drying Beds

Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	113	0.0	11.3	m3/d
Minimum flow	113	0.0	11.3	m3/d
Average flow	113	0.0	11.3	m3/d
Suspended solids	50000	0.0	500000	g/m3

**Activated Sludge - Drying Beds**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
% volatile solids	64.5	0.0	64.5	%
BOD	4510	0.0	44200	g/m3
Soluble BOD	100	0.0	100	g/m3
COD	45100	0.0	449000	g/m3
Soluble COD	215	0.0	215	g/m3
TKN	1940	0.0	19200	gN/m3
Soluble TKN	22.9	0.0	22.9	gN/m3
Ammonia	650	0.0	650	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	0.0	0.0	0.0	gN/m3
Total phosphorus	74.1	0.0	74.1	gP/m3
pH	7.6	0.0	7.6	-
Cations	160	0.0	160	g/m3
Anions	160	0.0	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	56.9	0.0	56.9	g/m3
Summer temperature	23	0.0	23	deg C
Winter temperature	10	0.0	10	deg C

**Activated Sludge - Secondary Clarifier**  
User Input Data

Description	Value	Units
Design Basis	Average Flow	
Solids Loading Rate - Maximum	97.6	kg/(m2·d)
Surface Overflow Rate	20.4	m3/(m2·d)
Sidewater Depth	2.74	m
Specific Gravity	1.03	
Underflow Concentration	1	%
Weir Overflow Rate - Maximum	186	m3/(m·d)
Effluent Suspended Solids	20	g/m3
Type Of Clarifier	Circular	
Override Design	FALSE	
Length-Rectangular Only	0.0	m
Width-Rectangular Only	0.0	m
Diameter-Circular Only	34.4	m
Excavation Depth	1.22	m
Number Of Tanks Per Battery	2	
Number Of Batteries	1	
Override Database Costs	FALSE	
Rectangular Clarifier Mechanism-20ft X 120ft	\$71,700	\$
Circular Clarifier Mechanism-90 ft Diameter	\$99,600	\$
Mechanical	20	years
Structural	40	years



**Activated Sludge - Secondary Clarifier**  
Design Output Data

Description	Value	Units
<b>Secondary Clarification</b>		
Surface area	1860	m <sup>2</sup>
Surface area per circular clarifier	929	m <sup>2</sup>
Diameter of each circular clarifier	34.4	m
Number of clarifiers per battery	2	
Number of batteries	1	
Surface overflow rate	20.4	m <sup>3</sup> /(m <sup>2</sup> ·d)
Solids loading rate	167	kg/(m <sup>2</sup> ·d)
Hydraulic retention time	3.23	hr
Sidewater depth	2.74	m
Weir overflow rate	186	m <sup>3</sup> /(m·d)
Weir length	203	m
Volume of wasted sludge	523	m <sup>3</sup> /d
Operation labor required	1550	pers-hours/yr
Maintenance labor required	860	pers-hours/yr
Electrical energy required	12200	kWh/yr
Volume of earthwork required	7940	m <sup>3</sup>
Slab thickness	25.8	cm
Volume of slab concrete required	541	m <sup>3</sup>
Wall thickness	29.2	cm
Volume of wall concrete required	208	m <sup>3</sup>
Construction and equipment cost	\$900,000	\$
O&M material and supply cost	\$9,000	\$/yr
Energy cost	\$977	\$/yr
Amortization cost	\$81,700	\$/yr

**Activated Sludge - Secondary Clarifier**  
Design Notes

Notes
Solids loading rate exceeds specified maximum.

**Activated Sludge - Secondary Clarifier**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	37800	37300	523	m <sup>3</sup> /d
Minimum flow	37800	37300	523	m <sup>3</sup> /d
Average flow	37800	37300	523	m <sup>3</sup> /d
Suspended solids	4500	20	10000	g/m <sup>3</sup>
% volatile solids	82.6	82.6	82.6	%
BOD	615	7.27	2040	g/m <sup>3</sup>
Soluble BOD	3.19	3.19	3.19	g/m <sup>3</sup>
COD	5580	29.6	12400	g/m <sup>3</sup>
Soluble COD	4.79	4.79	4.79	g/m <sup>3</sup>
TKN	40.7	17.9	842	gN/m <sup>3</sup>
Soluble TKN	16.2	16.2	16.2	gN/m <sup>3</sup>

**Activated Sludge - Secondary Clarifier**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
Ammonia	15.2	15.2	15.2	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	0.0	0.0	0.0	gN/m3
Total phosphorus	5.45	5.45	5.45	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	0.0	0.0	0.0	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Activated Sludge - Sludge Flotation Thickening**  
User Input Data

Description	Value	Units
Air Pressure	414	kPa
Detention Time In Float Tank	3	hr
Solids Loading	48.8	kg/(m2·d)
Hydraulic Loading	147	m3/(m2·d)
Recycle Time In Pressure Tank	2	min
Removal Of Solids	80	%
Air/Solids Ratio	0.02	
Float Concentration	4	%
Polymer Required	5E-4	kg/kg
Override Design	FALSE	
Diameter	10.7	m
Sidewater Depth	2.55	m
Number Of Units	1	
Override Database Costs	FALSE	
Standard 350 Sqft Air Flotation Unit	\$107,000	\$
Air Flotation Unit	20	years
Structural	40	years

**Activated Sludge - Sludge Flotation Thickening**  
Design Output Data (To be continued)

Description	Value	Units
<b>Sludge Flotation Thickening</b>		
Air to solids ratio	0.02	
Air pressure	414	kPa
Solids loading rate	48.8	kg/(m2·d)
Recycle flow	2290	m3/d
Surface area required	107	m2
Volume of pressure tank	3.18	m3

**Activated Sludge - Sludge Flotation Thickening**  
Design Output Data (Continue)

Description	Value	Units
Volume of flotation tank	351	m3
Pressure tank detention time	2	min
Flotation tank detention time	3	hr
Polymer required	2.61	kg/d
Number units	1	
Surface area per flotation unit	116	m2
Diameter per flotation unit	12.2	m
Amount of sludge generated	5850	kg/d
Area of flotation building	175	m2
Volume of earthwork required	437	m3
Slab thickness	25.6	cm
Volume of slab concrete required	37.7	m3
Wall thickness	28.8	cm
Volume of wall concrete required	35	m3
Sidewater depth	2.63	m
Operation labor required	1210	pers-hours/yr
Maintenance labor required	382	pers-hours/yr
Electrical energy required	328000	kWhr/yr
Construction and equipment cost	\$742,000	\$
O&M material and supply cost	\$7,420	\$/yr
Energy cost	\$26,200	\$/yr
<b>Polymer Feed System</b>		
Polymer dosage	2.61	kg/d
Liquid chemical solution fed	1.05	m3/d
O&M labor required	800	pers-hours/yr
Dry material handling and mixing labor required	453	pers-hours/yr
Total O&M labor required	1250	pers-hours/yr
Construction and equipment cost	\$10,700	\$
O&M material and supply cost	\$214	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$0	\$/yr

**Activated Sludge - Sludge Flotation Thickening**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	523	423	99.6	m3/d
Minimum flow	523	423	99.6	m3/d
Average flow	523	423	99.6	m3/d
Suspended solids	10000	2940	40000	g/m3
% volatile solids	82.6	82.6	82.6	%
BOD	2040	603	8160	g/m3
Soluble BOD	3.19	3.19	3.19	g/m3
COD	12400	3650	49500	g/m3
Soluble COD	4.79	4.79	4.79	g/m3
TKN	842	259	3320	gN/m3
Soluble TKN	16.2	16.2	16.2	gN/m3
Ammonia	15.2	15.2	15.2	gN/m3

**Activated Sludge - Sludge Flotation Thickening**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	0.0	0.0	0.0	gN/m3
Total phosphorus	5.45	5.45	5.45	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	0.0	0.0	0.0	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Activated Sludge - Hauling And Land Filling**  
User Input Data

Description	Value	Units
Distance To Disposal Site	16.1	km
Daily Operation	8	hr
Loading Time Per Vehicle	0.75	hr
Hauling Time Per Trip	1	hr
Disposal Cost Based On	Annual Charge Of Land Fill	
Override Database Costs	FALSE	
Standard 22 Cuyd Vehicle	\$56,800	\$
Annual Charge Of Land Fill	\$20,000	\$
Sludge Disposal \$/Cuyd	\$100	\$
Sludge Disposal \$/Ton	\$100	\$
Vehicle	6	years
Structural	40	years

**Activated Sludge - Hauling And Land Filling**  
Design Output Data (To be continued)

Description	Value	Units
<b>Sludge Hauling and Land Filling</b>		
Volume of sludge hauled	11.3	m3/d
Truck capacity	14.5	m3
Round trip time to disposal site	1	hr
Truck loading time	0.75	hr
Operational hours per day	8	hr
Number of trucks required	1	
Distance to disposal site	16.1	km
Total sludge volume hauled	11.3	m3/d
Maximum anticipated landfill downtime	30	d
Anticipated sludge storage height	2.44	m
Sludge storage shed area	138	m2
Width of sludge storage shed slab	8.32	m

**Activated Sludge - Hauling And Land Filling**  
Design Output Data (Continue)

Description	Value	Units
Length of sludge storage shed slab	16.6	m
Volume of earthwork required	121	m3
Volume of slab concrete required	52.8	m3
Surface area of canopy roof	138	m2
Round trip haul distance	32.2	km
Round trips per day per truck	1	
Distance traveled per year per truck	8050	km
Sludge hauled	11800	kg/d
Operation labor required	230	pers-hours/yr
LandFilling cost	\$20,000	\$/yr
Construction and equipment cost	\$95,900	\$
O&M material and supply cost	\$23,000	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$14,200	\$/yr

**Activated Sludge (Hauling And Land Filling)**  
Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	11.3	11.3	m3/d
Minimum flow	11.3	11.3	m3/d
Average flow	11.3	11.3	m3/d
Suspended solids	500000	500000	g/m3
% volatile solids	64.5	64.5	%
BOD	44200	44200	g/m3
Soluble BOD	100	100	g/m3
COD	449000	449000	g/m3
Soluble COD	215	215	g/m3
TKN	19200	19200	gN/m3
Soluble TKN	22.9	22.9	gN/m3
Ammonia	650	650	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	74.1	74.1	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	56.9	56.9	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Activated Sludge - Chlorination**  
User Input Data

Description	Value	Units
Contact Time At Peak Flow	30	min
Chlorine Dose	10	g/m3
Influent Coliform Count	1E7	/100mL
Override Design	FALSE	
Volume Of Tank	780	m3
Override Database Costs	FALSE	
Chlorine	\$940	\$
Standard 2000 lb/d Chlorinator	\$14,400	\$
Chlorinator	15	years
Structural	40	years

**Activated Sludge - Chlorination**  
Design Output Data

Description	Value	Units
<b>Chlorination</b>		
Volume of tank	777	m3
Average chlorine required	373	kg/d
Peak chlorine required	373	kg/d
Influent coliform count	1E7	/100mL
Effluent coliform count	29.2	/100mL
Operational labor required	1440	pers-hours/yr
Maintenance labor required	358	pers-hours/yr
Electrical energy required	131000	kWh/yr
Volume of earthwork required	332	m3
Volume of slab concrete required	77.9	m3
Volume of wall concrete required	140	m3
Number of chlorinators and evaporators	1	
Chlorination building area	20.4	m2
Number of chlorine cylinders	13	
Area of chlorine storage building	169	m2
Construction and equipment cost	\$390,000	\$
O&M material and supply cost	\$12,200	\$/yr
Energy cost	\$10,500	\$/yr

**Activated Sludge (Chlorination)**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Units
Maximum flow	37300	37300	m3/d
Minimum flow	37300	37300	m3/d
Average flow	37300	37300	m3/d
Suspended solids	20	20	g/m3
% volatile solids	82.6	82.6	%
BOD	7.27	7.27	g/m3
Soluble BOD	3.19	3.19	g/m3
COD	29.6	29.6	g/m3

**Activated Sludge (Chlorination)**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Units
Soluble COD	4.79	4.79	g/m3
TKN	17.9	17.9	gN/m3
Soluble TKN	16.2	16.2	gN/m3
Ammonia	15.2	15.2	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	5.45	5.45	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	0.0	0.0	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Trickling Filter**  
Process Summary

Process	Construction	Oper(/yr)	Maint(/yr)	Mat(/yr)	Chem(/yr)	Energy(/yr)	Amort(/yr)
Preliminary Treatment	\$420,000	\$37,100	\$15,900	\$10,500	\$0	\$3,720	\$35,200
Primary Clarification	\$757,000	\$19,900	\$9,420	\$7,570	\$0	\$808	\$63,500
Trickling Filter	\$2,400,000	\$22,400	\$16,500	\$13,000	\$0	\$54,100	\$208,000
Secondary Clarifier	\$900,000	\$30,100	\$14,300	\$9,000	\$0	\$976	\$81,700
Chlorination	\$390,000	\$27,900	\$6,000	\$12,200	\$142,000	\$10,500	\$37,200
Sludge Flotation Thickening	\$607,000	\$41,400	\$5,020	\$6,160	\$1,880	\$18,500	\$0
Anaerobic Digestion	\$4,190,000	\$37,400	\$21,200	\$19,600	\$0	\$14,500	\$376,000
Drying Beds	\$950,000	\$112,000	\$48,000	\$8,550	\$0	\$0	\$81,800
Hauling And Land Filling	\$89,800	\$3,890	\$0	\$23,000	\$0	\$0	\$13,700
Other Costs	\$17,000,000	\$0	\$0	\$0	\$0	\$0	\$0

**Trickling Filter using July 2000,(USA Avg) equipment cost database**

**Trickling Filter - Summary of Costs for Layout**

Design Output Data (To be continued)

Description	Value	Units
Administration hours	2120	hr/yr
Laboratory labor hours	3470	hr/yr
Estimated land for construction required	34.9	ha
Estimate administration labor cost	\$42,300	\$/yr
Estimated laboratory labor cost	\$76,400	\$/yr
Mobilization	\$564,000	\$
Site preparation	\$750,000	\$
Site electrical	\$1,630,000	\$
Yard piping	\$1,070,000	\$
Instrumentation and control	\$852,000	\$

**Trickling Filter - Summary of Costs for Layout**  
Design Output Data (Continue)

<b>Description</b>	<b>Value</b>	<b>Units</b>
Lab and administration buildings	\$1,330,000	\$
Total other direct cost	\$6,200,000	\$
Total unit process construction cost	\$10,700,000	\$
Profit	\$2,540,000	\$
Total construction cost(w/profit)	\$19,400,000	\$
Miscellaneous cost	\$972,000	\$
Legal cost	\$389,000	\$
Engineering design fee	\$2,920,000	\$
Inspection cost	\$389,000	\$
Contingency	\$1,940,000	\$
Technical	\$389,000	\$
Total indirect cost	\$7,000,000	\$
Total cost of land	\$862,000	\$
Interest during construction	\$2,970,000	\$
<b>OPERATION AND MAINTENANCE</b>		
Total administration and laboratory cost	\$119,000	\$/yr
Total operation cost	\$332,000	\$/yr
Total maintenance cost	\$136,000	\$/yr
Total material cost	\$110,000	\$/yr
Total chemical cost	\$143,000	\$/yr
Total energy cost	\$103,000	\$/yr
<b>PROJECT SUMMARY</b>		
Total annual labor cost	\$587,000	\$/yr
Total annual material, chemical and energy cost	\$356,000	\$/yr
Total annual O&M cost	\$943,000	\$/yr
Total annual amortization cost	\$898,000	\$/yr
Total project cost	\$30,300,000	\$
Present worth (NPV)	\$38,900,000	\$

**Trickling Filter - Influent Wastewater**  
User Input Data (To be continued)

<b>Description</b>	<b>Value</b>	<b>Units</b>
Average Flow	37900	m3/d
Minimum Flow	37900	m3/d
Maximum Flow	37900	m3/d
Suspended Solids	220	g/m3
% Volatile Solids	75	%
BOD	220	g/m3
Soluble BOD	80	g/m3
COD	500	g/m3
Soluble COD	300	g/m3
TKN	40	gN/m3



**Trickling Filter - Influent Wastewater**  
 User Input Data (Continue)

Description	Value	Units
Soluble TKN	28	gN/m3
Ammonia	25	gN/m3
Total Phosphorus	8	gP/m3
pH	7.6	
Cations	160	g/m3
Anions	160	g/m3
Settleable Solids	10	mL/L
Oil And Grease	100	g/m3
Nitrite	0.0	gN/m3
Nitrate	0.0	gN/m3
Non-Degradable Fraction Of VSS	40	%
Average Summer	23	deg C
Average Winter	10	deg C

**Trickling Filter (Influent Wastewater)**  
 Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	37900	37900	m3/d
Minimum flow	37900	37900	m3/d
Average flow	37900	37900	m3/d
Suspended solids	220	220	g/m3
% volatile solids	75	75	%
BOD	220	220	g/m3
Soluble BOD	80	80	g/m3
COD	500	500	g/m3
Soluble COD	300	300	g/m3
TKN	40	40	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	25	25	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0	0.0	gN/m3
Total phosphorus	8	8	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	10	10	mL/L
Oil and grease	100	100	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Trickling Filter - Preliminary Treatment-Screening**  
User Input Data

Description	Value	Units
Cleaning Method	Mechanically Cleaned	
Mechanically Cleaned Depth	0.304	m
Width	0.635	cm
Space	3.81	cm
Slope	30	Deg
Shape Factor	2.42	-
Approach	0.762	m/s
Max	0.914	m/s
Ave	0.762	m/s

**Trickling Filter - Preliminary Treatment-Grit Removal**  
User Input Data

Description	Value	Units
Particle Size	0.02	cm
Specific Gravity	2.65	-
Type Of Grit Removal	Horizontal	
Number Of Units	2	-
Design By	Depth	
Depth	1.22	m
Current Allowance	1.7	-
Manning Coefficient	0.035	-
Volume Of Grit	4	Cuft/Mgal(Us)
Detention Time	2.5	mins
Air Supply Per Unit Length Of Tank	3	Cfm/Ft
Surface Velocity	0.457	m/s
Tank Floor Velocity	0.304	m/s
Capital Cost	40	years

**Trickling Filter - Preliminary Treatment-Cost Overrides**  
User Input Data

Description	Value	Units
Override Costs - Only Positive Values Overridden	FALSE	

**Trickling Filter - Preliminary Treatment**  
Design Output Data (To be continued)

Description	Value	Units
<b>Mechanically Cleaned Bar Screen</b>		
Bar size	0.635	cm
Bar spacing	3.81	cm
Slope of bars from horizontal	30	degrees
Head loss through screen	0.00628	m
Approach velocity	0.762	m/s
Average flow through velocity (screen)	0.762	m/s
Maximum flow through velocity (screen)	0.914	m/s

**Trickling Filter - Preliminary Treatment**  
Design Output Data (Continue)

Description	Value	Units
Screen channel width	1.88	m
Average channel depth	0.304	m
<b>Horizontal Flow Grit Chamber</b>		
Maximum flow	37700	m <sup>3</sup> /d
Average flow	37700	m <sup>3</sup> /d
Minimum flow	37700	m <sup>3</sup> /d
Temperature	10	deg C
Maximum flow through velocity (grit chamber)	0.457	m/s
Average flow through velocity (grit chamber)	0.304	m/s
Size of smallest particle 100% removed	0.02	cm
Specific gravity of particle	2.65	
Number of units	2	
Maximum flow/unit	18800	m <sup>3</sup> /d
Width of channel	0.391	m
Depth of channel	1.22	m
Length of channel	44	m
Settling velocity of particle	0.0215	m/s
Slope of channel bottom	0.00114	
Allowance for currents	1.7	
Manning coefficient	0.035	
Hydraulic retention time	1.6	min
Volume of grit	1.13	m <sup>3</sup> /d
Construction and equipment cost	\$420,000	\$
O&M material and supply cost	\$10,500	\$/yr
Energy cost	\$3,720	\$/yr
Amortization cost	\$35,200	\$/yr

**Trickling Filter (Preliminary Treatment)**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Units
Maximum flow	37900	37900	m <sup>3</sup> /d
Minimum flow	37900	37900	m <sup>3</sup> /d
Average flow	37900	37900	m <sup>3</sup> /d
Suspended solids	220	220	g/m <sup>3</sup>
% volatile solids	75	75	%
BOD	220	220	g/m <sup>3</sup>
Soluble BOD	80	80	g/m <sup>3</sup>
COD	500	500	g/m <sup>3</sup>
Soluble COD	300	300	g/m <sup>3</sup>
TKN	40	40	gN/m <sup>3</sup>
Soluble TKN	28	28	gN/m <sup>3</sup>
Ammonia	25	25	gN/m <sup>3</sup>
Nitrite	0.0	0.0	gN/m <sup>3</sup>
Nitrate	0.0	0.0	gN/m <sup>3</sup>
Total phosphorus	8	8	gP/m <sup>3</sup>
pH	7.6	7.6	-

**Trickling Filter (Preliminary Treatment)**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Units
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	10	10	mL/L
Oil and grease	100	100	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Trickling Filter - Anaerobic Digestion**  
User Input Data

Description	Value	Units
Specific Gravity	1.05	
Percent Volatile Solids Destroyed	50	%
Concentration In Digester	5	%
Minimum Detention Time In Primary Digester	15	d
Location	Warm-Winter > 10 Deg C	
Raw Wastewater	20	deg C
Digester	40	deg C
Air	10	deg C
Fraction Of Influent Flow Returned As Supernatant	2	%
Suspended Solids	6250	g/m3
BOD	1000	g/m3
COD	2150	g/m3
TKN	950	gN/m3
Ammonia	650	g/m3
Override Design	FALSE	
Diameter	16.8	m
Sidewater Depth	7.71	m
Number Of Primary Digester Tanks	2	
Number Of Secondary Digester Tanks	1	
Number Of Batteries	1	
Override Database Costs	FALSE	
Standard 70 ft Diameter Floating Cover	\$229,000	\$
Standard 60 ft Diameter Gas Circulation Unit	\$70,300	\$
Standard 1 Million Btu/Hr Heating Unit	\$39,800	\$
Standard 2 in Diameter Gas Safety Equipment	\$15,600	\$
Standard Size Sludge Pump 8gpm At 70 ft Of Head	\$5,490	\$
Natural Gas Per 1000 Cuft	\$3	\$
Floating Cover	20	years
Gas Circulation Unit	20	years
Heating Unit	20	years
Gas Safety Equipment	20	years
Sludge Pump	25	years
Structural	40	years

**Trickling Filter - Anaerobic Digestion**  
Design Output Data

<b>Description</b>	<b>Value</b>	<b>Units</b>
<b>Anaerobic Digestion</b>		
Percent VSS destroyed	50	%
Solids concentration in digester	5	%
Raw sludge temperature	20	deg C
Digester temperature	40	deg C
Air temperature	10	deg C
Detention time	15	d
Digester depth	7.71	m
Digester diameter	16.8	m
Effective digester volume	5570	m3
Number of digesters per battery	3	
Number of primary digesters per battery	2	
Number of secondary digesters per battery	1	
Number of batteries	1	
Gas produced	57.2	m3/d
Heat required	1610000	BTU/hr
Digester gas required	48.1	m3/d
Total natural gas required	0.0	m3/d
Operation labor required	1930	pers-hours/yr
Maintenance labor required	1270	pers-hours/yr
Electrical energy required	181000	kWh/yr
Volume of earthwork required	5550	m3
Slab thickness	26.3	cm
Volume of slab concrete required	194	m3
Wall thickness	51.3	cm
Volume of wall concrete required	772	m3
Sidewater depth	7.71	m
Surface area/floor of 2-story control bldg	110	m2
Piping size	20.3	cm
Length of total piping system	254	m
Number of 90 degree elbows	39	
Number of tees	77	
Number of plug valves	56	
Total dry solids treated	8350	kg/d
Construction and equipment cost	\$4,190,000	\$
O&M material and supply cost	\$19,600	\$/yr
Energy cost	\$14,500	\$/yr
Amortization cost	\$376,000	\$/yr

**Trickling Filter - Anaerobic Digestion**  
Design Notes

<b>Notes</b>
Mass balance based on user input

**Trickling Filter - Anaerobic Digestion**  
Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	199	101	98	m3/d
Minimum flow	199	101	98	m3/d
Average flow	199	101	98	m3/d
Suspended solids	40000	6250	50000	g/m3
% volatile solids	76.8	76.8	62.4	%
BOD	16200	1000	4360	g/m3
Soluble BOD	57.6	100	100	g/m3
COD	55300	2150	43600	g/m3
Soluble COD	204	215	215	g/m3
TKN	1550	950	1900	gN/m3
Soluble TKN	28	28	28	gN/m3
Ammonia	27.2	650	650	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	4.18	4.18	4.18	gN/m3
Total phosphorus	85.3	85.3	85.3	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	65.4	65.4	65.4	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Trickling Filter - Primary Clarification**  
User Input Data (To be continued)

Description	Value	Units
Design Basis	Average Flow	
Surface Overflow Rate	40.7	m3/(m2·d)
Sidewater Depth	2.74	m
Specific Gravity	1.05	-
Underflow Concentration	4	%
Weir Overflow Rate	186	m3/(m·d)
Type Of Clarifier	Circular	
Suspended Solids	58	%
BOD	32	%
COD	40	%
TKN	5	%
Phosphorus	5	%
Override Design	FALSE	
Length-Rectangular Only	0.0	m
Width-Rectangular Only	0.0	m
Diameter-Circular Only	17.4	m
Excavation Depth	1.22	m
Number Of Tanks Per Battery	4	
Number Of Batteries	1	

### Trickling Filter - Primary Clarification

#### User Input Data (Continue)

Description	Value	Units
Override Database Costs	FALSE	
Standard 20 X 120 ft Rectangular Clarifier Mechanism	\$71,700	\$
Standard 90 ft Diameter Circular Mechanism	\$99,600	\$
Mechanical	40	years
Structural	40	years

### Trickling Filter - Primary Clarification

#### Design Output Data

Description	Value	Units
<b>Primary Clarification</b>		
Surface area	931	m <sup>2</sup>
Surface area per circular clarifier	233	m <sup>2</sup>
Diameter of each circular clarifier	17.4	m
Number of clarifiers per battery	4	
Number of batteries	1	
Surface overflow rate	40.7	m <sup>3</sup> /(m <sup>2</sup> ·d)
Solids loading rate	9.61	kg/(m <sup>2</sup> ·d)
Hydraulic retention time	1.62	hr
Sidewater depth	2.74	m
Weir length	204	m
Volume of sludge generated	130	m <sup>3</sup> /d
Operation labor required	1030	pers-hours/yr
Maintenance labor required	564	pers-hours/yr
Electrical energy required	10100	kWh/yr
Volume of earthwork required	3530	m <sup>3</sup>
Slab thickness	25.8	cm
Volume of slab concrete required	294	m <sup>3</sup>
Wall thickness	29.2	cm
Volume of wall concrete required	218	m <sup>3</sup>
Construction and equipment cost	\$757,000	\$
O&M material and supply cost	\$7,570	\$/yr
Energy cost	\$808	\$/yr
Amortization cost	\$63,500	\$/yr

### Trickling Filter - Primary Clarification

#### Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	38000	37800	130	m <sup>3</sup> /d
Minimum flow	38000	37800	130	m <sup>3</sup> /d
Average flow	38000	37800	130	m <sup>3</sup> /d
Suspended solids	236	99.1	40000	g/m <sup>3</sup>
% volatile solids	75.1	75.1	75.1	%
BOD	222	151	20900	g/m <sup>3</sup>
Soluble BOD	80.1	80.1	80.1	g/m <sup>3</sup>
COD	504	303	59100	g/m <sup>3</sup>

**Trickling Filter - Primary Clarification**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
Soluble COD	300	300	300	g/m3
TKN	42.4	40.3	658	gN/m3
Soluble TKN	28	28	28	gN/m3
Ammonia	26.7	26.7	26.7	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	0.0111	0.0111	0.0111	gN/m3
Total phosphorus	8.21	7.8	127	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	9.97	0.0	0.0	mL/L
Oil and grease	99.9	99.9	99.9	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Trickling Filter - Trickling Filter**  
User Input Data

Description	Value	Units
Solids Production Rate	0.65	kg VSS/kg BOD
Effluent BOD	30	g/m3
Hydraulic Loading Rate	44	m3/(m2·d)
Surfpac Specific Area	85.3	1/m
Override Design	FALSE	
Diameter	27.4	m
Tower Depth	4.08	m
Excavation Depth	1.22	m
Number Of Filter Towers	2	
Number Of Stages	1	
Override Database Costs	FALSE	
Selected Plastic Media and Installation	\$5	\$
50 ft Diameter Distributor Arm	\$34,800	\$
Standard 3000 gpm Pump and Driver Unit	\$37,900	\$
Media	40	years
Distributor Arm	20	years
Pump	25	years
Structural	40	years

**Trickling Filter - Trickling Filter**  
Design Output Data (To be continued)

Description	Value	Units
<b>Trickling Filtration</b>		
Reaction rate constant	0.00156	
Hydraulic loading rate	44	m3/(m2·d)



**Trickling Filter - Trickling Filter**  
Design Output Data (Continue)

Description	Value	Units
Adjusted hydraulic loading rate	32.1	m <sup>3</sup> /(m <sup>2</sup> ·d)
Total hydraulic loading rate	32.2	m <sup>3</sup> /(m <sup>2</sup> ·d)
Recirculation ratio	0.00403	
Number of towers per stage	2	
Number of stages	1	
Depth of filter tower	4.08	m
Diameter of filter tower	27.4	m
Surface area per filter tower	590	m <sup>2</sup>
Total surface area	1180	m <sup>2</sup>
Volume per filter tower	2400	m <sup>3</sup>
Total volume	4810	m <sup>3</sup>
Operation labor required	520	pers-hr/yr
Maintenance labor required	448	pers-hr/yr
Volume of earthwork required	4700	m <sup>3</sup>
Volume of slab concrete required	240	m <sup>3</sup>
Volume of wall concrete required	332	m <sup>3</sup>
Number of posts per tower	446	
Total length of precast beams	2100	m
Construction and equipment cost	\$2,070,000	\$
O&M material and supply cost	\$10,700	\$/yr
Energy cost	\$841	\$/yr
Amortization cost	\$177,000	\$/yr
<b>Internal Recycle Pumping</b>		
Average daily pumping rate	37800	m <sup>3</sup> /d
Total pumping capacity	38000	m <sup>3</sup> /d
Design capacity per pump	19000	m <sup>3</sup> /d
Number of pumps	3	
Number of batteries	1	
Firm pumping capacity	37800	m <sup>3</sup> /d
Operation labor required	637	pers-hrs/yr
Maintenance labor required	539	pers-hours/yr
Electrical energy required	666000	kWh/yr
Volume of earthwork required	90.1	m <sup>3</sup>
Area of pump building	37	m <sup>2</sup>
Construction and equipment cost	\$329,000	\$
O&M material and supply cost	\$2,300	\$/yr
Energy cost	\$53,300	\$/yr

**Trickling Filter (Trickling Filter)**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Units
Maximum flow	37800	37800	m <sup>3</sup> /d
Minimum flow	37800	37800	m <sup>3</sup> /d
Average flow	37800	37800	m <sup>3</sup> /d
Suspended solids	99.1	98.2	g/m <sup>3</sup>
% volatile solids	75.1	80	%
BOD	151	30	g/m <sup>3</sup>

**Trickling Filter (Trickling Filter)**  
Water Quality Data (Continue)

Parameter	Influent	Effluent	Units
Soluble BOD	80.1	15	g/m3
COD	303	45	g/m3
Soluble COD	300	22.5	g/m3
TKN	40.3	28.2	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	26.7	28.2	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	0.0111	12.1	gN/m3
Total phosphorus	7.8	5.46	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	99.9	0.0	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Trickling Filter - Drying Beds**  
User Input Data

Description	Value	Units
Depth Applied	30.5	cm
Time To Drain	2	d
Drained Solids	20	%
Final Solids	50	%
Evaporation Rate	127	mm/month
Rainfall	76.2	mm/month
Correction For Evaporation	0.75	
Fraction Absorbed	0.57	
Override Design	FALSE	
Total Surface Area Requirement	9150	m2
Width Of Drying Beds	6.1	m
Number Of Drying Beds	33	
Depth Of Gravel	30.5	cm
Depth Of Sand	22.9	cm
Override Database Costs	FALSE	
Pipe Costs For 4 in Perforated Clay Pipe	\$9	\$
Pipe Costs For 6 in Perforated Clay Pipe	\$11	\$
Pipe Costs For 8 in Perforated Clay Pipe	\$14	\$
Sand	\$13	\$
Gravel In Place	\$25	\$
Pipe	20	years
Structural	40	years

**Trickling Filter - Drying Beds**  
Design Output Data

Description	Value	Units
<b>Sludge Drying Beds</b>		
Total surface area required	9150	m <sup>2</sup>
Initial depth of sludge	30.5	cm
Final solids	50	%
Bed holding time	28.5	d
Total drying bed surface area	9150	m <sup>2</sup>
Number beds	33	
Surface area of each individual bed	277	m <sup>2</sup>
Length of each bed	45.5	m
Volume of earthwork required	13700	m <sup>3</sup>
Volume concrete for dividing wall	916	m <sup>3</sup>
Volume of R.C. in-place for truck tracks	209	m <sup>3</sup>
Volume of sand	2090	m <sup>3</sup>
Volume of gravel	2790	m <sup>3</sup>
Clay pipe diameter	15.3	cm
Total length clay pipe	25100	cm
Sludge solids produced	4900	kg/d
Operational labor required	5760	pers-hours/yr
Maintenance labor required	2880	pers-hours/yr
Construction and equipment cost	\$950,000	\$
O&M material and supply cost	\$8,550	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$81,800	\$/yr

**Trickling Filter - Drying Beds**  
Water Quality Data (To be continued)

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	98	0.0	9.8	m <sup>3</sup> /d
Minimum flow	98	0.0	9.8	m <sup>3</sup> /d
Average flow	98	0.0	9.8	m <sup>3</sup> /d
Suspended solids	50000	0.0	500000	g/m <sup>3</sup>
% volatile solids	62.4	0.0	62.4	%
BOD	4360	0.0	42700	g/m <sup>3</sup>
Soluble BOD	100	0.0	100	g/m <sup>3</sup>
COD	43600	0.0	435000	g/m <sup>3</sup>
Soluble COD	215	0.0	215	g/m <sup>3</sup>
TKN	1900	0.0	18700	gN/m <sup>3</sup>
Soluble TKN	28	0.0	28	gN/m <sup>3</sup>
Ammonia	650	0.0	650	gN/m <sup>3</sup>
Nitrite	0.0	0.0	0.0	gN/m <sup>3</sup>
Nitrate	4.18	0.0	4.18	gN/m <sup>3</sup>
Total phosphorus	85.3	0.0	85.3	gP/m <sup>3</sup>
pH	7.6	0.0	7.6	-
Cations	160	0.0	160	g/m <sup>3</sup>
Anions	160	0.0	160	g/m <sup>3</sup>
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	65.4	0.0	65.4	g/m <sup>3</sup>

### Trickling Filter - Drying Beds

Water Quality Data (Continue)

Parameter	Influent	Effluent	Sludge	Units
Summer temperature	23	0.0	23	deg C
Winter temperature	10	0.0	10	deg C

### Trickling Filter - Secondary Clarifier

User Input Data

Description	Value	Units
Design Basis	Average Flow	
Solids Loading Rate - Maximum	97.6	kg/(m <sup>2</sup> ·d)
Surface Overflow Rate	20.4	m <sup>3</sup> /(m <sup>2</sup> ·d)
Sidewater Depth	2.74	m
Specific Gravity	1.03	
Underflow Concentration	1	%
Weir Overflow Rate - Maximum	186	m <sup>3</sup> /(m·d)
Effluent Suspended Solids	20	g/m <sup>3</sup>
Type Of Clarifier	Circular	
Override Design	FALSE	
Length-Rectangular Only	0.0	m
Width-Rectangular Only	0.0	m
Diameter-Circular Only	34.4	m
Excavation Depth	1.22	m
Number Of Tanks Per Battery	2	
Number Of Batteries	1	
Override Database Costs	FALSE	
Rectangular Clarifier Mechanism-20ft X 120ft	\$71,700	\$
Circular Clarifier Mechanism-90 ft Diameter	\$99,600	\$
Mechanical	20	years
Structural	40	years

### Trickling Filter - Secondary Clarifier

Design Output Data (To be continued)

Description	Value	Units
<b>Secondary Clarification</b>		
Surface area	1860	m <sup>2</sup>
Surface area per circular clarifier	928	m <sup>2</sup>
Diameter of each circular clarifier	34.4	m
Number of clarifiers per battery	2	
Number of batteries	1	
Surface overflow rate	20.4	m <sup>3</sup> /(m <sup>2</sup> ·d)
Solids loading rate	2	kg/(m <sup>2</sup> ·d)
Hydraulic retention time	3.23	hr
Sidewater depth	2.74	m
Weir overflow rate	186	m <sup>3</sup> /(m·d)
Weir length	203	m

**Trickling Filter - Secondary Clarifier**  
Design Output Data (Continue)

Description	Value	Units
Volume of wasted sludge	360	m3/d
Operation labor required	1550	pers-hours/yr
Maintenance labor required	860	pers-hours/yr
Electrical energy required	12200	kWh/yr
Volume of earthwork required	7940	m3
Slab thickness	25.8	cm
Volume of slab concrete required	541	m3
Wall thickness	29.2	cm
Volume of wall concrete required	208	m3
Construction and equipment cost	\$900,000	\$
O&M material and supply cost	\$9,000	\$/yr
Energy cost	\$976	\$/yr
Amortization cost	\$81,700	\$/yr

**Trickling Filter - Secondary Clarifier**  
Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	37800	37500	360	m3/d
Minimum flow	37800	37500	360	m3/d
Average flow	37800	37500	360	m3/d
Suspended solids	98.2	20	10000	g/m3
% volatile solids	80	80	80	%
BOD	30	18.6	1820	g/m3
Soluble BOD	15	15	15	g/m3
COD	45	46.5	12000	g/m3
Soluble COD	22.5	22.5	22.5	g/m3
TKN	28.2	29.6	828	gN/m3
Soluble TKN	28	28	28	gN/m3
Ammonia	28.2	28.2	28.2	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	12.1	12.1	12.1	gN/m3
Total phosphorus	5.46	5.46	5.46	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	0.0	0.0	0.0	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Trickling Filter - Sludge Flotation Thickening**  
User Input Data

Description	Value	Units
Air Pressure	414	kPa
Detention Time In Float Tank	3	hr
Solids Loading	48.8	kg/(m <sup>2</sup> ·d)
Hydraulic Loading	147	m <sup>3</sup> /(m <sup>2</sup> ·d)
Recycle Time In Pressure Tank	2	min
Removal Of Solids	80	%
Air/Solids Ratio	0.02	
Float Concentration	4	%
Polymer Required	5E-4	kg/kg
Override Design	FALSE	
Diameter	10.7	m
Sidewater Depth	2.55	m
Number Of Units	1	
Override Database Costs	FALSE	
Standard 350 Sqft Air Flotation Unit	\$107,000	\$
Air Flotation Unit	20	years
Structural	40	years

**Trickling Filter - Sludge Flotation Thickening**  
Design Output Data (To be continued)

Description	Value	Units
<b>Sludge Flotation Thickening</b>		
Air to solids ratio	0.02	
Air pressure	414	kPa
Solids loading rate	48.8	kg/(m <sup>2</sup> ·d)
Recycle flow	1580	m <sup>3</sup> /d
Surface area required	73.8	m <sup>2</sup>
Volume of pressure tank	2.19	m <sup>3</sup>
Volume of flotation tank	242	m <sup>3</sup>
Pressure tank detention time	2	min
Flotation tank detention time	3	hr
Polymer required	1.8	kg/d
Number units	1	
Surface area per flotation unit	89.2	m <sup>2</sup>
Diameter per flotation unit	10.7	m
Amount of sludge generated	4030	kg/d
Area of flotation building	137	m <sup>2</sup>
Volume of earthwork required	342	m <sup>3</sup>
Slab thickness	25.4	cm
Volume of slab concrete required	29.5	m <sup>3</sup>
Wall thickness	28.5	cm
Volume of wall concrete required	30	m <sup>3</sup>
Sidewater depth	2.56	m
Operation labor required	1000	pers-hours/yr
Maintenance labor required	301	pers-hours/yr
Electrical energy required	231000	kWhr/yr
Construction and equipment cost	\$598,000	\$

**Trickling Filter - Sludge Flotation Thickening**  
Design Output Data (Continue)

Description	Value	Units
O&M material and supply cost	\$5,980	\$/yr
Energy cost	\$18,500	\$/yr
<b>Polymer Feed System</b>		
Polymer dosage	1.8	kg/d
Liquid chemical solution fed	0.721	m3/d
O&M labor required	727	pers-hours/yr
Dry material handling and mixing labor required	408	pers-hours/yr
Total O&M labor required	1140	pers-hours/yr
Construction and equipment cost	\$9,180	\$
O&M material and supply cost	\$184	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$0	\$/yr

**Trickling Filter - Sludge Flotation Thickening**  
Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	360	292	68.7	m3/d
Minimum flow	360	292	68.7	m3/d
Average flow	360	292	68.7	m3/d
Suspended solids	10000	2940	40000	g/m3
% volatile solids	80	80	80	%
BOD	1820	544	7220	g/m3
Soluble BOD	15	15	15	g/m3
COD	12000	3550	48000	g/m3
Soluble COD	22.5	22.5	22.5	g/m3
TKN	828	263	3230	gN/m3
Soluble TKN	28	28	28	gN/m3
Ammonia	28.2	28.2	28.2	gN/m3
Nitrite	0.0	0.0	0.0	gN/m3
Nitrate	12.1	12.1	12.1	gN/m3
Total phosphorus	5.46	5.46	5.46	gP/m3
pH	7.6	7.6	7.6	-
Cations	160	160	160	g/m3
Anions	160	160	160	g/m3
Settleable solids	0.0	0.0	0.0	mL/L
Oil and grease	0.0	0.0	0.0	g/m3
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

**Trickling Filter - Hauling And Land Filling**  
User Input Data (To be continued)

Description	Value	Units
Distance To Disposal Site	16.1	km

### Trickling Filter - Hauling And Land Filling

User Input Data (Continue)

Description	Value	Units
Daily Operation	8	hr
Loading Time Per Vehicle	0.75	hr
Hauling Time Per Trip	1	hr
Disposal Cost Based On	Annual Charge Of Land Fill	
Override Database Costs	FALSE	
Standard 22 Cuyd Vehicle	\$56,800	\$
Annual Charge Of Land Fill	\$20,000	\$
Sludge Disposal \$/Cuyd	\$100	\$
Sludge Disposal \$/Ton	\$100	\$
Vehicle	6	years
Structural	40	years

### Trickling Filter - Hauling And Land Filling

Design Output Data

Description	Value	Units
<b>Sludge Hauling and Land Filling</b>		
Volume of sludge hauled	9.8	m3/d
Truck capacity	14.5	m3
Round trip time to disposal site	1	hr
Truck loading time	0.75	hr
Operational hours per day	8	hr
Number of trucks required	1	
Distance to disposal site	16.1	km
Total sludge volume hauled	9.8	m3/d
Maximum anticipated landfill downtime	30	d
Anticipated sludge storage height	2.44	m
Sludge storage shed area	121	m2
Width of sludge storage shed slab	7.76	m
Length of sludge storage shed slab	15.5	m
Volume of earthwork required	106	m3
Volume of slab concrete required	46.7	m3
Surface area of canopy roof	121	m2
Round trip haul distance	32.2	km
Round trips per day per truck	1	
Distance traveled per year per truck	8050	km
Sludge hauled	10300	kg/d
Operation labor required	200	pers-hours/yr
LandFilling cost	\$20,000	\$/yr
Construction and equipment cost	\$89,800	\$
O&M material and supply cost	\$23,000	\$/yr
Energy cost	\$0	\$/yr
Amortization cost	\$13,700	\$/yr



**Trickling Filter (Hauling And Land Filling)**  
Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	9.8	9.8	m3/d
Minimum flow	9.8	9.8	m3/d
Average flow	9.8	9.8	m3/d
Suspended solids	500000	500000	g/m3
% volatile solids	62.4	62.4	%
BOD	42700	42700	g/m3
Soluble BOD	100	100	g/m3
COD	435000	435000	g/m3
Soluble COD	215	215	g/m3
TKN	18700	18700	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	650	650	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	4.18	4.18	gN/m3
Total phosphorus	85.3	85.3	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	65.4	65.4	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C

**Trickling Filter - Chlorination**  
User Input Data

Description	Value	Units
Contact Time At Peak Flow	30	min
Chlorine Dose	10	g/m3
Influent Coliform Count	1E7	/100mL
Override Design	FALSE	
Volume Of Tank	780	m3
Override Database Costs	FALSE	
Chlorine	\$940	\$
Standard 2000 lb/d Chlorinator	\$14,400	\$
Chlorinator	15	years
Structural	40	years

**Trickling Filter - Chlorination**  
Design Output Data (To be continued)

Description	Value	Units
<b>Chlorination</b>		
Volume of tank	781	m3
Average chlorine required	374	kg/d

**Trickling Filter - Chlorination**  
Design Output Data (Continue)

Description	Value	Units
Peak chlorine required	374	kg/d
Influent coliform count	1E7	/100mL
Effluent coliform count	29.2	/100mL
Operational labor required	1440	pers-hours/yr
Maintenance labor required	360	pers-hours/yr
Electrical energy required	131000	kWh/yr
Volume of earthwork required	333	m3
Volume of slab concrete required	78.2	m3
Volume of wall concrete required	140	m3
Number of chlorinators and evaporators	1	
Chlorination building area	20.4	m2
Number of chlorine cylinders	13	
Area of chlorine storage building	169	m2
Construction and equipment cost	\$390,000	\$
O&M material and supply cost	\$12,200	\$/yr
Energy cost	\$10,500	\$/yr

**Trickling Filter (Chlorination)**  
Water Quality Data

Parameter	Influent	Effluent	Units
Maximum flow	37500	37500	m3/d
Minimum flow	37500	37500	m3/d
Average flow	37500	37500	m3/d
Suspended solids	20	20	g/m3
% volatile solids	80	80	%
BOD	18.6	18.6	g/m3
Soluble BOD	15	15	g/m3
COD	46.5	46.5	g/m3
Soluble COD	22.5	22.5	g/m3
TKN	29.6	29.6	gN/m3
Soluble TKN	28	28	gN/m3
Ammonia	28.2	28.2	gN/m3
Nitrite	0.0	0.0	gN/m3
Nitrate	12.1	12.1	gN/m3
Total phosphorus	5.46	5.46	gP/m3
pH	7.6	7.6	-
Cations	160	160	g/m3
Anions	160	160	g/m3
Settleable solids	0.0	0.0	mL/L
Oil and grease	0.0	0.0	g/m3
Summer temperature	23	23	deg C
Winter temperature	10	10	deg C