102672

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System Summary

Sheet No. 1 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

Item	Quantity
Transmissivity (gpd/ft)	5440
Hydraulic Gradient (ft/ft)	0.0025
Porosity (%)	20
Est. One Pore Volume of Liquid (Mgal)	308
Est Total Vol. TCA (gal)	400
Est. Total Vol. DCE (gal)	170
Est. Max. Depth of Contamination (ft.)	300
Est. Time to Extract 1 Pore Vol. (yrs)	3.3
Est. Time to Extract 3 Pore Vol. (yrs)	10.
Est. Time to Extract 5 Pore Vol. (yrs)	16.7
Est. Time to Extract 10 Pore Vol. (yrs)	33.5
Est. Range of Pumping Duration (yrs)	4.-17.

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System Summary

Sheet No. 2 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

Item	80' well	150' well	300' well
Number of Wells	5	5	5
Well Diameter (ft)	0.5	0.5	0.5
Well Depth (ft)	80'	150	300
Screened Interval (ft)	30-80	80-150	150-300
Estimated Pumping Rate (gpm)	5	20	10

Total Pumping rate per 3 Well Cluster (gpm) = 35
Total Pumping rate for System (gpm) = 175

Baker Engineers

S.O. No. 15438-17-SRI

Subject: Berks Sand Pit Extraction System

Sheet No. 1 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Assumptions (these assumptions should be field verified, if possible)

- For the purpose of design, assume the aquifer is homogeneous and isotropic. This is obviously not true for the Berks Sand Pit site. Appropriate modifications to this pump design should be made after further field studies
- Assume the shallow and fractured bedrock aquifers may be treated as one single, aquifer.
- Assume MW-1 exhibits representative behavior of a well in/or near a fractured zone. Hence, a representative average transmissivity is:

$$T = 5440 \text{ gpd/ft}^{(1)}$$

- Assume an average hydraulic gradient[1] of:

$$I_{avg} = \frac{0.06+0.03}{2} = 0.045$$

- Assume an average porosity of 20%[2]
- Assume the aquifer can sustain an average pumping rate of

$$Q = 35 \text{ gpm} = 50400 \text{ gpd}$$

for an extended period of time

Ref:

1. BAKER/TSA (September, 1988) Final Remedial Investigation Re[illegible] for the Berks Sand Pit Site, Vol 1 and 2. Prepared for PADE[illegible]
2. Freeze, R.A. and J.A Cherry (1979) Groundwater, Prentice-Hall.

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System

Sheet No. 2 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Extraction System Objectives

1. Extract Contaminated Groundwater
2. Create a Hydraulic Barrier and Capture Zone to Retard Contaminant Migration

Assume a line of wells perpendicular to the gradient (~N to S) near the leading edge of the plume. These wells should be placed to enhance the natural gradient and capture contaminated groundwater.

The length of the "capture zone" perpendicular to the gradient should be such that the width of the plume will be covered. A capture zone of ~900 feet should accomplish this.

Spacing of Extraction Wells Along Line Using Stagnation Points[1]

$$r = \frac{Q}{2\pi h n V_n}$$

where

r = distance to downgradient stagnation point (ft)

Q = pumping rate (gpd) = 50400 gpd

h = effective saturated thickness yielding water to well (ft)

n = porosity = 0.20

V_n = average linear velocity

Ref.

AR300961

1. Keely, Joseph F. and Chin Fu Tsang (1983). "Velocity Plots and Capture Zones of Pumping Centers for Groundwater Investigations" in Groundwater

Baker Engineers

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Subject: Benks Sand Pit Extraction System

Sheet No. 3 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

AND $V_n = \frac{Q}{A_n} = \frac{KI}{n}$

if $T = Kb$ then $K = T/b$

substituting $V_n = \frac{TI}{bn}$

AND

$$r = \frac{Q}{2\pi h n \left(\frac{TI}{bn}\right)} = \frac{Q(bn)}{2\pi h n T I}$$

where T = transmissivity (gpd/ft)
I = hydraulic gradient
b = saturated thickness

Assuming $h = b$ (actually $h \leq b$ - this would lead to a larger stagnation distance; hence the assumption $h = b$ is conservative)

$$r = \frac{Q}{2\pi T I} \qquad \text{units } [L] = \frac{[L^3/T]}{[L^2/T]}$$

Also

$2\pi r$ = upgradient inflow zone (ft)

πr = inflow zone on one side of well (ft)

This method assumes
1. homogeneous, isotropic porous medium
2. uniform hydraulic conductivity and gradient
3. $h = b$

AR300962

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

Sheet No. 4 of 11

Drawing No.

Computed by RPA Checked By RJW Date 9/8/88

REVISION #1

FROM the RI: $I = 0.045$ ft/ft

$T = 5440$ gpd/ft

$Q = 35$ gpm $= 50400$ gpd

so

$$r = \frac{50400}{2\pi(5440)(0.045)} = 32.8 \text{ ft downgradient}$$

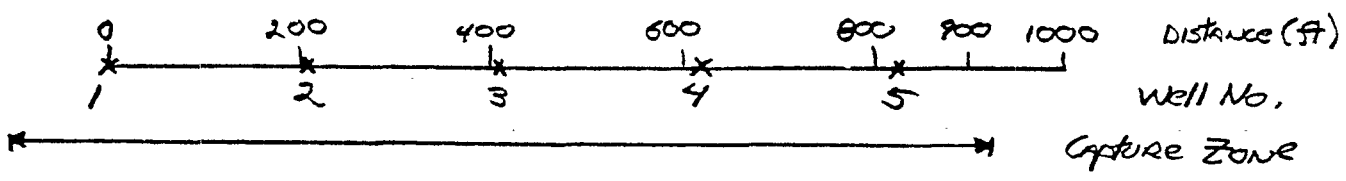
AND the inflow zone on each side of well:

$$\pi r = \pi(32.8) = 103 \text{ ft.}$$

MAXIMUM distance between wells:

$$2 \times 103 \text{ ft} = 206 \text{ feet.}$$

Number of wells: $900/206 = 4.4 \rightarrow$ Need at least 5 wells



so Use 5 wells spaced 206 feet apart

Total capture zone perpendicular to gradient:

$$(4 \times 206) + (2 \times 103) = 1030 \text{ feet}$$

AR300963

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S.O. No. 15438-17-SR1

Subject: Banks Sand Pit Extraction System

Sheet No. 5 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Preliminary Well Design

The packer test samples[1], although they did not pass the QA/QC procedures, qualitatively indicate a vertical distribution of contaminants to an approximate depth of 250 to 300 feet. Assume a 3 well cluster will be effective in removing contaminants over depth. The specific well design should be based on further field investigation.

For the purpose of preliminary design use for each cluster

Well #	Depth (ft)	Screened Interval (ft)	Diameter (ft)	Pumping Rate (gpm)
1	80	30-80	0.5	5
2	150	80-150	0.5	20
3	300	150-300	0.5	10

Well #1 will extract water from the shallow aquifer
Wells 2 and 3 will extract water from the fractured bedrock aquifer.
Rates should be optimized in the field
Using this configuration gives:

5 - 80 ft wells
5 - 150 ft wells
5 - 300 ft wells

Ref: BAKER/TSA (Sept. 1988) Final RI.

AR300964

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S.O. No. 15438-17-SRI

Subject: Banks Sand Pit Extraction System

Sheet No. 6 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Pumping Duration

The pumping duration is based on the volume of liquid in the system and the total pumping rate

It is assumed that adsorption processes play a minor role in contaminant attenuation at the site. In other words TCA and DCE are assumed to be conservative constituents. TCA and DCE are also assumed to have high mobility indices (1,2,3). Hence a large portion of the contaminant will be removed with the removal of contaminated water (ie one pore volume). Lab tests are necessary to determine a better approximation of the extraction rate

It is assumed that the removal of three to five pore volumes of water may significantly reduced groundwater contamination. However this needs to be VERIFIED

PD = Pumping Duration in years

$$PD_{MIN} = \frac{(4171{,}000\ ft^3)(7.48\ gal/ft^3)}{(5\ clusters)(35\ gpm/cluster)(60\ min/hr)(24\ hr/d)(365\ d/yr)}$$

PD_{MIN} = 3.3 years - time to remove 1 pore volume

PD_3 = 10.0 years - time to remove 3 pore volumes

PD_5 = 16.7 years - time to remove 5 pore volumes

PD_{10} = 33.5 years - time to remove 10 pore volumes

1. Ford, K.L. and P. Gurba (1984). "Methods of Determining Relative Contaminant Mobilities and Migration Pathways Using Physical Chemical Data" In Proceedings of the 5th National Conference on Management of Uncontrolled Hazardous Waste Sites, Wash. DC.

2. MacKay, D.M, P.V. Roberts and J.A. Cherry (1985) Transport of Organic Contaminants in Groundwater in Environ Sci Technol. Vol. 19, No. 5, pp 384-392.

3. Wilson J.T. et al. (1981) Transport and Fate of Selected Pollutants in a Sandy Soil in J. Environ. Qual. Vol. 10. No. 4, pp 501-506.

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System

Sheet No. 7 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Range of Most Probable Pumping Durations:
3.3 years to 16.7 years
SAY → 4 years to 17 years

System Configuration and Estimated Drawdown
- Drawdown calculated using Specific Capacity, Distance Drawdown and Superposition Methods.

Specific Capacity Estimate:
Using data from Pump Test No 1 (MW-1)[1] for a Time Period of 1 day[2]

$$\frac{Q}{S_w} = \frac{4\pi T}{\ln\left(\frac{2.25\,Tt}{r_w^2 S}\right)}$$

where
Q = pumping rate (gpd) = 27 gpm = 38880 gpd
S_w = drawdown in pumping well = 15.28 ft.
T = transmissivity = 5440 gpd/ft
t = time = 1 day
r_w = pumping well radius = 0.25 ft
S = storativity = 0.0025 → Average for all MW wells

1. BAKER/TSA (Sept, 1988) Final RI AR300966

2. Lohman, S.W. (1972) Ground-water Hydraulics. Geological Survey Professional Paper 708. U.S. Gov. Printing Office.

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Subject: Berks Sand Pit Extraction System

Sheet No. 8 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/8/88

REVISION #1

Estimate #1:

$$\frac{Q}{S_w} = \frac{27\,gpm}{15.28\,ft} = 1.77\ gpm/ft$$

Estimate #2:

$$\frac{Q}{S_w} = \frac{4\pi(5440)}{\ln\left(\frac{2.25(5440)(1)}{(0.25)^2(0.0025)}\right)} = 3761\ gpd/ft = 2.61\ gpm/ft$$

Averaging Est #1 and Est #2:

$$\frac{Q}{S_w} \simeq \frac{1.77+2.61}{2} = 2.19\ gpm/ft \longrightarrow \text{USE } 2.2\ gpm/ft.$$

DISTANCE-DRAWDOWN ESTIMATES

$$s_2 = s_1 - \frac{Q}{2\pi T}\ln\left(\frac{r_2}{r_1}\right)$$

where

Q = pumping rate (gpd)
T = transmissivity (gpd/ft)
r_1 = pumping well radius
r_2 = distance to observation well (ft)
s_1 = drawdown at pumping well (ft)
s_2 = drawdown at observation well (ft)

AR300967

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S.O. No. 15438-17-SRP

Subject: Beaks Sand Pit Extraction System

Sheet No. 9 of 11

Drawing No.

Computed by RPA Checked By RSW Date 9/8/88

REVISION #1

Let $Q = 35 gpm = 50400 gpd$ $T = 5440 gpd/ft$

$r_1 = 0.25 ft$

$s_1 = \frac{Q}{2.2} = \frac{35}{2.2} = 15.9 ft$ (from Specific Capacity)

r_2 varies from 0 to 824 ft by 206 ft increments

For $r_2 = 0$; $s_1 = s_2 = 15.9 ft$

For $r_2 = 206 ft$

$$s_2 = 15.9 - \frac{50400}{2\pi(5440)} \ln\left(\frac{206}{0.25}\right) = 6.0 ft$$

For $r_2 = 412 ft$

$$s_2 = 15.9 - \frac{50400}{2\pi(5440)} \ln\left(\frac{412}{0.25}\right) = 5.0 ft.$$

For $r_2 = 618 ft$.

$$s_2 = 15.9 - \frac{50400}{2\pi(5440)} \ln\left(\frac{618}{.25}\right) = 4.4 ft$$

For $r_2 = 824 ft$

$$s_2 = 15.9 - \frac{50400}{2\pi(5440)} \ln\left(\frac{824}{.25}\right) = 4.0 ft.$$

Summary of Drawdown over distance for Single Pumping Well Cluster

Distance from Pumping well (ft)	Drawdown (ft)
0	15.9
206	6.0
412	5.0
618	4.4
824	4.0

AR300968

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

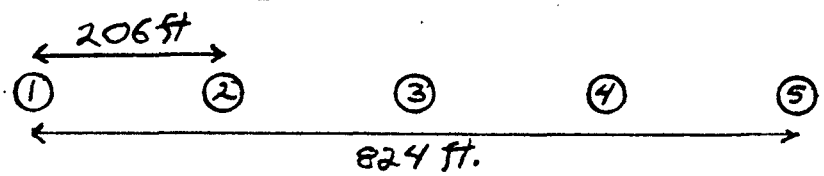
Sheet No. 10 of 11

Drawing No.

Computed by RPA Checked By PSW Date 9/8/88

REVISION #1

Superposition of Drawdowns for 5 Pumping Well Clusters in a Line



DRAWDOWN at Well #1

$DD_1 = 15.9 + 6.0 + 5.0 + 4.4 + 4.0 = 35.3$ ft

DRAWDOWN at Well #2

$DD_2 = 15.9 + 6.0 + 6.0 + 5.0 + 4.4 = 37.3$ ft

DRAWDOWN at Well #3

$DD_3 = 15.9 + 6.0 + 6.0 + 5.0 + 5.0 = 37.9$ ft.

By Symmetry

$DD_4 = 37.3$ ft

$DD_5 = 35.3$ ft.

Notes:

1. These drawdowns do not take into account the flow field at the site.
2. Actual well configuration, placement, pumping rates etc should be based on further field studies:
   Pump Tests
   Geophysics
   etc.

AR300969

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S.O. No. 15438-17-SR1

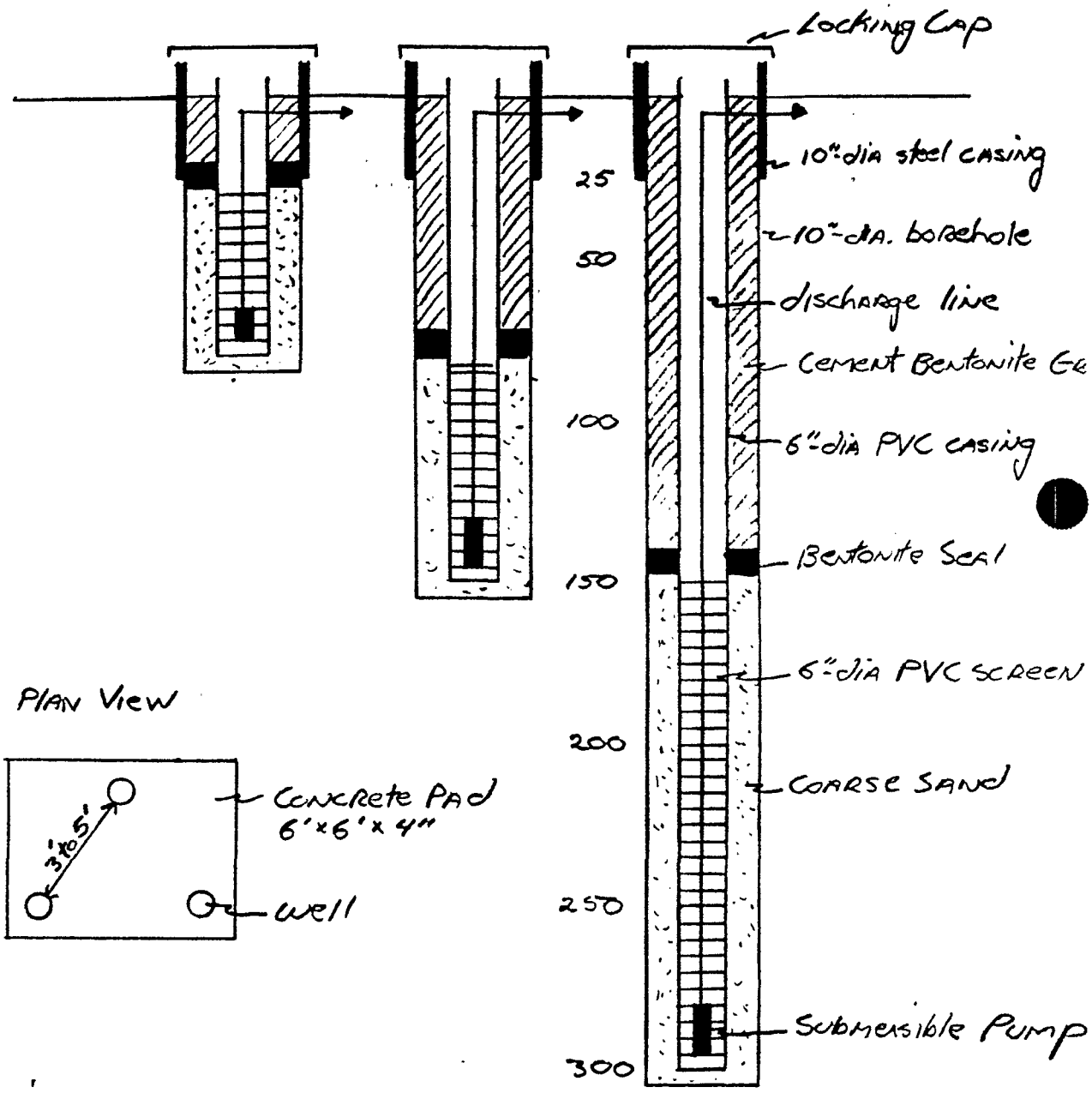
Subject: Berks Sand Pit Extraction System

Sheet No. 11 of 11

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1



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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Mobility of TCA & DCE

Sheet No. 1 of 2

Drawing No.

Computed by RAA Checked By Date 5/27/88

REVISED 9/9/88

Relative Mobility Index[1] (MI)

$$MI = \frac{\log[(S V_p)]}{[K_{oc}]}$$

where

S = water solubility (mg/l)
V_p = vapor pressure (mm Hg)
K_{oc} = organic carbon partition coefficient

$$\log K_{oc} = -0.55 \log(S) + 3.64$$

For TCA:[2]

S = 4400 mg/l

V_p = 100 mm Hg

$$\log K_{oc} = -0.55 \log(4400) + 3.64 = 1.64$$

$$K_{oc} = 43.26$$

$$MI = \log\left[\frac{(4400)(100)}{43.26}\right] = 4.0$$

Relative Index[1]	Description
>5	extremely mobile
0-5	very mobile
-5-0	slightly mobile
-10--5	immobile
<-10	very immobile

so TCA is very mobile

Ref.

1. Ford, K. L and P. Gurba (1984) Methods of Determining Relative Contaminant Mobilities and migration pathways using physical-chemical data in Proceedings of the 5th National Conference on Management of Uncontrolled Hazardous waste Sites, Washington D.C.

2. Weschler K (1983) Handbook of Environmental Data on Organic

AR300971

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Mobility of TCA & DCE

Sheet No. 2 of 2

Drawing No.

Computed by RPA Checked By Date 5/27/88

REVISED 9/9/88

For DCE[2]

$S = 5500$ mg/l (estimated from DCA solubility)

$V_p = 500$ mm Hg

$\log K_{oc} = -0.55 \log(5500) + 3.64 = 1.58$

$K_{oc} = 38.26$

$$MI = \frac{\log\left[\frac{(5500)(500)}{38.26}\right]}{} = 4.91 \quad \text{very mobile}$$

Note This analysis indicates that TCA & DCE are relatively mobile Hence, adsorption onto soil particles would be expected to be low Distribution of TCA in a Soil, water, Sediment, Air, Biota[1] system indicates that this constituent will reside primarily in the and will only be minimally adsorbed (<2%). This is a further indication that the retardation factor is probably close to one

Predicted Retardation Factors[2] for selected halogenated hydrocarbons ranged from 1.2 to 3.2 with an average for 8 compounds of 1.7

It was assumed that removal of 3 pore volumes of water will remove a significant portion of the TCA. An upper limit was assumed to be 10 pore volumes

AR 300972

Ref.

1. Ford, K.L. and P. Gurba (1984). Methods of Determining Relative Contaminant Mobilities and Migration Pathways using Physical-chemical data in Proceedings of the 5th National Conference on Management of Uncontrolled Hazardous Waste Sites, Washington, DC.
2. Wilson, J.T., C. Garfield, W.S. Dunlap, R.L. Cosby, D.A. Foster and L.B. Baskin (198. Transport and Fate of Selected Organic Pollutants in a Sandy Soil in

AR 300972

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Beaks Sand Pit Extraction System

Sheet No. 1 of 4

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

DRAWDOWN ESTIMATES by the Theis Equations

FROM[1]: $u = \frac{r^2 S}{4Tt}$ AND $T = \frac{Q}{4\pi s} W(u)$

Then $s = \frac{Q}{4\pi T} W(u)$

Assuming:

T = transmissivity = 5440 gpd/ft = 727.3 ft²/day

S = storativity = 0.0025

Q = Pumping Rate = 35 gpm = 6738 ft³/day

t = time in days

r = radial distance in feet

s = drawdown in feet

W(u) = well function

AND Let r = 0.25 ft, 206 ft, 412 ft, 618 ft, 824 ft.

W(u) is approximated by

$$W(u) = -0.577216 - \ln(u) + u - \frac{1}{2\times 2!}u^2 + \frac{1}{3\times 3!}u^3$$

$$W(u) = -0.577216 - \ln(u) + u - \frac{u^2}{4} + \frac{u^3}{18}$$

1. Lohman, S.W. (1972). Ground-water Hydraulics. USGS Professional Paper 708, Washington, D.C.

2. BAKER/TSA. (September, 1988) Final RI.

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Subject: Banks Sand Pit Extraction System

S.O. No. 15438-17-SR1

Computed by RPA Checked By PJU Date 7/7/88

Sheet No. 2 of 4

Drawing No.

Revision #1

FOR r = 0.25 ft

$\frac{r^2S}{4T}$	t (days)	$\frac{1}{t}$ (days)$^{-1}$	u	W(u)	$\frac{Q}{4\pi T}$	$s = \frac{Q}{4\pi T} W(u)$ (ft)
37×10^{-8}	0.5	2.0	1.07×10^{-7}	15.48	0.7372	11.41
	1.0	1.0	5.37×10^{-8}	16.17		11.92
	5.0	0.2	1.07×10^{-8}	17.78		13.11
	10.0	0.1	5.37×10^{-9}	18.47		13.62
	20.0	0.05	2.69×10^{-9}	19.16		14.12
	40.0	0.025	1.34×10^{-9}	19.86		14.64
	60.0	0.0167	8.97×10^{-10}	20.26		14.94
	100.0	0.01	5.37×10^{-10}	20.77		15.31
	200.0	0.005	2.69×10^{-10}	21.46		15.82
	400.0	0.0025	1.34×10^{-10}	22.16		16.34
	1000.0	0.001	5.37×10^{-11}	23.07		17.01
	2000.0	0.0005	2.69×10^{-11}	23.77		17.52
	4000.0	0.00025	1.34×10^{-11}	24.46		18.03

FOR r = 206 ft

55×10^{-2}	0.5	2.0	7.29×10^{-2}	2.11	0.7372	1.56	
	1.0	1.0	3.65×10^{-2}	2.77		2.04	
	5.0	0.2	7.29×10^{-3}	4.35		3.21	
	10.0	0.1	3.65×10^{-3}	5.04		3.72	
	40.0	0.025	9.12×10^{-4}	6.43		4.74	
	100.0	0.01	3.65×10^{-4}	7.34		5.41	
	400.0	0.0025	9.12×10^{-5}	8.73		6.43	6.44
	1000.0	0.001	3.65×10^{-5}	9.64		7.11	
	4000.0	0.00025	9.12×10^{-6}	11.03		8.13	

AR300974

Baker Engineers

Subject: Beaks Sand Pit Extraction System

S.O. No. 15438-17-SR1

Computed by RPA Checked By PSW Date 9/9/88

Drawing No. Sheet No. 3 of 4

Revision #1

$\frac{r^2 S}{4T}$	t (day)	t^{-1} (day^{-1})	u	W(u)	$\frac{Q}{4\pi T}$	$S = \frac{Q}{4\pi T} W(u)$ (ft)	
			For r = 412 ft				
1.46×10^{-1}	0.5	2.0	2.92×10^{-1}	0.93	0.7372	0.68	.69
	1.0	1.0	1.46×10^{-1}	1.49		1.10	
	5.0	0.2	2.92×10^{-2}	2.99		2.20	
	10.0	0.1	1.46×10^{-2}	3.67		2.70	2.71
	40.0	0.025	3.65×10^{-3}	5.04		3.72	
	100.0	0.01	1.46×10^{-3}	5.96		4.39	
	400.0	0.0025	3.65×10^{-4}	7.34		5.41	
	1000.0	0.001	1.46×10^{-4}	8.26		6.09	
	4000.0	0.00025	3.65×10^{-5}	9.64		7.11	
			For r = 618 ft				
3.28×10^{-1}	0.5	2.0	6.56×10^{-1}	0.39	0.7372	0.29	
	1.0	1.0	3.28×10^{-1}	0.84		0.62	
	5.0	0.2	6.56×10^{-2}	2.2		1.63	1.62
	10.0	0.1	3.28×10^{-2}	2.88		2.12	
	40.0	0.025	8.2×10^{-3}	4.24		3.12	3.13
	100.0	0.01	3.28×10^{-3}	5.15		3.80	
	400.0	0.0025	8.2×10^{-4}	6.53		4.82	4.81
	1000.0	0.001	3.28×10^{-4}	7.45		5.49	
	4000.0	0.00025	8.2×10^{-5}	8.83		6.51	
			For r = 824 ft				
5.84×10^{-1}	0.5	2.0	1.17	0.09	0.7372	0.07	
	1.0	1.0	5.84×10^{-1}	0.46		0.34	
	5.0	0.2	1.17×10^{-1}	1.68		1.24	
	10.0	0.1	5.84×10^{-2}	2.32		1.71	
	40.0	0.025	1.46×10^{-2}	3.67		2.70	2.71
	100.0	0.01	5.84×10^{-3}	4.57		3.37	
	400.0	0.0025	1.46×10^{-3}	5.96		4.39	
	1000.0	0.001	5.84×10^{-4}	6.87		5.07	5.06
	4000.0	0.00025	1.46×10^{-4}	8.26		6.09	

BR300975

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S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

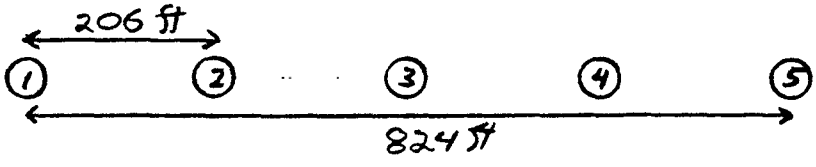
Sheet No. 4 of 4

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

Estimated DRAWDOWNS using Superposition



DRAWDOWN at Well #1

t = 1 day

$s_1 = 11.92 + 2.04 + 1.10 + 0.62 + 0.34 = 16.02$ ft

t = 1000 days

$s_1 = 17.01 + 7.11 + 6.09 + 5.49 + 5.07 = 40.77$ ft.

DRAWDOWN at Well #2

t = 1 day

$s_1 = 11.92 + 2.04 + 2.04 + 1.10 + 0.62 = 17.72$ ft

t = 1000 days

$s_1 = 17.01 + 7.11 + 7.11 + 6.09 + 5.49 = 42.81$ ft

DRAWDOWN at Well #3

t = 1 day

$s_1 = 11.92 + 2.04 + 2.04 + 1.10 + 1.10 = 18.20$ ft

t = 1000 days

$s_1 = 17.01 + 7.11 + 7.11 + 6.09 + 6.09 = 43.41$ ft

By Symmetry

DRAWDOWN at well #4

t = 1 day $s_1 = 17.72$ ft

t = 1000 days $s_1 = 42.81$

DRAWDOWN at well #5

t = 1 day $s_1 = 16.02$

AR300976

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

Sheet No. 1 of 6

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

QUANTITIES FOR EXTRACTION WELL INSTALLATION

1. Drilling, 10"-dia borehole

300 ft + 150 ft + 80 ft = 530 LF/cluster

530 LF/cluster × 5 clusters = 2650 LF

2. Core, NX Assume top of rock is 25 ft below surface
Core 2 wells to 300 feet

5 wells × 275 ft/well = 1375 LF

3. Steel Casing, 10"-dia : Assume 30 feet of casing per well.

15 wells × 30 ft/well = 450 LF

4. No. of Core Boxes : Assume 12 LF/Box

$\frac{1375 \text{ LF of Core}}{12 \text{ LF/Box}}$ = 114.6 Boxes ⟶ USE 120 Boxes

5. 6"-dia Schedule 40 Flush Jointed and Threaded Solid PVC casing

80' well : 40 LF
150' well : 90 LF
300' well : 160 LF
Total 290 LF/cluster

5 clusters × 290 LF/cluster = 1450 LF

AR300977

Baker Engineers

S.O. No. 15438-17-SR1

Subject: BERKS SAND PIT
Extraction System

Sheet No. 2 of 6

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

6. 6"-dia PVC SCREEN

80' well:	50 LF
150' well:	70 LF
300' well	150 LF
Total	270 LF/cluster

5 clusters × 270 LF/cluster = 1350 LF

COST: $14.50/LF (vendor Quote)

7. Fittings

6"-dia PVC endcaps and extenders: 15

Locking Caps with Locks: 15

8. Concrete Pads:

5 clusters × (6' × 6' × 4/12)/27 CF/CY = 2.2 CY

USE 3 CY

9. Grout (Portland Cement w/ 4% Bentonite)

80' well	28 LF
150' well	78 LF
300' well	148 LF
Total	254 LF

USE 255 LF/cluster

5 clusters × 255 LF/cluster = 1275 LF USE 1300 LF

Area per hole: cross section

$$\frac{\pi}{4}\left(\left(\frac{10}{12}\right)^2 - \left(\frac{6}{12}\right)^2\right) = 0.35\ ft^2$$

Volume: (0.35 ft² × 1300 LF) = 455 CF

USE 460 CF

AR300978

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

Sheet No. 3 of 6

Drawing No.

Computed by RPA Checked By PSW Date 9/9/88

REVISION #1

10 Portland Cement (96% of Grout)

$$\left(\frac{460\ CF \times 196\ lb/CF}{96\ lb/BAG}\right) \times .96 = 901.6\ Bags$$

USE 905 Bags

11. Bentonite, Powdered (4% of Grout)

$$\left(\frac{460\ CF \times 80\ lb/CF}{50\ lb/BAG}\right) \times .04 = 29.4\ Bags$$

USE 30 Bags

12. Bentonite Pellets: Assume 3' seal in each well

$$3\ LF/well \times 0.35\ ft^2 \times 15\ wells = 15.75\ CF$$

$$\frac{15.75\ CF \times 80\ lb/CF}{50\ lb/BAG} = 25.2\ Bags$$

USE 26 BAGS

13 Coarse Sand

80' well	50 LF
150' well	70 LF
300' well	150 LF
Total	270 LF/cluster

$$\frac{270\ LF/cluster \times 5\ clusters \times 0.35\ ft^2}{27\ CF/CY} = 17.5\ CY$$

USE 20 CY

14. Volume of Cuttings

$$5\ clusters \times (300 + 150 + 80\ ft/cluster) = 2650\ LF$$

$$AREA = \frac{\pi}{4}\left(\frac{10}{12}\right)^2 = 0.55\ ft^2$$

$$Volume = (2650\ LF)(0.55\ ft^2) = 1458\ CF$$

AR300979

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Extraction System

Sheet No. 4 of 6

Drawing No.

Computed by RPA Checked By RSW Date 9/9/88

REVISION #1

15. Equipment: 2 Drill Rigs
1 Steam Cleaner
1 Bulldozer - tek mtd Medium
1 Water Truck
1 Flatbed Truck

16 Professional Field Staff.

	Rate	Rate*
1 Geologist (Coord)	55.00	70.00
1 H&S Officer	55.00	70.00
1 Geologist	45.00	60.00

* Rate includes @ 80 per diem per 8 Hr day

Assume a 6-Month construction Period

Geologist (Coord)

6 mnths × 4.2 wks/mn × 5 d/wk × 8 hr/d = 1008 hrs

SAY 1010 hrs.

H&S Officer

3 wks × 5 d/wk × 8 hr/day = 120 hrs

Geologist

4 mnths × 4.2 wks/mn × 5 d/wk × 8 hr/d = 672 hrs

SAY 700 hrs

	Rate	Hours	Total
Geologist (Coordinator)	70	1010	70,700
H&S	70	120	8400
Geologist	60	700	42,000

AR300980

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Banks Sand Pit
Extraction System

Sheet No. 5 of 6

Drawing No.

Computed by RPA Checked By RSW Date 9/9/88

REVISION #1

17. Well Construction Labor

Assume 2 days/cluster to construct

Driller $250/day

Helper $200/day

$450/day

5 clusters × 2 days/cluster = 10 days

18. Packer Tests

Perform in 1 hole/cluster (300 ft) for 5 clusters

Assume 10 tests/hole

Assume 1 day per hole at $200/hr (Labor, mat., equip.) Vendor Quote

(5 holes × 8 hrs/hole × $200/hr) = $8000

Analytics

$150/sample × 10 samples/hole × 5 holes = $7500

19. Well Development

$175/hr (Labor, mat. equip) Vendor Quote

Assume 3 hrs/well

3 hrs/well × 15 wells = 45 hrs

45 hrs × $175/hour = $7875.

20. Borehole Geophysics

Assume a total of $5000

AR300981

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System

Sheet No. 6 of 6

Drawing No.

Computed by RPA Checked By PSW Date 9/9/88

REVISION #1

21 Pump Tests Assume 1 test per cluster

2 - 72 hrs tests + 28 hrs recovery = 100 hrs x 2 = 200 hr

3 - 24 hrs tests + 12 hrs recovery = 36 hrs x 3 = 108 hrs

40 hours set-up

(200 + 108 + 40) x $200/hr = $69 600

Analytics 10 samples @ 150/sample = $1500

22. Cuttings Disposal

a. Use 55-gal DOT DRUMS. Assume 1/4 of cuttings will need to be containerized, transported off-site and incinerated

1460 CF x 0.25 = 365 CF = 13.5 CY use 15 CY

Number of DRUMS 15 CY / 0.25 CY/DRUM = 60 DRUMS x $25 = $1500

b. TRANSPORT: $4.00 load-mile for 150 miles and 1 load.

$4.00 load-mile x 150 miles = $600

c. Analytics: Composite Samples: 12 samples

12 samples x $850/sample = $10,200

D INCINERATION @ $650 per drum

60 DRUMS x 650 per drum = $39,000

E. Handling: 1 hr/DRUM at $200/hr (Geol + Tech + Tech)

60 x $200/hr = 12000

Total

$1500 + $600 + $10,200 + $39,000 + $10,800 = $62,100.

AR300982

Baker Engineers

S.O. No. 15438-17-SRI

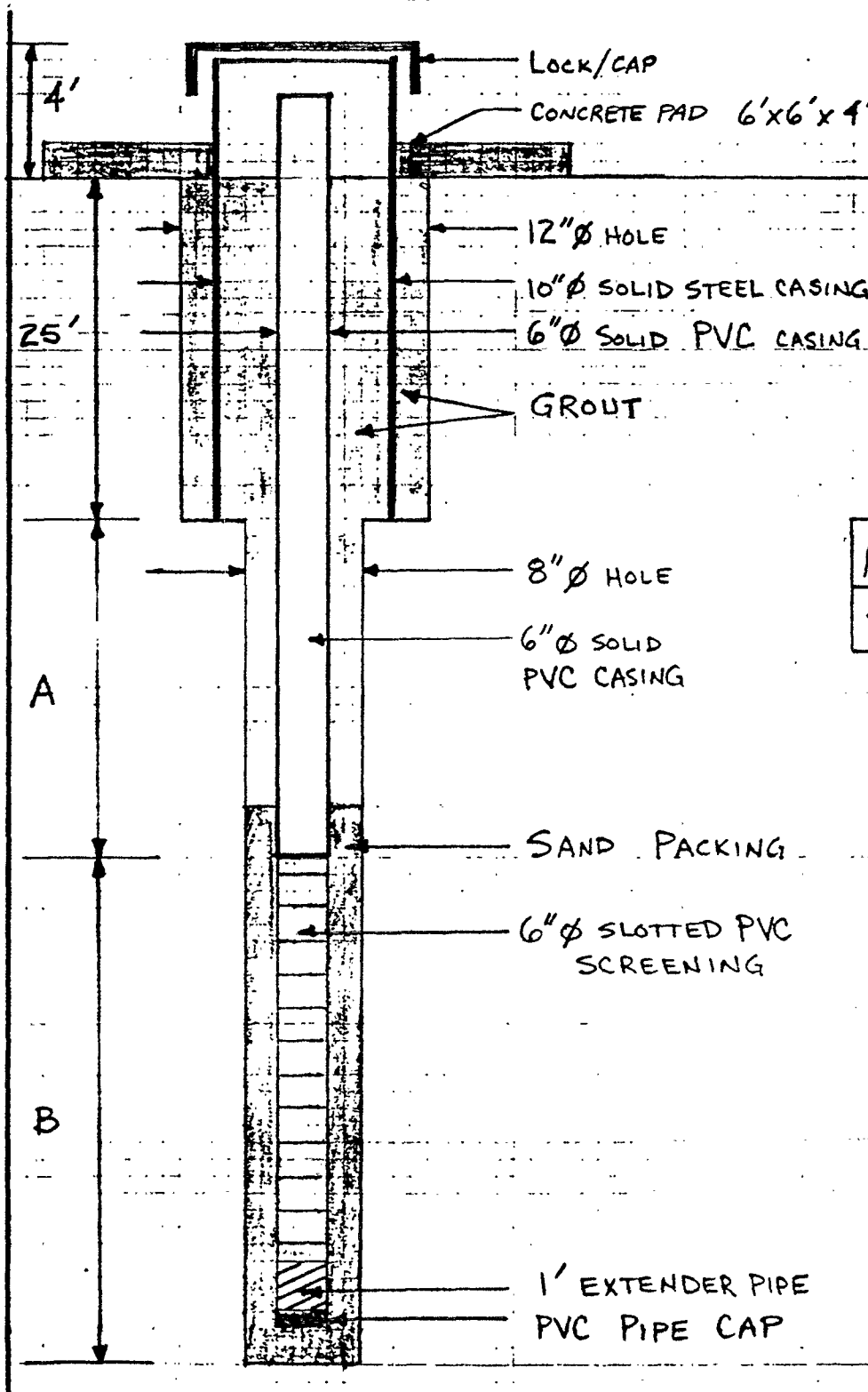
Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

Sheet No. 1 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88
Delete



	300' WELLS	150'	80'
A	125'	55'	5'
B	150'	70'	50'

6 WELL CLUSTERS; EACH CONTAINING A 300', 150', 80' WELL (18 WELLS TOTAL)

PLUS:
900' OF 2" CORING FOR CORE SAMPLES

AR300983

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

Sheet No. 2 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/3/88

REVISION DATE: 6/29/
Revised 9/9/88
Delete

QUANTITIES

(1) DRILLING, 12"Ø HOLE

(18 WELLS x 25/WELL) = 450 VLF

(2) DRILLING, 8"Ø HOLE

18 WELLS x (125 + 55 + 5) ≡ 3,500 VLF

(3) DRILLING, 2"Ø CORES

900 VLF → 3 WELLS @ 300 VLF EACH

(4) PIPE, SOLID STEEL CASING 10"Ø

450 LF + (18 x 4') ≡ 525 LF

(5) PIPE, SOLID PVC CASING 6"Ø

18 x (25 + 1 + 3) + 6 x (125 + 55 + 5) ≡ 1,700 LF

(6) SCREENING, 6"Ø MANUFACTURED SLOTS

6 x (150 + 70 + 50) - 18 (1 + 0.5 + 1 + 1) ≡ 1,600 LF

(7) LOCKING / CAPS = 18 EACH

COST $14.50/LFT
VENDER QUOTE

(8) CONCRETE PADS

6 x (6' x 6' x 4/12') ≡ 80 CFT

AR300984

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

Sheet No. 3 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88
Delete

QUANTITIES CON'T

(9) GROUT (PORTLAND CEMENT WITH 4% BENTONITE)

$$18 \times 25' \times 0.785398\left(\left(12''/12\right)^2 - \left(6''/12\right)^2\right)$$

$$+$$

$$6 \times (125+55+5) \times 0.785398\left(\left(8''/12\right)^2 - \left(6''/12\right)^2\right)$$

$$= 435 \text{ CFT} \quad (500 \text{ CFT})$$

(10) PORTLAND CEMENT (w/ 4% BENTONITE)

$$(500 \text{ CFT} \times 0.96 \times 196 \text{ pcf}) \div 96 \text{ lb/bag} = 1{,}000 \text{ bags}$$

(11) BENTONITE 4% (WITH PORTLAND CEMENT)

$$(500 \text{ CFT} \times 0.04 \times 80 \text{ pcf}) \div 50 \text{ lb/bag} = 40 \text{ bags}$$

(12) SAND PACKING

$$6 \times (150+70+50) \times 0.785398\left(8/12^2 - 6/12^2\right)$$

$$= 247 \text{ CFT} \quad (\text{Use } 15 \text{ CYD})$$

(13) VOLUME OF BORE HOLE CUTTINGS

$$(18 \times 25 \times 0.785) + 6(125+55+5+150+70+50) \times 0.349$$

$$= 1{,}310 \text{ CFT} \quad (1{,}500 \text{ CFT})$$

AR300985

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

Sheet No. 4 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88
Delete #14, 15, 16

QUANTITIES CON'T

(14) NUMBER OF 55-GALLON DRUMS (CUTTINGS, CLOTHES, ETC)

7 CFT / DRUM — COST. $25 @ DRUM

(1,500/7) = 214 DRUMS

USE 300 DRUMS

(15) EQUIPMENT REQUIRED

2 DRILLING RIGS (1-AIR ROTARY, 1-AUGERING)
1 WELDING MACHINE
1 STEAM CLEANING SET-UP
1 CEMENT MIXER - PORTABLE
1 WATER TRUCK - 3,000 GALLON
1 BULLDOZER - TRACK MOUNT, MEDIUM SIZE
75 CORE BOXES - HOLDING 12 LFT EACH
1 FLATBED TRUCK - MEDIUM SIZED, DRUM MOVING

(16) PROFESSIONAL FIELD STAFF

~~1 CONSTRUCTION INSPECTION ENGINEER @ $45/HR~~ Delete
1 GEOLOGIST @ $~~45~~/HR 70
~~1 HEALTH AND SAFETY OFFICER @ $45/HR.~~ Delete

ASSUME 6 MONTHS TO INSTALL WELLS AND SYSTEM

6 MON x 4.2 WK/MONTH x 5 DAY/WK x 8 HR/DAY ≅ 1,000 HRS.

(18) PUMPS, FOR 300 FT. WELLS

STATIC HEAD = 300 FT. Q = 15 GPM

V = 2 FPS MIN.

$$ID = 0.639\sqrt{\frac{15}{2}} \geq 1.75''$$

AR300986

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

Sheet No. 5 of 17

Drawing No.

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REVISED 9/9/88

QUANTITIES CON'T

PUMPS $\Delta P_{100}^{2''\phi} = 0.30$ psi/100 FT. (DRISCOPIPE 1000*)

$\Delta H_{100}^{2''\phi} = 0.69$ FT/100 FT

H_L FOR 300' PLASTIC PIPE $= (0.69 \times 3) \equiv 2$ FT.

LONGEST DISTANCE WELL CLUSTER TO SURGE TANK $\equiv$ 950 FT.

H_L FOR 950' PLASTIC PIPE $= (0.69 \times 9.5) \equiv 7$ FT

MINOR $H_L \equiv$ ASSUME 2 FT

TOTAL HEAD $= (300 + 2 + 7 + 2) \equiv 315$ FEET

MASS FLOW RATE $= 15 \frac{GAL}{MIN} \times \cancel{62.4}\ 8.345 \frac{lb}{GAL} = \cancel{936}\ 125 \frac{lb}{MIN}$

HYDRAULIC H.P. $\geq \frac{\cancel{936}\ 125\ lb/MIN \times 315\ FT\ HEAD}{33{,}000}$

$= \cancel{8.93}\ 1.2$ HYD. H.P.

ASSUME 30% PUMP EFFICIENCY

BRAKE H.P. $= \left(\frac{\cancel{8.93}\ 1.2}{0.30}\right) = \cancel{29.7}\ 4.0$ BHP

ASSUME 85% MOTOR EFFICIENCY

ELECTRICAL HP TO MOTOR $= \frac{\cancel{29.7}\ 4.0\ BHP}{0.85} = \cancel{35}\ 4.7$ EHP

KW INPUT TO MOTOR $= \frac{\cancel{29.7}\ 4.0 \times .7457}{0.85} = \cancel{26}\ 3.5$ KW

KW LOAD $= (6 \times 3.5) = 21$ KW
$\times 5$

AR300987

Baker Engineers

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Subject: BERKS SAND PIT
PUMPING WELL SYSTEM
FS DESIGN

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Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88

QUANTITIES CON'T

(19) PUMPS, FOR 150 FT. WELLS

Q = 15 GPM V = 2 FPS

ID = 1.75", USE 2"Ø DRISCOPIPE 1000*

STATIC HEAD = 150 FT.

FRICTION $H_L = 0.69 \times \frac{(150+900)}{100} = 8$ FT

MINOR H_L = ASSUME 2'

MASS FLOW RATE = ~~936 lb/MIN~~ $(15 \times 8.345) = 125$ lb/MIN.

HYD. HP = $\frac{\cancel{936}\ 125 \times (150+8+2)}{33{,}000} = \cancel{4.54}\ 0.60$ Hyd.HP

BRAKE HP = $\frac{\cancel{4.54}\ 0.60}{0.30} = \cancel{15}\ 2.0$ BHP

ASSUME 85% MOTOR EFFICIENCY

ELECTRICAL HP TO MOTOR = $\left(\frac{\cancel{15}\ 2.0 \text{ BHP}}{.85}\right) = \cancel{17.6}\ 2.4$ EHP

KW INPUT TO MOTOR = $\left(\frac{\cancel{17.6}\ 2.0 \times .7457}{.85}\right) = \cancel{15}\ 1.75$ KW

NEED 6 SUCH PUMPS

KW LOAD = $(6 \times 1.75) = 10.5$ KW

AR300988

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 7 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88

QUANTITIES CON'T

(20) PUMPS, FOR 80 FT WELLS

$Q = 5\ GPM \quad V = 2\ FPS$

$ID = 0.639\sqrt{\frac{5}{2}} = 1.01''$ USE 1"Ø NOMINAL

$\Delta P_{100}^{1''\phi} = 0.20\ psi/100\ FT.$

$\Delta H_{100}^{1''\phi} = 0.46\ FT/100\ FT.$

$H_L = 0.46\left(\frac{80+900}{100}\right) \cong 5\ FT.$

MINOR $H_L \equiv$ ASSUME 2'

TOTAL $H_L = (80 + 2 + 5) = 87\ FT.$

MASS FLOW RATE = 5GPM × ~~62.4~~ 8.345 = ~~312~~ 42 lb/min

HYD. HP = $\left(\frac{\cancel{312}\ 42 \times 87}{33{,}000}\right) = \cancel{0.82}\ 0.11$ HYD. HP

BRAKE HP = $\left(\frac{\cancel{0.82}\ 0.11}{0.30}\right) \equiv \cancel{2.7}\ 0.4$ BHP (3 BHP)

ASSUME 85% MOTOR EFFICIENCY

ELEC. HP TO MOTOR = $\left(\frac{\cancel{3}\ 0.4\ BHP}{.85}\right) \cong \cancel{3.5}\ 0.5$ EHP

KW TO MOTOR = $\left(\frac{\cancel{3.5}\ 0.4 \times .7457}{.85}\right) = \cancel{3.0}$ KW

KW LOAD = (6 × 0.6) = 3.6 KW

NEED 6 SUCH PUMPS

AR300989

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 8 of 17

Drawing No.

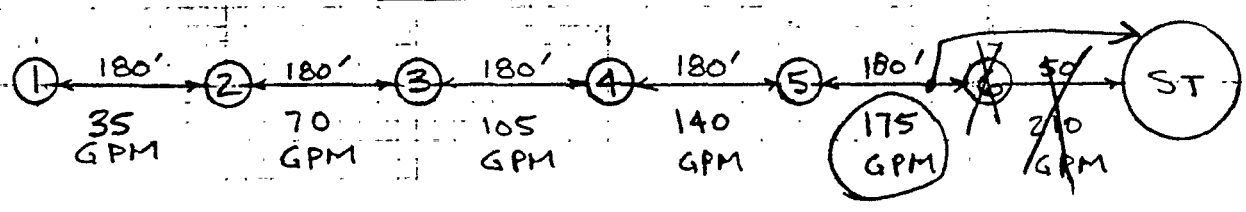
Computed by LJS Checked By RPA Date 6/3/88

REVISED 9/9/88

QUANTITIES, CON'T

(21) PIPE, MANIFOLD LINE FROM WELL CLUSTERS TO SURGE TANK (V = 2 FPS)

ASSUMES WORST CASE FOR PIPE SIZE, WELL CLUSTERS



DRISCOPIPE 1000*

1 TO 2

$ID = 0.639\sqrt{\frac{35}{2}} = 2.67''$ — USE 3" NOMINAL SDR 11 (160 psi RATING)

2 TO 3

$ID = 0.639\sqrt{\frac{70}{2}} = 3.78''$ — USE 4" NOMINAL SDR 11

3 TO 4

$ID = 0.639\sqrt{\frac{105}{2}} = 4.63''$ — USE 6" NOMINAL SDR 11

4 TO 5

$ID = 0.639\sqrt{\frac{140}{2}} = 5.35''$ — USE 6" NOMINAL SDR 11

5 TO 6

$ID = 0.639\sqrt{\frac{175}{2}} = 5.97''$ — USE 8" NOMINAL SDR 11

~~6 TO ST~~

~~$ID = 0.639\sqrt{\frac{210}{2}} = 6.55''$~~ — ~~USE 8" NOMINAL SDR~~

NOMINAL DIAM.	LENGTH (FT)	
3"	200'	ALLOWS FOR 20' OFFSET.
4"	200'	

AR300000

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 9 of 17

Drawing No.

Computed by LJS Checked By RAA Date 6/3/88

REVISED 9/9/88

QUANTITIES, CON'T

(22) PLUMBING FIXTURES

ITEM	NO.	UNITS
PITLESS ADAPTERS 2"Ø	18	EA
HIGH/LOW CUTOFFS	18	SETS
FOOT VALVES 2"Ø	18	EA
GLOBE VALVES 2"Ø	18	EA
PIPE COUPLINGS 2"Ø	300	EA
90° ELBOWS 2"Ø	72	EA
PIPE COUPLINGS 3"Ø	20	EA
PIPE COUPLINGS 4"Ø	20	EA
PIPE COUPLINGS 6"Ø	40	EA
PIPE COUPLINGS 8"Ø	40	EA
BRANCHED TEES 3"Ø	3	EA
BRANCHED TEES 4"Ø	3	EA
BRANCHED TEES 6"Ø	6	EA
BRANCHED TEES 8"Ø	6	EA
CHECK VALVES 2"Ø	18	EA

(23) TRENCHING, MANIFOLD PIPE 6' DEEP x 2' WIDE 950 LF

(24) BEDDING, MANIFOLD PIPE 950 LFT 2' WIDE 8"Ø PIPE

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 10 of 17

Drawing No.

Computed by LJS Checked By RJH Date 6/3/88

REVISION DATE: 6/29/6

(25) DRUM DISPOSAL

ASSUME LAND BAN ON F WASTES APPLIES AND DRUMS MUST BE INCINERATED.

COST PER DRUM $25 DOT APPROVED

STORAGE AREA $2,000

250 MILE HAUL TO NJ INCINERATOR

$3.50 PER LOAD-MILE 60 DRUMS/LOAD

DRUM HANDLING, LOADING, ETC: 1 HR/DRUM

CREW B-10N MEAN: SITE $550/DAY

$$\frac{(300 \text{ DRUMS} \times 1 \text{ HR/DM})}{8} \times \frac{\$550}{\text{DAY}} = \$20,625$$

TRANSPORT

ASSUME 25' DEEP SOIL CASING CUTTINGS ARE "CLEAN"

$$25' \times \frac{\pi}{4}(1^2) \times 18 \text{ WELLS} = \frac{360 \text{ CFT}}{7 \text{ CFT/DRUM}} \equiv 50 \text{ DRUMS CLEAN}$$

(300 - 50) = ~~250~~ 150 DRUMS FOR INCINERATION

250/60 × 250 MILES = 1,250 LOAD-MILES

ANALYTICAL TESTING:

- PASS/FAIL INDICATOR ORGANICS $500/TEST 1 TESTS/WHOLE
- FROM DRUMS TO INCINERATOR 3 TESTS $1500/TEST

INCINERATION COSTS

RANGES FROM $600 TO 800 PER DRUM

AR300992

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 11 of 17

Drawing No.

Computed by LJS Checked By RFA Date 6/3/88

REVISION DATE: 6/2
Revised 9/9/88
Delete

(26) PACKER TESTS

VENDER QUOTE

1 DAY/HOLE LEVEL C $200/HR INCL'D L, M, E

8 HR/HOLE x 18 = 144 HOURS

(27) WELL DEVELOPMENT

VENDER QUOTE $175/HR INCL'D L, M, E

2 HR/WELL + SET-UP TIME

USE ~~4~~ 3 HR/WELL x 18 = 90 HRS.

(28) PUMP TESTS

WANT 72-HRS/TEST @ $150/HR INCL'D L, M, E

1 TEST/CLUSTER + SETUP TIME

90 HR/TEST x 6 TESTS = 540 HRS.

(29) WELL CONSTRUCTION (LABOR & EQUIP COSTS)

ASSUME 3-DAYS/CLUSTER TO CONSTRUCT
(DRILLING & MAT'LS INCL'D ELSEWHERE)

MEANS: SITE - CREWS B-43, 55, 61

0.5	FOREMAN	$ 74/DAY	BARE COST
3	LABORERS	398	
1	TRK DRIVER	138	
1	CEMENT MIXER	200	
1	WATER TRK	150	
1	STEAM CLEANER	75	

$ 1,035/DAY x 18 = $18,630

AR300993

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 12 of 17

Drawing No.

Computed by LJS Checked By RFF Date 6/7/88

REVISED 9/9/88

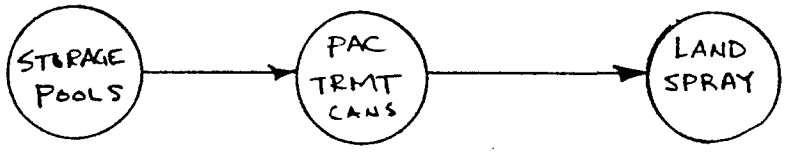
QUANTITIES CON'T

(30) TREATMENT OF PUMPING TEST WATERS

@ 35 gpm x 60 x 72 HRS = 151,200 GALLONS/TEST

6 TESTS x 151,200 GALLONS = 0.907 MG

ASSUME:



(2) SWIMMING POOLS FOR STORAGE

~ 30,000 GALLONS @ 4' DEEP 36'ϕ

ABOVE GROUND NO ACCESSORIES

VENDOR QUOTE

$1,800/POOL @ 17,000 GALLONS OVAL 18' x 33' x 4' DEEP

LINER & SIDES ONLY

USE 2 POOLS $250 SHIPPING TO SITE

(4) PAC CANISTERS

$3,400 EACH 1000# VIRGIN CARBON

$2,800 EACH 1000# REACTIVATE CARBON

* $460 EACH 165# REACTIVATED CARBON 10GPM

FOB PITTSBURGH

USE 4 CANISTERS @ $500 EACH FOB SITE

ALLOW $1,500 FOR SMALL PUMP, PIPING, ETC.

SET-UP, ETC.

2 MEN 1 day PER POOL TO SET UP, TEAR DOWN & MOVE

6 x 1 x 2 = 12 MAN DAYS

AR300994

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 13 of 17

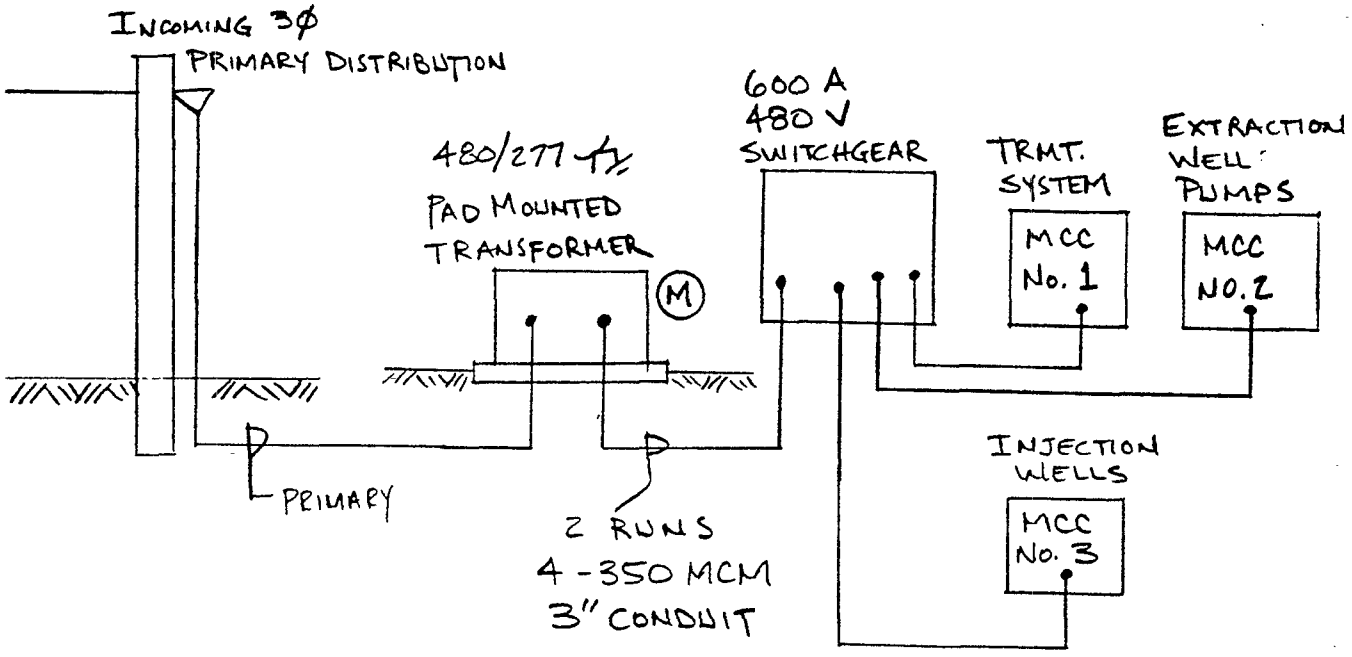
Drawing No.

Computed by BBL/LJS Checked By RPA Date 6/13/88

REVISED 9/9/88

(31) ELECTRICAL SUPPORT SYSTEMS

(a) DISTRIBUTION



INCOMING SERVICE SIZING:

ASSUME: 500 KVA
600 A SERVICE

2 - 350 MCM PER PHASE
2 x 310 = 620 A

2 RUNS
4 - 350 MCM
3" CONDUIT

LOAD ESTIMATE

EXTRACTION WELLS	~~270~~ 35	KW
INJECTION WELLS	15	KW
TREATMENT SYSTEM	200	KW
TOTAL	~~485~~ 250	KW

ASSUME 1 KW ≈ 1 KVA

AR300995

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL DESIGN
FS DESIGN

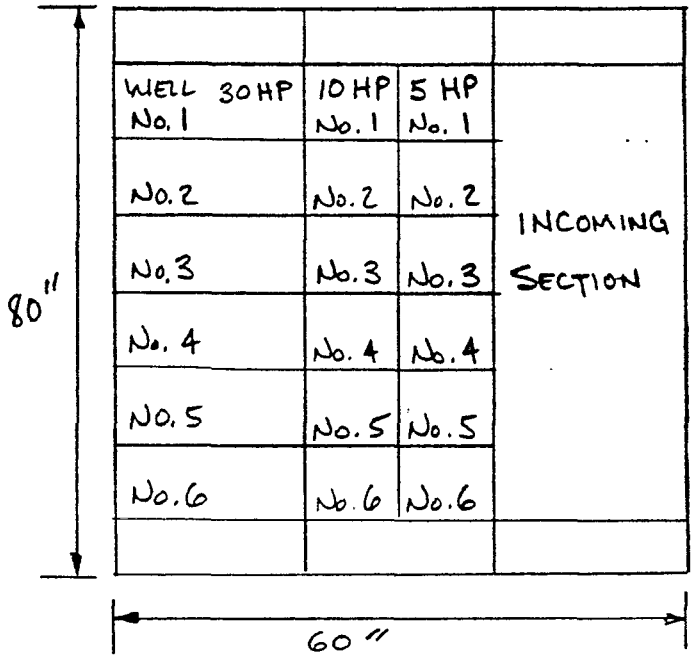
Sheet No. 14 of 17

Drawing No.

Computed by BBL/LJS Checked By RPA Date 6/13/88

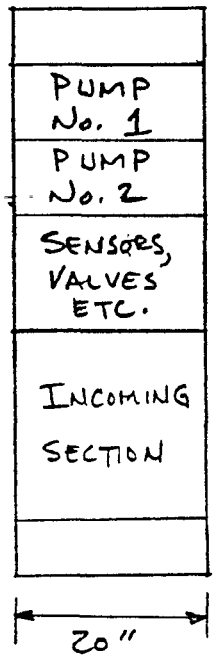
REVISED 9/9/88

(b) MOTOR CONTROL CENTERS



MCC No. 2
(EXTRACTION WELLS)

~~HP = (6 x 30) + (6 x 10) + (6 x 5)~~
~~= 270 HP~~



MCC No. 3
(INJECTION WELLS)

HP = (2 x 10) = 20 H.P.

HP = (6 x 4.7) + (6 x 2.4) + (6 x 0.5) ≅ 46 HP

AR300996

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL DESIGN
FS DESIGN

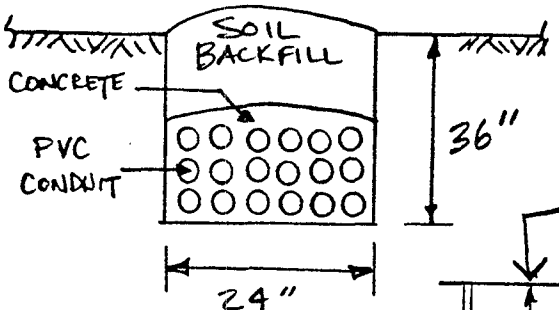
Sheet No. 15 of 17

Drawing No.

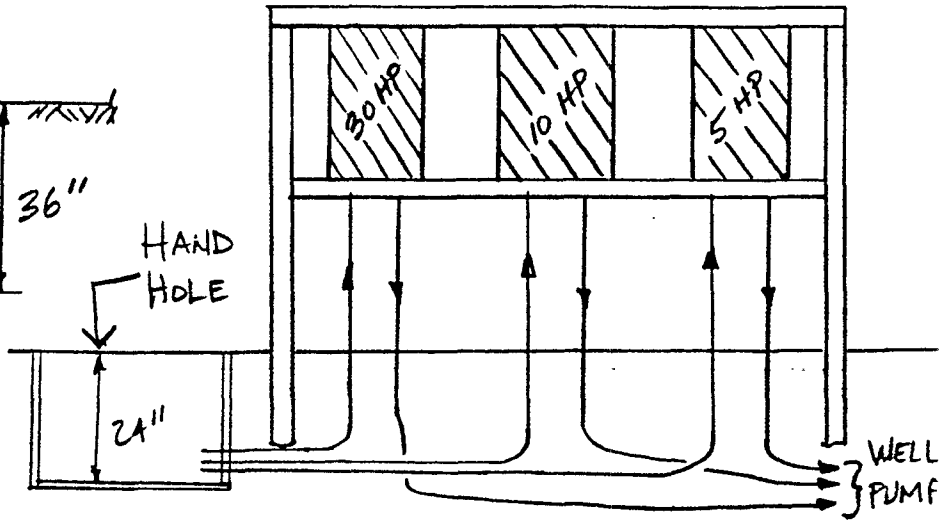
Computed by BBL/LJS Checked By RPG Date 6/13/88

REVISED 9/9/88

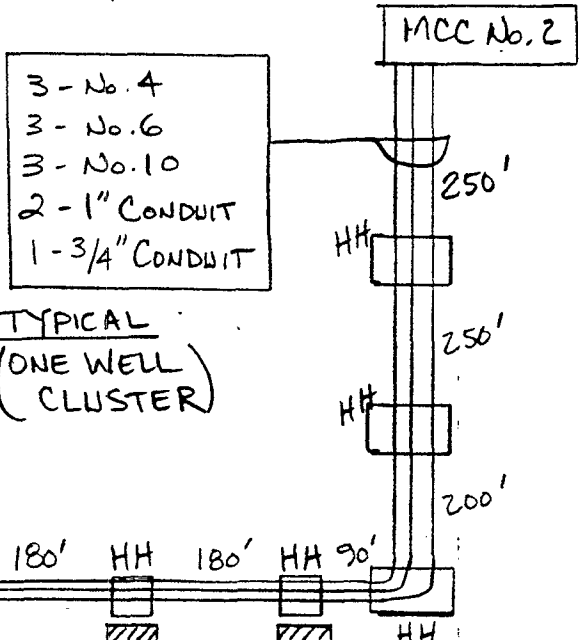
(C) TYPICALS



TRENCH



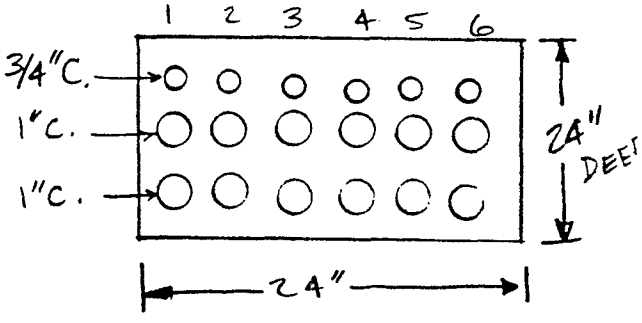
PUMP CONTROLLERS



TYPICAL (ONE WELL CLUSTER)

WELL CLUSTERS

PUMP CONTROLLERS



30" WIDE

HAND HOLE

(FOR PULLING WIRE)

1150' OUTER WELL CLUSTER
970' MIDDLE
790' INNER

AR300997

Baker Engineers

S.O. No. 15438-17-SRE

Subject: BERKS SAND PIT
PUMP WELL SYSTEM
FS DESIGN

Sheet No. 16 of 17

Drawing No.

Computed by BBL Checked By LJS Date 6-13-88

(d) WIRE SIZING

REVISED 9/9/8

(A) 30 H.P. MOTOR

FLA - 40A @ 480V.

#8 AWG

80 A BREAKER

V.D. ASSUME 5% LONGEST DISTANCE = 700' + 450' = 1150'

V.D. = 0.05 x 480

$$CM = \left[\frac{40 \times \sqrt{3} \times 1150 \times 10.8}{.05 \times 480}\right] = 35,853 \text{ CM}$$

→ USE #4 41,616 CM 1" CONDUIT

$$CM = \left[\frac{\overset{\text{AMP}}{40} \times \sqrt{3} \times \overset{\text{DISTANCE}}{700} \times 10.8}{.05 \times 480 \text{ (V.D.)}}\right] = 21,823 \text{ CM}$$

USE #6 26,244 CM 1" CONDUIT

(B) 15 H.P. MOTOR

FLA - 21A @ 480V

#10 AWG 40 A BREAKER

V.D. ASSUME 5% LONGEST DIST. = 1150'

$$CM = \left[\frac{21 \times \sqrt{3} \times 1150 \times 10.8}{0.05 \times 480}\right] = 18,823 \text{ CM}$$

→ USE #6 26,244 CM 1" CONDUIT

(C) 5 H.P. MOTOR

FLA - 7.6 A @ 480V

#12 AWG 15 A BREAKER

$$V.D. = \left[\frac{7.6 \times \sqrt{3} \times 1150 \times 10.8}{.05 \times 480}\right] = 6,812 \text{ CM}$$

→ USE #10 10,404 CM 3/4" CONDUIT

AR300998

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
PUMP WELL DESIGN
FS DESIGN

Sheet No. 17 of 17

Drawing No.

Computed by LJS Checked By RPA Date 6/13/88

REVISED 9/9/88

(e) QUANTITIES

#	ITEM DESCRIPTION	QUANTITY	UNIT	MEANS REF.*
1	PAD MOUNT TRANSFORMER 480/277V	1	EA	
2	ELECTRIC METER	1	EA	
3	4-350MCM WIRE	100	LF	
4	SWITCHGEAR 480V/600A	1	EA	
** 5	MCC No.2/SIZE 6, 72" HIGH	1	EA	ELEC. 163-110-0600
6	3" CONDUIT PVC	100	LF	
7	MCC No.2/PILOT LIGHTS	18	EA	ELEC 163-110-1700
8	MCC No.2/PUSH BUTTONS	18	EA	ELEC 163-110-1800
9	3-No.4 WIRE (30 HP MOTORS)	7,620	LF	
10	3-No.6 WIRE (15 HP MOTORS)	6,720	LF	
11	3-No.10 WIRE (5HP MOTORS)	6,300	LF	
12	1" PVC CONDUIT	14,340	LF	
13	3/4" PVC CONDUIT	6,300	LF	
14	HAND HOLES	12	EA	ELEC 167-110-1100
15	UTILITY TRENCHING & BACKFILL	1,600	LF	
16	PUMP CONTROLLERS	18	EA	
17	CONCRETE-CONDUIT BEDDING	250	CYL	

* ELEC - ELECTRICAL
MECH - MECHANICAL
SITE - SITE WORK
} MEANS COST DATA 1988

** THIS UNIT IS OVERSIZED FOR H.P. LOAD REQUIRE

AR300599

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit
Extraction System O&M

Sheet No. 1 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION #1

1. Operating Labor

Operator - 20 hrs/week for 30 years
$25/hour

52 wk/yr x 20 hrs/wk x $25.00/hr = $26000

Geologist

80 hrs/year x $70/hr = $5600/year
40 hrs/year x $55/hr = $2200/year

2. Maintenance Materials

Pump Replacement

Replace 2 pump per year
$ /pump Avg

2 pumps/yr x $ /pump = $ /year

Pump Maintence

Assume $100 parts etc/pump/year
15 x 200 = $3000/year

Piping and Valves etc Use 6" dia Pipe as "Average"

$14.19/LF of Pipe
$4.17/LF for Trench
$1.17/LF for Bed
$25.00/LF for Fittings
$44.53/LF Total

Assume (100LF/yr x 44.53/LF) + $1000 mob-demob
= $5453/year

AR301000

Baker Engineers

S.O. No. 15438-17-SR

Subject: Berks Sand Pit
Extraction System O&M

Sheet No. 2 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/9/88

REVISION # 1

3. Analytics

One Sample of Extracted water Every 2 weeks
$150/sample

26 samples/year x $150/sample = $3,900.

Semi-annual sample from each well
(15 samples) x (2 samples/yr) x $150/sample = $4500

Total Analytical Costs
3900 + 4500 = $8400.

AR301001

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
EXTRACTION WELL SYSTEM
FS- O&M COSTS

Sheet No. 1 of 2

Drawing No.

Computed by LJS Checked By RPA Date 6/20/88

REVISION DATE: ~~6/29/88~~ 9/9/88
delete #1,2

① OPERATING LABOR

1 OPERATOR
16 HR / WEEK 500 HOURS
30 - YEARS
$ ~~50~~ 25 / HOUR

(16 x 4.2 x 12 x $50) = $40,320 / YEAR

② MAINTENANCE MATERIALS

(a) PUMP REPLACEMENT

REPLACE 3/YEAR

1-300' WELL	$1,300	
1-150' WELL	580	(3x250) = 750
1-80' WELL	+ 380	
	$2,260 / YEAR (MAT'LS)	

(b) PUMP MAINTENANCE

ASSUME $200 PARTS, ETC / PUMP / YEAR
18 x 200 = $3,600 / YEAR

(c) PIPING & VALVES, ETC.

USE 6"ϕ PIPE AS "AVERAGE"

$14.19	LF	PIPE
4.17	LF	TRENCH
1.17	LF	BEDDING
25.00	LF	FITTINGS ALLOWANCE
$ 44.53	LF	TOTAL

ASSUME: 100 LF / YEAR + $2,000 MOB/DEMOB / YEAR

③ MAINTENANCE LABOR

(a) PUMP INSTALLATION
$250 / PUMP x 3 / YEAR = $750 / YEAR

(b) PUMP MAINTENANCE
8 HR / PUMP x 18 PUMPS x $50 / HR = $7,200 / YEAR

AB301002

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
EXTRACTION WELL SYSTEM
FS - O&M COSTS

Sheet No. 2 of 2

Drawing No.

Computed by LJS Checked By RPA Date 6/20/88

REVISED 6/29/88

④ ELECTRICAL COSTS

$0.07 / KW-HR

300' WELLS 78.3 KW x 24 x 365 = 686,280

150' WELLS 39.8 KW x 24 x 365 = 348,903

80' WELLS 7.2 KW x 24 x 365 = 63,072

1,098,255 KW-HR

$76,878/YEAR

⑤ ADMINISTRATION
DISPOSAL
I, T, L
AUX. MATILS
} NOT APPLICABLE

⑥ Decommissioning

X (F/U, 30-YR, 10%) = $2,645,053
164.491

X = $16,080/YEAR
SINKING FUND

AR301003

BERKS SAND PIT RI/FS EXTRACTION WELL SYSTEM CAPITAL COSTS
SO#15438-17-SRI BERKENS2.WK1

ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	REFERENCE SOURCE	ITEM TOTAL ($)
1) EQUIPMENT MOBILIZATION	1	EA	$10,000.00	ASSUMED	10,000
2 DRILL RIGS					
1 STEAM CLEANER					
1 WATER TRUCK					
1 FLATBED TRUCK					
1 105 HP DOZER (<25 MILE MOB.)					
2) SITE PREPARATION					
CLEAR AND GRUB (LIGHT TREES)	5	ACRES	$1,660.00	MEANS/SITE/021-104-0010	8,300
3) DRILLING, 18" DIA. HOLE	2,650	VLF	$26.88	MEANS/SITE/026-704-0200	71,232
4) BENTONITE PELLETS	26	PAIL	60	ASSUMED	1,560
5) DRILLING W/ CORE	1,375	VLF	$29.30	MEANS/SITE/020-123-1050	40,288
6) PIPE, 10" DIA. STEEL CASING	450	LF	$83.58	MEANS/SITE/151-701-1440	37,611
7) PIPE, 6" DIA. PVC, SOLID CASING	1,450	LF	$14.19	MEANS/SITE/151-551-1960	20,576
8) PIPE, 6" DIA. PVC SLOTTED SCREEN	1,350	LF	$14.50	VENDER QUOTE	19,575
9) LOCKING WELLHEAD STEEL CAPS	15	EA	$100.00	ASSUMED	1,500
10)CONCRETE, FOR WELL CLUSTER PADS	5	CYD	$93.05	MEANS/SITE/033-130-4650	465
11)PORTLAND CEMENT, FOR GROUTING	905	BAG	$6.00	MEANS/SITE/033-114-0240	5,430
12)BENTONITE, FOR GROUTING	30	BAG	$9.50	MEANS/SITE/071-501-0300	285
13)SAND, PACKING AT WELL SCREENS	20	CYD	$15.40	MEANS/SITE/041-032-0300	308
14)DRUMS, 55-GAL.,D.O.T.,FOR DISPOSAL	60	EA	$25.00	ASSUMED	1,500
15)WOOD CORE BOXES, 12 LF/BOX,FOB-SITE	120	EA	$50.00	ASSUMED	6,000
16)PROFESSIONALS - ON SITE					
(A) GEOLOGIST (COORDINATOR)	1,010	HOUR	$70.00	ESTIMATED	70,700
(B) HEALTH AND SAFETY	120	HOUR	$70.00	ESTIMATED	8,400
(C) GEOLOGIST	700	HOUR	$60.00	ESTIMATED	42,000

AR301004

17)PUMPS, FOR 300-FT. WELLS					
30 H.P.,315-FT. HEAD, SUBMERS.	5	EA	$1,300.00	VENDER QUOTE	6,500
18)PUMPS, FOR 200-FT. WELLS					
15 H.P.,160-FT.HEAD, SUBMERS.	5	EA	$580.00	VENDER QUOTE	2,900
19)PUMPS, FOR 80-FT. WELLS					
5 H.P., 90-FT.HEAD, SUBMERS.	5	EA	$380.00	VENDER QUOTE	1,900
20)PUMP INSTALLATION AND FOR-SITE	15	EA	$250.00	VENDER QUOTE	3,750
21)PIPE, MANIFOLD 3"DIA. PVC SOLID	200	LF	$8.69	MEANS/CONS/151-551-1930	1,738
22)PIPE, MANIFOLD 4"DIA. PVC SOLID	200	LF	$10.14	MEANS/CONS/151-551-1940	2,028
23)PIPE, MANIFOLD 6"DIA. PVC SOLID	400	LF	$14.19	MEANS/CONS/151-551-1960	5,676
24)PIPE, MANIFOLD 8"DIA. PVC SOLID	400	LF	$39.64	MEANS/CONS/151-551-0320	15,856
25)TRENCHING, MANIFOLD PIPE					
SLOPE 0:1, 2-FT.WIDE, 6-FT.DEEP	950	LF	$4.17	MEANS/SITE/12.3-110-1340	3,962
26)BEDDING, MANIFOLD PIPE					
SLOPE 0:1, 2-FT.WIDE,8"DIA.PIPE	950	LF	$1.17	MEANS/SITE/12.3-310-1460	1,112
27)PLUMBING FIXTURES AND RELATED					
(A) PITLESS ADAPTERS,2"DIA.BRASS	15	EA	$120.00	VENDER QUOTE	1,800
(B) PUMP L.W.CUT-OFF AND ALARM	15	EA	$199.78	MEANS/MECH/156-290-5000	2,997
(C) PUMP H.W. CUT-OFF AND ALARM	15	EA	$199.78	MEANS/MECH/156-290-5000	2,997
(D) FOOT VALVE, PVC, 2"DIA.	15	EA	$102.95	MEANS/MECH/151-975-4970	1,544
(E) GLOBE VALVE, STEEL, 2"DIA.	15	EA	$829.00	MEANS/MECH/151-980-3700	12,435
(F) COUPLINGS, PVC,2"DIA.-SCH.40	300	EA	$12.88	MEANS/MECH/151-558-1120	3,864
(G) 90-ELBOW,2"DIA.,PVC,SCH.40	72	EA	$16.00	MEANS/MECH/151-558-0590	1,152
(H) COUPLINGS,PVC,3"DIA.,SCH.40	20	EA	$17.76	MEANS/MECH/151-558-1140	355
(I) COUPLINGS,PVC,4"DIA.,SCH.40	20	EA	$23.10	MEANS/MECH/151-558-1160	462
(J) COUPLINGS,PVC,6"DIA.,SCH.40	40	EA	$38.85	MEANS/MECH/151-558-1180	1,554
(K) COUPLINGS,PVC,8"DIA.,SCH.40	40	EA	$56.50	MEANS/MECH/151-558-1190	2,260
(L) TEE-3"DIA. PVC SCH.40	3	EA	$40.00	MEANS/MECH/151-558-0870	120
(M) TEE-4"DIA. PVC SCH.40	3	EA	$53.33	MEANS/MECH/151-558-0880	160
(N) TEE-6"DIA. PVC SCH.40	6	EA	$103.00	MEANS/MECH/151-558-0890	618
(O) TEE-8"DIA. PVC SCH.40	6	EA	$168.00	MEANS/MECH/151-558-0900	1,008
(P) CHECK VALVES, 2"DIA.BRONZE	15	EA	$96.39	MEANS/MECH/151-955-2500	1,446
(Q) EXTENDER PIPE/CAP 6"DIA. PVC	15	EA	$50.00	ASSUMED	750
28)DEMOBILIZATION - AT 100% OF MOB.	1	EA	$10,000.00	ASSUMED	10,000
29)DRUM DISPOSAL AND HANDLING					
(A) TEMPORARY DRUM STORAGE AREA	1	EA	$2,000.00	ASSUMED	2,000
(B) HANDLING,FILLING, LOADING	60	HRS	$200.00	ESTIMATED	12,000
(C) TRANSPORT TO INCINERATOR	150	LOAD-MILE	$4.00	ASSUMED	600
(D) PASS/FAIL ANALYTICAL TESTS	12	TESTS	$850.00	ASSUMED	10,200
					0
(F) INCINERATION OF DRUMS	60	DRUMS	$650.00	ASSUMED	39,000

30)ELECTRICAL SYSTEMS AND EQUIPMENT					
(A) 4-350 MCM WIRE	100	LF	$334.00	MEANS/ELEC/161-165-0450	33,400
(B) SWITCHGEAR, 600 AMP	1	EA	$8,775.00	MEANS/ELEC/89.1-410-0240	8,775
(C) M.C.C. - SIZE 6, 72"HIGH	1	EA	$7,092.00	MEANS/ELEC/163-110-0600	7,092
(D) PILOT LIGHTS, FOR M.C.C.	18	EA	$81.80	MEANS/ELEC/163-110-1700	1,472
(E) PUSH BUTTONS, FOR M.C.C.	18	EA	$58.80	MEANS/ELEC/163-110-1800	1,058
(F) 3-NO.4 WIRE	77	CLF	$68.83	MEANS/ELEC/161-165-0180	5,300
(G) 3-NO.6 WIRE	68	CLF	$49.99	MEANS/ELEC/161-165-0160	3,399
(H) 3-NO.10 WIRE	63	CLF	$27.28	MEANS/ELEC/161-165-0040	1,719
(I) CONDUIT - 3" PVC	100	LF	$6.03	MEANS/ELEC/160-205-9170	603
(J) CONDUIT - 1" PVC	14,340	LF	$2.35	MEANS/ELEC/160-205-9120	33,699
(K) CONDUIT - 3/4" PVC	6,300	LF	$1.97	MEANS/ELEC/160-205-9110	12,411
(L) HAND HOLES-FOR WIRE PULLING	12	EA	$469.00	MEANS/ELEC/167-110-0600	5,628
(M) UTILITY TRENCHING/BACKFILL	1,600	LF	$2.24	MEANS/SITE/12.3-110-1320	3,584
(N) CONCRETE - CONDUIT BEDDING	250	CYD	$45.70	MEANS/SITE/033-122-0010	11,425
(O) PUMP CONTROLLERS	18	EA	$500.00	ASSUMED	9,000
31)PACKER TESTS- 8 HR/WELL, LEVEL C (INCLUDES:LABOR,EQUIP.,MATL)	40	HOUR	$200.00	VENDER QUOTE	8,000
32)WELL DEVELOPMENT- 3 HR/WELL,LEVEL C (INCLUDES:LABOR,EQUIP.,MATL)	45	HOUR	$175.00	VENDER QUOTE	7,875
33)PUMP TESTS- 1/CLUSTER INCLUDES:LABOR,EQUIP.,MATL)	348	HOUR	$200.00	VENDER QUOTE	69,600
34)ANALYTICS - PACKER TEST SAMPLES	50	TESTS	$150.00	ASSUMED	7,500
35)WELL CONSTRUCTION (INCLUDES:LABOR/EQUIP. ONLY) 1-CREW 2-DAYS/CLUSTER	10	CREW-DAYS	$450.00	ASSUMED	4,500
36) (INTENTIONALLY BLANK)					
37)BOREHOLE GEOPHYSICS	1	EA	$5,000.00	ASSUMED	5,000
38)LONG-TERM PUMP TESTS 1-TESTS AT 500-HR. EACH	500	HR	$50.00	ASSUMED	25,000
39)ANALYTICS: LONG-TERM PUMP TESTS	10	TESTS	$150.00	ASSUMED	1,500
A) SUB-TOTAL (A)					768,015
B) SUBCONTRACTORS WORK ESTIMATED AT 20% OF SUB-TOTAL					153,603
C) FEE AT 10% OF SUBCON. WORK					15,360

D) SUB-TOTAL E + F + FEE					783,373
E) CITY INDEX COST ADJUSTMENT AT 0.949 AVERAGE FOR READING, PENNSYLVANIA APPLIED TO SUB-TOTAL (D)				BASED ON MEANS/SITE/CITY COST INDEX,APPENDIX(1988)	743,421
F) TOTAL ADJUSTED DIRECT COSTS (TADC)					743,421
G) INDIRECT CONTRACTOR COSTS AT 35% OF TADC				BASED ON MEANS/SITE/APPX.	260,197
H) CONTRACTOR PROFIT AT 10% OF TADC + INDIRECT					100,362
I) TOTAL FIELD COST (TFC)					1,103,980
J) HEALTH AND SAFETY COST ALLOWANCE AT 5% OF TFC					55,199
K) CONTINGENCY COST AT 20% OF TFC					220,796
L) ENGINEERING COST AT 10% OF TFC					110,398
M) TOTAL CAPITAL COST TFC + H/S + CONT + ENG					$1,490,373

SYSTEM: EXTRACTION WELL SYSTEM OPEWS2.WK1

BERKS SAND PIT ANNUAL OPERATION COSTS

NO.	ITEM DESCRIPTION	ANNUAL QUANTITY	UNITS	UNIT COST	ANNUAL COST
1)	OPERATING LABOR				
	(A) OPERATOR	1,040	HR	$25.00	$26,000
	(B) GEOLOGIST (FIELD)	80	HR	$70.00	$5,600
	(C) GEOLOGIST	40	HR	$70.00	$2,800
2)	MAINTENANCE MATERIALS				
	(A) PUMP REPLACEMENT AT 3-YR. LIFETIME	1	EA	$2,260.00	$2,260
	(B) PUMP MAINTENANCE	15	EA	$200.00	$3,000
	(C) PIPING,VALVES,ETC.	100	LF	$44.53	$4,453
	(D) MOB/DEMOB	1	EA	$1,000.00	$1,000
3)	MAINTENANCE LABOR				
	(A) PUMP REPLACEMENT	3	EA	$250.00	$750
	(B) PUMP MAINTENANCE	144	HR	$50.00	$7,200
	(C)				
4)	ANALYTICS				
	(A) BI-WEEKLY	26	SAMPLES	$150.00	$3,900
	(B) SEMI-ANNUAL	30	SAMPLES	$150.00	$4,500
	(C)				
5)	PURCHASED SERVICES				
	(A) ELECTRICAL POWER	1,098,255	KW-HR	$0.07	$76,878

E.				
6) DISPOSAL (A)				
7) ADMINISTRATION (A)				
(B)				
8) INSURANCE,TAXES,LICENSES (A) (B) (C)				
9) OTHER COSTS				
(E.				
A) SUBTOTAL (A)				$138,341
B, CONTINGENCY COST AT 20% OF SUBTOTAL(A)				$27,668
C) SALVAGE AND DECOMMISSION: AT 100% CAPITAL COSTS INCURRED AT 30-TH YEAR, INTEREST = 10% ANNUAL SINKING PAYMENT	$1,646,480			$10,010
D) ANNUALIZED CAPITAL COST				$176,019

ORIGINAL (Red)

E) PRESENT WORTH
AT 10% INTEREST
AT 30 YEARS

$1,659,312

ORIGIN. (Red)

PUBLIC WATER SUPPLY SYSTEM

Baker Engineers

S.O. No. 15438-17-SR.I

Subject: BERKS SAND PIT FS
A.W.S. - PUBLIC WATER SUPPLY
ERRATA SHEETS

Sheet No. 1 of 2

Drawing No.

Computed by LJS Checked By RAK Date 10/17/88

ORIGINAL (Red)

THE PURPOSE OF THIS ERRATA SHEET IS TO MODIFY THE DESIGN AND COST ESTIMATE OF THE PUBLIC WATER SUPPLY SYSTEM TO REMOVE COSTS ASSOCIATED WITH PROVIDING FIRE WATER FLOW AS PER USEPA INSTRUCTIONS.

CAPITAL COSTS

1) PUMPS (AT WELLS)
   SUBMERSIBLE 6" DIAM.
   $2,000 EACH NEED 2 PUMPS

2) DRILLING, NX CORE
   200 VLF

3) BOOSTER PUMP
   NEED 1 PUMP

4) PROFESSIONALS ON-SITE
   GEOLOGIST 120 HOURS @ $70/HR
   CONSTRUCTION INSPECTOR 500 HOURS @ $60/HR.

5) PUMP INSTALLATION & FOB SITE
   2 PUMPS @ $250 EACH

6) WATER STORAGE TANK
   2 DAYS @ 24,500 GPD AVERAGE = 50,000 GALLONS
   APPROXIMATE COST $57,000

7) FOUNDATION
   20 FT DIAMETER 25 CYD CONCRETE

AR301012

Baker Engineers

S.O. No. 15438-17-SRI

ORIGINAL (Red)

Subject: BERKS SAND PIT FS
AWS- PUBLIC WATER SUPPLY
ERRATA SHEETS

Sheet No. 2 of 2

Drawing No.

Computed by LJS Checked By RAK Date 10/17/88

8) ELECTRICAL Equipment
DELETE 50 KW DIESEL BACKUP GENERATOR

9) FIRE HYDRANTS
DELETE

10) MAIN LINE VALVES
6" DIAM. IRON NEED 6 VALVES

OPERATING COSTS

1) OPERATOR
$25/HR. RATE

2) MAINTENANCE LABOR
0.5 DAY/YEAR FOR PAINTING, PUMP REPLACEMENT, AND WATER MAIN REPAIR

TREATMENT REPLACEMENT @ $25/HOUR

3) ENGINEERING COSTS
$70/HOUR RATE

Baker Engineers

S.O. No. 15438-17-SPT ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 1 of 37

Drawing No.

Computed by LJS Checked By RS Date 5/23/88

PURPOSE: CONCEPTUAL DESIGN AND COST ESTIMATE TO PROVIDE A PUBLIC WATER SUPPLY SYSTEM TO THE 27 LOCAL DWELLINGS NEAR THE SITE.

(1) POPULATION

ASSUME AN AVERAGE OF 4 PERSONS PER DWELLING

(27 x 4) = 108

ASSUME A 25% POPULATION INCREASE OVER DESIGN LIFE

(108 x 1.25) = 135 DESIGN POPULATION

(2) POTABLE WATER DEMAND

REF #1: METCALF & EDDY (1979)
WASTEWATER ENGINEERING, TABLE 2-1

FOR PENNSYLVANIA: 181 gpcd

(3) FIRE FLOW DEMAND

REF #2: "GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOW", INSURANCE SERVICES OFFICE, DECEMBER 1974; NOTE #10.

SINCE EXPOSURE DISTANCE ARE GENERALLY 100' OR MORE, USE 500 gpm FIRE FLOW.

ASSUME: 2-HOUR DURATION FOR FIRE FLOW
1 FIRE PER DAY

DAILY FIRE FLOW DEMAND (FFD) = (500 x (60 x 2)) = 60,000 gpd

AR301014

Baker Engineers

S.O. No. 15438-17-SRI ORIGI. (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 2 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/24/88

(4) GROUNDWATER YIELDS IN SITE VICINITY

REF # 3: PA-DER (1978). WATER RESOURCES REPORT No. 44 "GEOLOGY, AND G.W. RESOURCES OF NORTHERN BERKS COUNTY, PA.", TABLE 14

Want wells in granitic gneiss formation (metamorphic)

WELL #	DEPTH (FT)	DIAMETER (INCH)	YIELD (gpm)	HARDNESS (gpg)	FORMATION
1054	108	6	---	2	gn/meta
621	123	6	22	---	gn/meta
620	300	8	10	---	gn/meta
618	152	6	44	---	gn/meta
1011	170	8	45	2	gn/meta
602	300	6	60	4	Cha/meta
515	262	---	100	---	gn/meta
1010	150	8	90	2	Cha/meta
624	312	6	39	---	Cha/meta

gn/meta

DEPTH: 100 - 300' AVE: 185' Discard high/Low AVE: 175'

YIELD: 10 - 100 gpm AVE: ~~44~~ gpm AVE: 37 gpm

HARNESS: 2 - 4 gpg

USE: 200 FT. DEPTH 35 gpm YIELD 6"ϕ CASING
LOW HARDNESS

AR301015

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 3 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/24/88

(5) SYSTEM DESIGN NUMBERS

(a) AVERAGE DAILY FLOW (ADF) = (135 x 181 gpcd) ≡ 24,500 gpd (17 gpm)

(b) MAXIMUM DAILY FLOW (MDF) = (24,500 x 1.80) ≡ 44,100 gpd (30.6 gpm)

(c) PEAK HOURLY FLOW (PHF) = (24,500 x 3.50) ≡ 85,800 gpd (59.6 gpm)

DESIGN FOR WORST OF FOLLOWING TWO CASES:

CASE 1: MDF + FIRE FLOW DEMAND

(44,100 gpd + 60,000 gpd) = 104,100 gpd

CASE 2: PEAK HOURLY FLOW = 85,800 gpd

∴ DESIGN FOR MAXIMUM DAILY FLOW PLUS FIRE FLOW DEMAND

DESIGN FLOW = 104,100 gpd

72.3 gpm AVERAGE

0.161 CFS

SYSTEM PRESSURE: 20 psig MINIMUM

PER DWELLING:

$$\frac{17\text{ gpm} \times 4\text{ PEAK}}{27\text{ DWELLINGS}} \equiv 2.5\text{ GPM / DWELLING PEAK HOURLY FLOW}$$

AR301016

Baker Engineers

S.O. No. 15438-17-SRI

ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 4 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/24/88

(6) FINISHED WATER STORAGE REQUIREMENTS

REF #4: PA-DER. "PUBLIC WATER SUPPLY MANUAL"
PART II - COMMUNITY SYSTEM DESIGN
STANDARDS, SEPT. 1986, § 2.1.1 etc.

STORE TO MEET PEAK HOURLY FIRE FLOW DEMAND
BUT ALSO STORE A MINIMUM OF ONE DAYS'
MAXIMUM DAILY DEMAND.

MDF = 44,100 GALLONS
FFD = 60,000 GALLONS

104,100 GALLONS EFFECTIVE STORAGE

USE 100,000 GALLON STORAGE TANK FOR
DISTRIBUTION OF FINISHED WATER

(7) NUMBER OF PUMPING WELLS REQUIRED

YIELD PER WELL: 35 gpm → 50,400 gpd

SYSTEM DEMAND: 72.3 gpm → 104,100 gpd

$$\frac{104,100}{50,400} \equiv 2 \text{ PUMPING WELLS}$$

ONE WELL IS ADEQUATE TO SUPPLY MAXIMUM DAILY FLOW,
SECOND WELL FOR FIRE FLOW DEMAND AND BACKUP.

Baker Engineers

S.O. No. 15438-17-SRJ

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 5 of 37

Drawing No.

Computed by LJS Checked By JRC Date 5/24/88

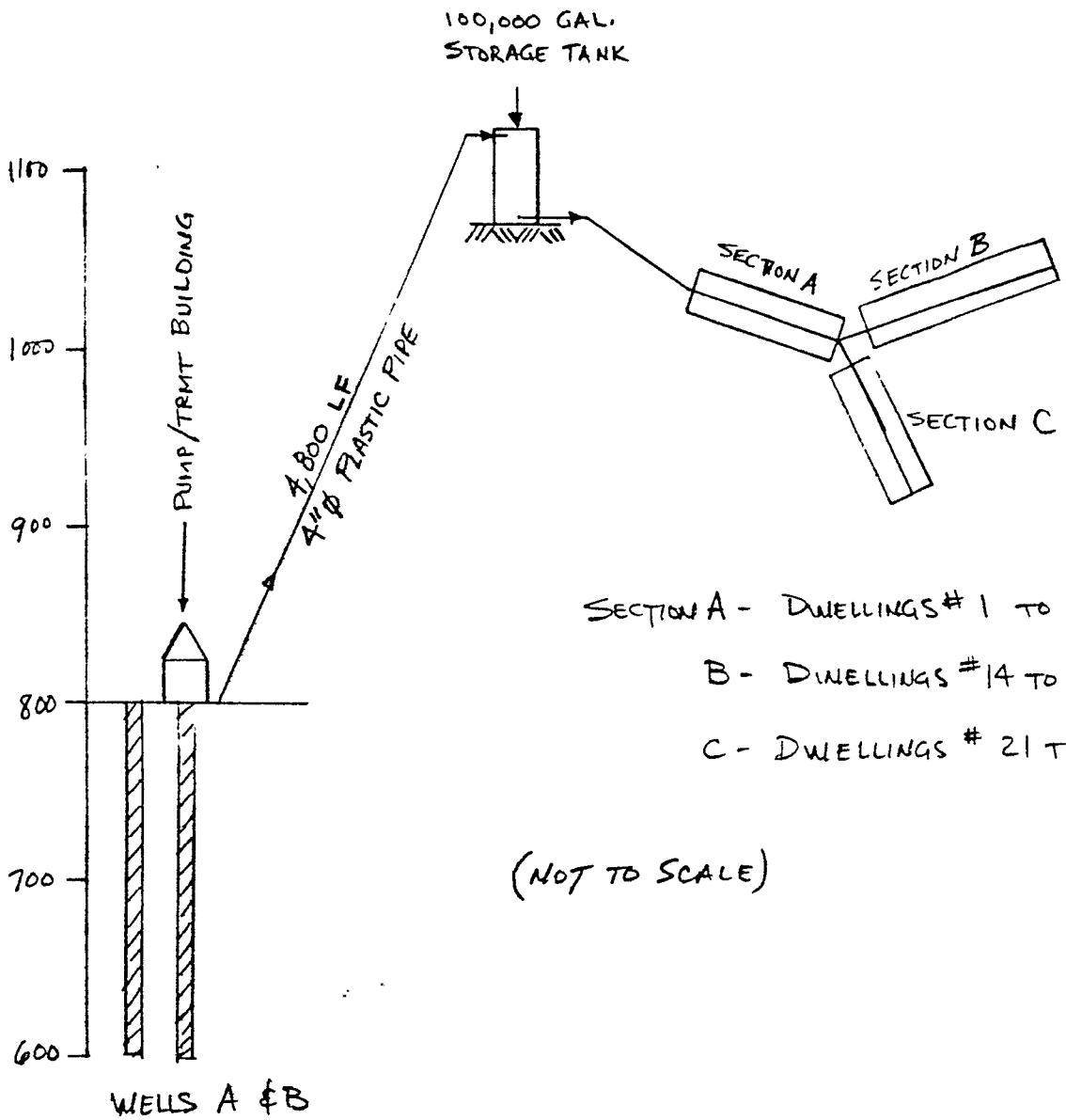
ORIGINAL (Red)

(8 GENERAL SYSTEM LAYOUT

(a) LOCATE PUMPING WELLS IN VALLEY NEAR INTERSECTION OF BENFIELD ROAD AND THE HIGHWAY BETWEEN HUFFS CHURCH AND HENNINGSVILLE.

(b) LOCATE TREATMENT FACILITIES NEAR PUMPING WELLS

(c) LOCATE FINISHED WATER STORAGE TANK NEAR WELL LST-1 OFF BENFIELD ROAD AT ABOUT ELEVATION 1070 FT.



SECTION A - DWELLINGS # 1 TO 13

B - DWELLINGS # 14 TO 20

C - DWELLINGS # 21 TO 27

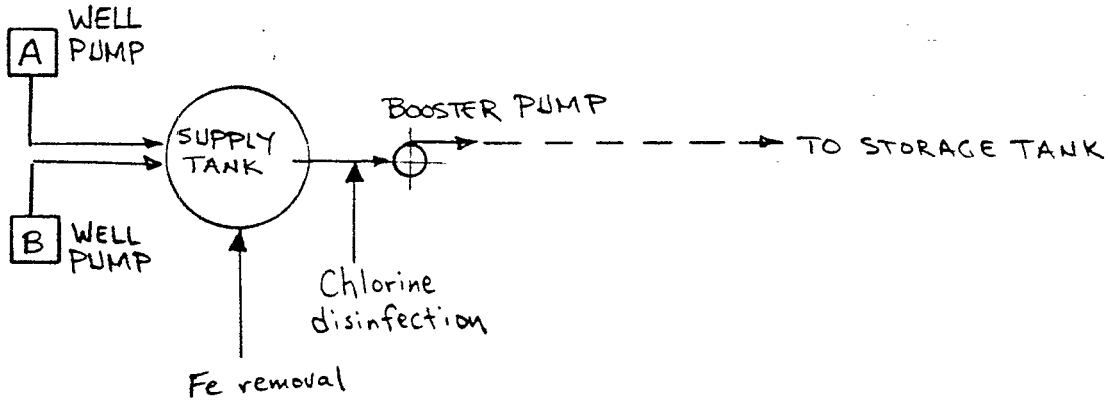
(NOT TO SCALE)

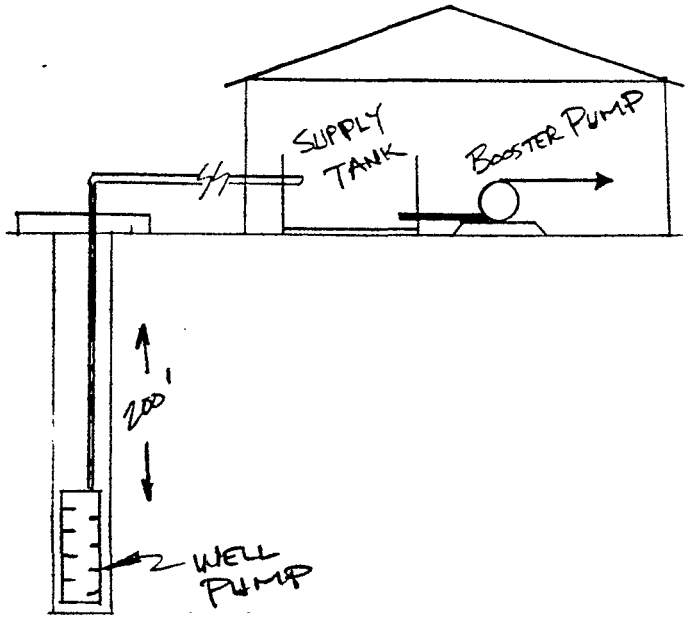
AR301018

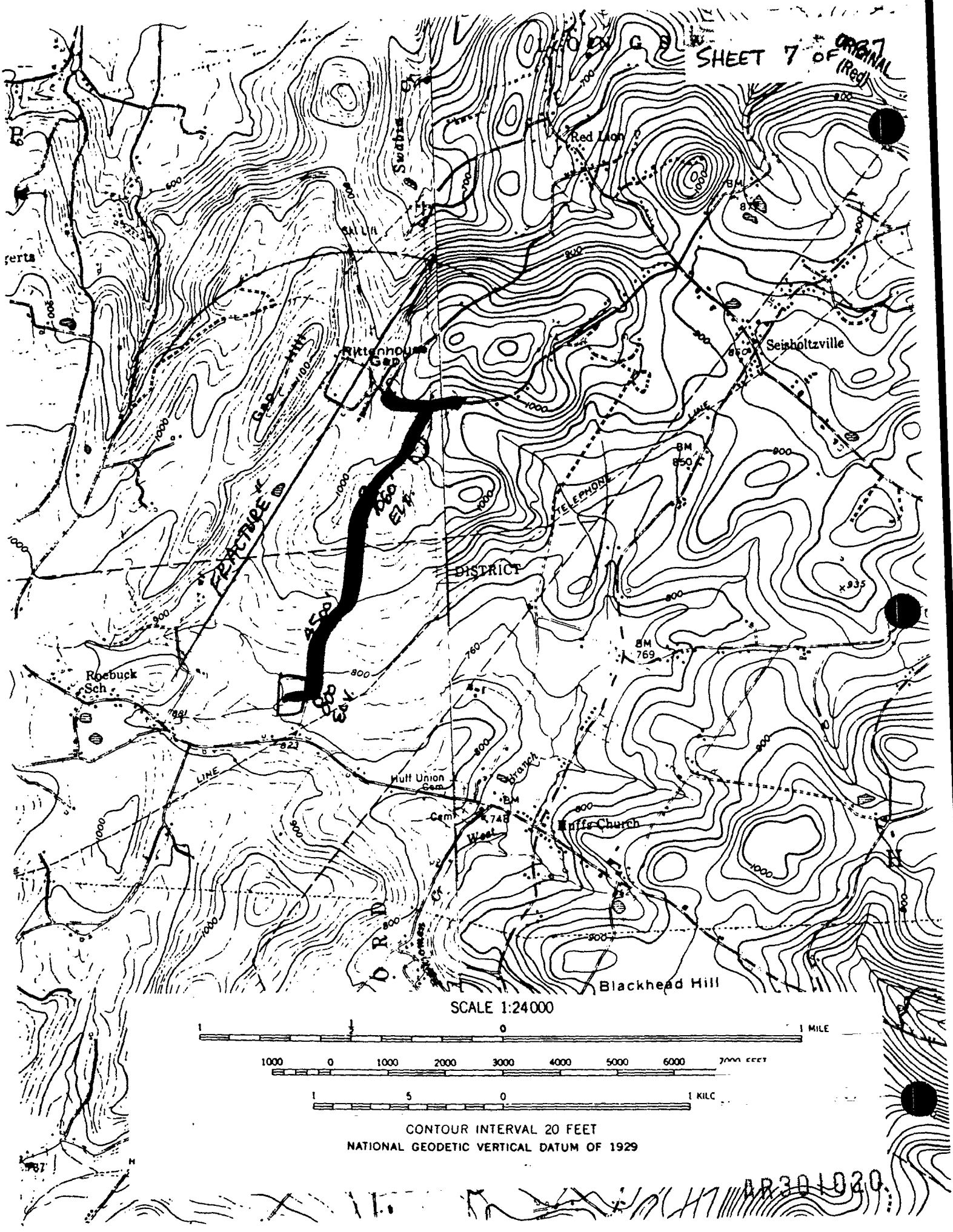
LOCATING THE PUMPING WELLS IN THE VALLEY IS PREFERED:

- BETTER GROUNDWATER RECHARGE AREA THAN ON TOP OF HILL NEAR LST-2, WHICH MINIMIZES POTENTIAL FOR DRY WELLS INITIALLY AND DURING SERVICE;
- MORE LIKELY TO FIND FRACTURES, WHICH WOULD GIVE IMPROVED YIELDS.

(9) GENERAL PUMP STATION LAYOUT






SHEET 7 OF 7
ORIGINAL (Red)
Red Lion
Sudbrig
Rittenhouse Gap
Seisholtzville
FRACTURE
DISTRICT
TELEPHONE
LINE
Roebuck Sch
Hull Union Cem
Huffs Church
Blackhead Hill
SCALE 1:24000
1 MILE
7000 FEET
1 KILO
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

AR301020

Baker Engineers

S.O. No. 15438-17-SRT ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 8 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/24/88

(10) WELL PUMPS - SUBMERSIBLES

(a) STATIC HEAD = 200 FT.

(b) ASSUME HAZEN-WM^S COEFFICIENT C = 80

$$h_f = 0.002083(L)\left(\frac{100}{C}\right)^{1.85} \times \frac{gpm^{1.85}}{d^{4.8655}}$$

L = SAY 200' + 300' = 500'

Q = gpm = 35 gpm (0.078 CFS)

d = SAY 2"ϕ PVC (INCHES)

REF. #5: CAMERON HYDRAULIC DATA (1984)
16th ED., INGERSOLL-RAND, p. 3-7

$$h_f = \left(1.57377 \times \frac{718.664}{29.1515}\right) = 38.8 \text{ FEET}$$

(c) MINOR LOSSES

$$\text{AREA} = \pi/4\, d^2 = 0.0218 \text{ FT}^2$$

$$\text{VELOCITY} = \frac{Q}{A} = \frac{0.078 \text{ CFS}}{0.0218 \text{ FT}^2} = 3.58 \text{ FPS}$$

MINOR LOSS COEFFICIENTS @ 2"ϕ PIPE (REF #5 p. 3-111 on

90° ELBOWS	K = 0.63 × SAY	4	= 2.52
GATE VALVE	K = 0.15 × SAY	1	= 0.15
ENTRANCE	K = 0.78 ×	1	= 0.78
EXIT	K = 1.0 ×	1	= 1.00
			$\Sigma K = 4.45$

$$h_L = \Sigma K \frac{(0.00259)\, gpm^2}{d^4} = 4.45 \times \frac{3.173}{16}$$

h_L = 0.88 FEET (MINOR)

AR301021

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 9 of 37

Drawing No.

Computed by LJS Checked By TSS Date 5/24/88

(d) TOTAL DYNAMIC HEAD (TDH)

200' STATIC
39' FRICTION
1' MINOR

Σ = 240' TDH (104 PSI)

(e) HORSEPOWER REQUIREMENTS

MASS FLOW RATE = $35 GPM \times \left(\frac{500}{60}\right) = 291.6$ lb/MIN

HYDRAULIC HP = $\left(\frac{291.6 \times 240' \text{ HEAD}}{33{,}000}\right) = 2.12$ HYD HP

ASSUME 30% PUMP EFFICIENCY

BRAKE HP = $\left(\frac{2.12}{0.30}\right) = 7$ BHP MINIMUM

(f) ELECTRIC MOTOR HP REQUIREMENTS

ASSUME 85% MOTOR EFFICIENCY

ELECTRICAL HP TO MOTOR = $\left(\frac{7 \text{ BHP}}{0.85}\right) = 8.2$ EHP/PUMP

KW INPUT TO MOTOR = $\left(\frac{7 \text{BHP} \times 0.7457}{0.85}\right) = 6.1$ KW/PUMP

NEED 2 SUCH PUMPS

AR301022

Baker Engineers

S.O. No. 15438-17-SR ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 10 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

(11) HEAD LOSSES – BOOSTER PUMP TO STORAGE TANK

DRISCOPIPE MANUAL (1981) PHILLIPS DRISCOPIPE, INC.

$$\Delta P_{100} = 452\, Q^{1.85} / C^{1.85} D^{4.86} \quad (\text{psi loss}/100')$$

PICK Q = 100 gpm POLYETHYLENE PIPE HIGH DENSITY

C = 155

D = INSIDE DIAMETER (INCHES)

FROM CHART #2: @ 100 gpm 4"ϕ $\Delta P_{100} = 0.20$ V ~ 2.4 FPS

6"ϕ $\Delta P_{100} = 0.03$ V ~ 1.1 FPS

$$\Delta H_{100} = \frac{\Delta P_{100} \times 144}{62.4}$$

$\Delta H_{100}^{4''\phi} = 0.46$ FT/100 FT

$\Delta H_{100}^{6''\phi} = 0.07$ FT/100 FT.

L = 4,800 FT. OF PIPE NEEDED (PLASTIC)

FRICTION

@ 4"ϕ $H_L = (48 \times 0.46) = 22'$ HEAD LOSS TO PIPE FRICTION

@ 6"ϕ $H_L = (48 \times 0.07) = 3.5'$ HEAD LOSS TO PIPE FRICTION (SAY 4')

MINOR

CHART #5 AND #35

ITEM	APPROX. NO.	D – INNER DIAMETER EQUIV. LENGTH (FT)
90° FAB, ELL	8	30 D
45° FAB, ELL	8	18 D
GATE VALVE (OPEN)	2	15 D
ENTRANCE	1	6D (4"ϕ) 9D (6"ϕ)
EXIT	1	12D (4"ϕ) 18D (6"ϕ)

AR304023

Baker Engineers

S.O. No. 15438-17-SRI ORIGIN. (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 11 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

SPEC: DRISCOPIPE 1000 HDPE PE3408 PIPE

4"Ø NOMINAL SIZE 4.224" ID

6"Ø NOMINAL SIZE 6.217 ID

4"Ø

$(8 \times 30) + (8 \times 18) + (2 \times 15) + 6 + 2 = 422\ D$

$422 \times 4.224''/12 = 149$ FT

$\left(\frac{149}{100}\ \text{FT} \times 0.46\right) = 0.68$ FT MINOR H_L

6"Ø

$(8 \times 30) + (8 \times 18) + (2 \times 15) + 9 + 4 = 427\ D$

$427 \times 6.217/12 = 222$ FT

$\left(\frac{222}{100} \times 0.07\right) = 0.16$ FT MINOR H_L

HEAD	4"Ø	6"Ø
STATIC	315'	315'
FRICTION	22'	4'
MINOR	1	1
TOTAL	338'	320'

PRESSURE IN PIPE ~147 psi ~139 psi

$psi = \frac{H \times 62.4}{144}$

AR000252

AR301024

Baker Engineers

S.O. No. 15438-17-SRI ORIGIN. (Rev)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 12 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

(12) BOOSTER PUMP SIZING

PICK Q = 100 gpm ASSUME 30% PUMP EFFICIENCY

CAMERON HYDRAULIC DATA HANDBOOK (1984) 16TH ED.

MASS FLOW RATE = 100 gpm × $\left(\frac{500}{60}\right)$ = 834 lb/MIN. (PPM)

4"Ø

HYDRAULIC H.P. NEEDED = $\frac{834 \text{ PPM} \times 338' \text{ HEAD}}{33{,}000}$

= 8.54 HHP

BRAKE HP NEEDED = $\frac{8.54}{0.30}$ = 28.5 BHP

6"Ø

HHP NEEDED = $\frac{834 \times 320}{33{,}000}$ = 8.08 HHP

BHP NEEDED = $\frac{8.08}{0.30}$ = 26.9 BHP

NOT MUCH ADVANTAGE TO USING A 6"Ø PIPE.

∴ → USE: 4"Ø NOMINAL SIZE POLYETHYLENE PIPE
SDR 11 (160 psi PRESSURE RATING)
DRISCOPIPE #1000 (PE 3408) PIPE
4,800 FEET PLUS SOME

∴ → USE: ~30 BHP CENTRIFUGAL PUMP
26.3 KW

AR301025

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 13 of 37

Drawing No.

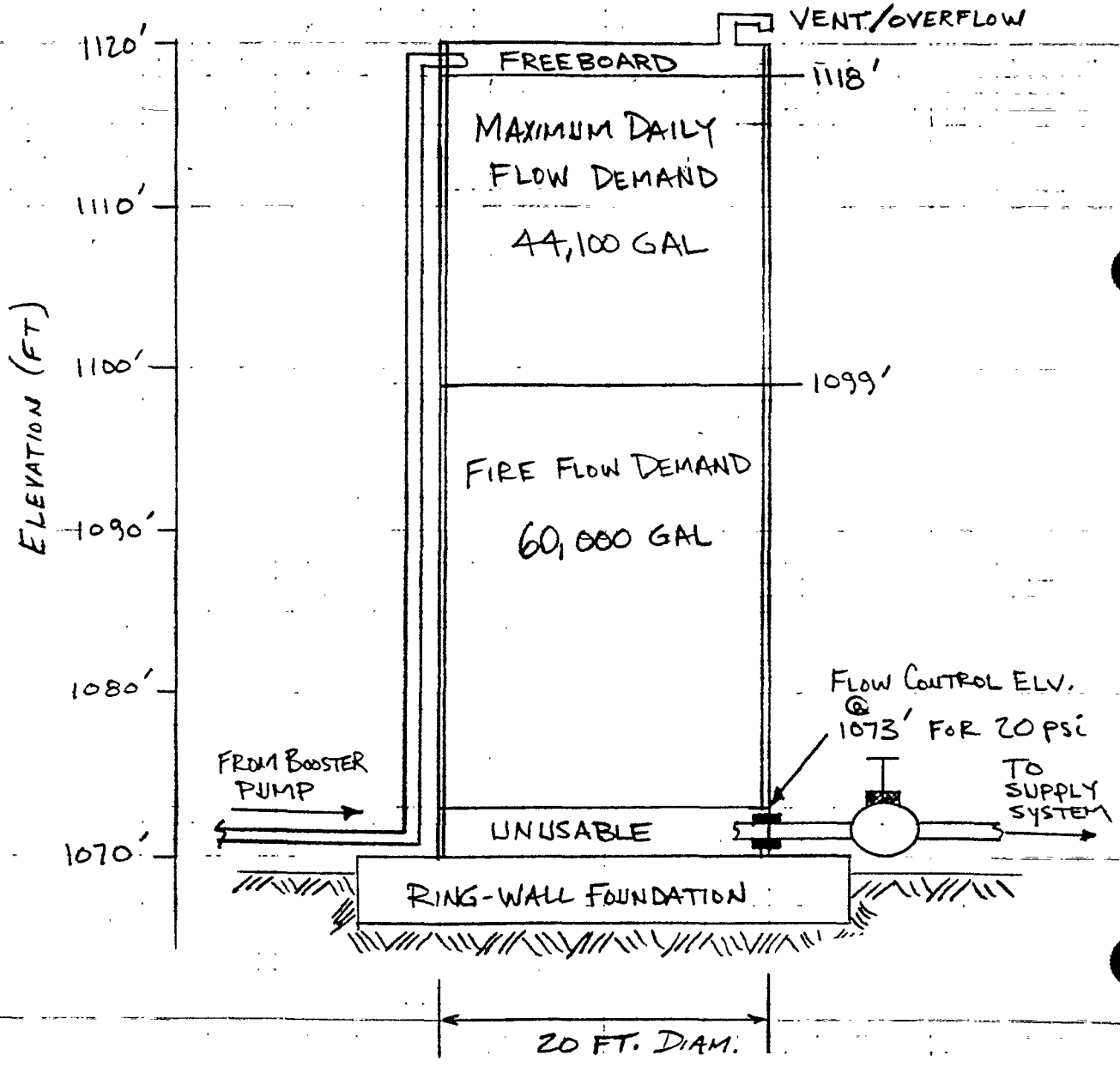
Computed by LJS Checked By TFS Date 5/25/88

(13) STORAGE TANK DESIGN

~100,000 GAL. REQ'D WELDED STEEL

(100,000/7.481) = 13,367 CFT

PICK D = 20' A = 314 FT² H = 42.6' (SAY 50')



AR301026

Baker Engineers

S.O. No. 15438-17-SRT

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 14 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

(14) WATER DISTRIBUTION SYSTEM – PRELIMINARY PIPE SIZING

(a) $Q_{(FIRE + MDF)} = (500 + 17) \equiv$ SAY 600 gpm

$Q_{PEAK\ HR.} = 60$ gpm $Q_{ADF} = 17$ gpm

$P_{AT\ DWELLING} \geq 20$ psi (46.2 FT. HEAD)

FULL FLOW GRAVITY SYSTEM

TANK ELEVATIONS

- MINIMUM FOR FIRE @ ELV. 1073'
- MINIMUM FOR DWELLINGS @ ELV 1099'
- MAXIMUM @ ELV. 1118'

REFERENCE: DRISCOPIPE MANUAL CHART # 7, AND HDPE DRISCOPIPE* 1000 SPEC SHEET

(b) SECTION A

FIRE PLUG #1

MIN. Δ ELV. = (1073 - 1013) = 60' HEAD

DISTANCE FROM TANK = 1560'

AVE. SLOPE = (60/15.6) = 3.8 FT/100'

CHART #7 @ 600 gpm MIN. ID = 5.5 INCHES

TRY { 6" NOMINAL PIPE ACTUAL ID = 6.115" A = 29.36 IN²
SDR 26 65psi RATING

$$V = \left(\frac{.320 \times 600}{29.36}\right) = 6.53 \text{ FPS}$$

$$\Delta P_{100}^{6.115''\phi} = \left(\frac{452 \times 600^{1.85}}{155^{1.85} \times 6.115^{4.86}}\right) = 0.833 \text{ psi/100' OF PIPE}$$
$$= 1.92 \text{ FT/100' PIPE}$$

H = 60' – (1.92 × 15.6) – SAY 2' MINOR = 28.0' HEAD (NG)

P = 12.1 psi (NG)

AR301027

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 15 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

TRY : 8" NOMINAL PIPE ACTUAL ID = 7.961 IN. SDR 26
65 psi PRESSURE RATING $A = 49.77\ IN^2$

$$V = \left(\frac{0.320 \times 600}{49.77}\right) = 3.85\ FPS$$

$$\Delta P_{100}^{7.961''\phi} = \left(\frac{452 \times 600^{1.85}}{155^{1.85} \times 7.961^{4.86}}\right) = 0.231\ psi/100\ FT. = 0.533\ FT/100\ FT$$

$$H = 60' - (0.533 \times 15.6) - 2'_{MINOR} = 49.7'\ HEAD$$

$$\underline{P = 21.5\ psi\ (OK)}$$

PRESSURE AT DWELLING #1

$Q_{ADF} = 17\ gpm$ $\quad \Delta P_{100}^{7.961''\phi} = \left(\frac{452 \times 17^{1.85}}{155^{1.85} \times 7.961^{4.86}}\right) = 3.1 \times 10^{-4}\ psi/100'$ (IGNORE)

$\Delta H = (1099 - 1040) = 59'$

$\underline{P = 25\ psi\ (OK)}$

$Q_{PEAK} = 60\ gpm$ $\quad \Delta P_{100}^{7.961''\phi} = \left(\frac{452 \times 60^{1.85}}{155^{1.85} \times 7.961^{4.86}}\right) = 3.3 \times 10^{-3}\ psi/100'$ (IGNORE)

$\underline{P = 25\ psi\ (OK)}$

FIRE PLUG #2

MIN. ΔELV. = (1073 − 984) = 89' DISTANCE = 2290'
AVE SLOPE = (89/22.9) = 3.88 '/100' Q = 600 GPM
MIN. ID = 5.5" USE 8" NOMINAL SIZE

$H = 89 - (0.533 \times 22.9) - 2'_{MINOR} = 74.8'$ HEAD

$\underline{P = 32.4\ psi\ (OK)}$

AR301028

(C) SECTION B

FIRE PLUG #3

MIN. ΔELV. = (1073 − 982) = 91' HEAD DISTANCE = 2640'

AVE SLOPE = (91/26.4) = 3.45'/100' Q = 600 gpm

MIN. ID = 5.5" USE 8" NOMINAL SIZE

H = 91 − (0.533 × 26.4) − SAY 3' MINOR = 73.9' HEAD

P = 32 psi (OK)

DWELLING #19

Q_{ADF} = 17 gpm $\Delta P_{100}^{7.961''\phi}$ = 3.1 × 10^{-4} psi/100' (IGNORE)

ΔH = (1099 − 1006) = 93' P = 40 psi (OK)

FIRE PLUG #4

MIN. ΔELV. = (1073 − 974) = 99' HEAD DISTANCE = 3110 FT.

AVE. SLOPE = (99/31.1) = 3.18 FT/100' Q = 600 gpm

MIN. ID = 5.6" USE 8" NOMINAL SIZE

H = 99 − (.533 × 31.1) − SAY 4' MINOR = 78.4 FT HEAD

P = 34 psi (OK)

DWELLING #14

CHECK MAXIMUM PRESSURE Q_{ADF} = 17gpm

ΔH = (1118 − 960) = 158' HEAD P = 68 psi (OK)

MAXIMUM

DWELLING #17

$Q_{PEAK\ HOUR} = 60$ gpm MIN ΔELV = (1099 - 975) = 124 FT.

DISTANCE = 3,410 FT. AVE SLOPE = (124/34.1) = 3.64'/100'

MIN ID = 2.4" TRY 3" NOMINAL SIZE DRISCOPIPE*1000

ACTUAL ID = 3.230" A = 8.19 in² V = 2.3 FPS (OK)

$$\Delta P_{100}^{3.230''\phi} = \left(\frac{452 \times 60^{1.85}}{155^{1.85} \times 3.230^{4.86}}\right) = 0.262 \text{ psi}/100'$$

$$= 0.605 \text{ FT}/100'$$

HEAD AT FIRE PLUG #4 = 78.4 FT.

DISTANCE FIRE PLUG #4 TO DWELLING #17 = 300 FT.

HEAD AT DWELLING #17 = 78.4 - (.605 x 3.0) - SAY 2' MINOR

H = 74.6 FT

P = 32 psi (OK)

USE: 3" NOMINAL SIZE SDR 26 DRISCOPIPE*1000 BETWEEN FIRE PLUG #4 AND DWELLING #17

(d) SECTION C

FIRE PLUG #5

MIN. ΔELV. = (1073 - 948) = 125' HEAD DISTANCE = 3,200 FT.

AVE. SLOPE = (125/320) = 3.90 FT/100' Q = 600 gpm

MIN. ID = 5.5" USE 8" NOMINAL SIZE

HEAD = 125 - (0.533 x 32) - SAY 4' MINOR = 103.7 FT.

P = 45 psi (OK)

Baker Engineers

S.O. No. 15434-17-SRI ORIGIN (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

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Drawing No.

Computed by LJS Checked By JRS Date 5/26/88

DWELLING #27

$Q_{PEAK\ HOUR}$ = 60 gpm MIN. ΔELV. = (1099 - 975) = 124 FT.

DISTANCE FIRE PLUG #5 TO DWELLING #27 = 280'

ΔELV. = (975 - 948) = 27 FT. HEAD LOSS

DISTANCE TANK TO DWELLING #17 = (3200 + 280) = 3,480'

AVE SLOPE = ((124 - 27)/34.8) = 2.78'/100'

MIN. ID ≈ 2.6" USE 3" NOMINAL SIZE DRISCOPIPE #1000

ACTUAL ID = 3.230" @ SDR 26

HEAD AT FIRE PLUG #5 = 103.9 FT.

HEAD = (103.9 - 27) - (.605 x 2.8) - SAY 2' MINOR = 73.2 FT.

P = 31 psi (OK)

DWELLING #25

CHECK FOR MAXIMUM PRESSURE

ΔH = (1118 - 940) = 178' HEAD P = 77 psi (OK)
MAXIMUM

CONCLUSION

SYSTEM SHOULD FUNCTION PROPERLY FOR 8"Φ PLASTIC MAINS; VERIFY OPERATION OF SYSTEM USING KENTUCKY PIPES COMPUTER PROGRAM.

AR301031

SHT 19 OF 37 ORIGIN (Red)

USA AND CANADA — WORLDWIDE — OTHER COUNTRIES

DRISCOPIPE* 1000

HIGH DENSITY POLYETHYLENE PE 3408 PIPE for MUNICIPAL and INDUSTRIAL SYSTEMS

Dimensions and Pressure Ratings

For Additional Information on Prices and Fusion Equipment, Please Contact. . .

PHILLIPS DRISCOPIPE, INC.
A SUBSIDIARY OF PHILLIPS PETROLEUM COMPANY

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AR301032

ORIGINAL (Red)

DRISCOPIPE* 1000 (PE 3408) PIPE — Dimensions and Pressure Ratings

SDR 32.5 — 50 psi

Nominal Size	Dimensions - Inches			Nominal Weight Lbs./100'
	Nominal OD	Approx. ID	Minimum Wall	
3"	3.500	3.264	.108	52
4"	4.500	4.224	.138	84
5"	5.563	5.211	.171	123
6"	6.625	6.217	.240	178
7"	7.125	6.872	.220	205
8"	8.625	8.095	.265	299
10"	10.750	10.088	.331	462
12"	12.750	11.966	.392	648
14"	14.000	13.124	.431	783
16"	16.000	15.016	.492	1021
18"	18.000	16.876	.554	1294
20"	20.000	18.770	.615	1596
21.5"	21.500	20.176	.662	1846
24"	24.000	22.524	.738	2296
28"	28.000	26.276	.862	3131
800mm	31.496	29.558	.969	3959
36"	36.000	33.784	1.108	5174

SDR 26 — 65 psi

3"	3.500	3.230	.135	65
4"	4.500	4.154	.173	103
5"	5.563	5.135	.214	156
6"	6.625	6.115	.255	219
7"	7.125	6.577	.274	253
8"	8.625	7.961	.332	368
10"	10.750	9.924	.413	571
12"	12.750	11.770	.490	804
14"	14.000	12.924	.538	969
16"	16.000	14.770	.615	1266
18"	18.000	16.616	.692	1603
20"	20.000	18.462	.769	1979
21.5"	21.500	19.846	.827	2288
24"	24.000	22.154	.923	2850
28"	28.000	25.846	1.077	3880
800mm	31.496	29.074	1.211	4907
36"	36.000	33.230	1.385	6415

SDR 21 — 80 psi

3"	3.500	3.166	.167	77
4"	4.500	4.072	.214	125
5"	5.563	5.033	.265	189
6"	6.625	5.995	.315	266
7"	7.125	6.445	.340	309
8"	8.625	7.803	.411	452
10"	10.750	9.726	.512	701
12"	12.750	11.536	.607	986
14"	14.000	12.666	.667	1190
16"	16.000	14.476	.762	1553
18"	18.000	16.286	.857	1965
36"	36.000	32.572	1.714	7861

SDR 19 — 90 psi

3"	3.500	3.130	.185	84
4"	4.500	4.026	.237	137
5"	5.563	4.977	.293	207
6"	6.625	5.927	.349	293
7"	7.125	6.375	.375	339
8"	8.625	7.717	.454	496
10"	10.750	9.618	.566	771
12"	12.750	11.406	.671	1084
14"	14.000	12.526	.737	1307
16"	16.000	14.316	.842	1707
18"	18.000	16.104	.948	2162
630mm	24.803	22.193	1.305	4101
36"	36.000	32.210	1.895	8643

SDR 17 — 100 psi

Nominal Size	Dimensions -Inches			Nominal Weight Lbs./100'
	Nominal OD	Approx. ID	Minimum Wall	
3"	3.500	3.086	.206	92
4"	4.500	3.970	.265	151
5"	5.563	4.909	.327	229
6"	6.625	5.845	.390	325
7"	7.125	6.280	.419	377
8"	8.625	7.611	.507	550
10"	10.750	9.486	.632	855
12"	12.750	11.250	.750	1203
14"	14.000	12.352	.824	1452
16"	16.000	14.118	.941	1895
18"	18.000	15.882	1.059	2340
630mm	24.803	21.800	1.460	4554

SDR 15.5 — 110 psi

3"	3.500	3.048	.226	100
4"	4.500	3.920	.290	164
5"	5.563	4.845	.359	250
6"	6.625	5.771	.427	354
7"	7.125	6.205	.460	410
8"	8.625	7.513	.556	600
10"	10.750	9.362	.694	933
12"	12.750	11.104	.823	1312
14"	14.000	12.194	.903	1581
16"	16.000	13.936	1.032	2065
18"	18.000	15.678	1.161	2614
630mm	24.803	21.603	1.600	4963

SDR 13.5 — 130 psi

3"	3.500	2.982	.259	113
4"	4.500	3.834	.333	185
5"	5.563	4.739	.412	284
6"	6.625	5.643	.491	403
7"	7.125	6.069	.528	466
8"	8.625	7.347	.639	682
10"	10.750	9.158	.796	1059
12"	12.750	10.862	.944	1489
14"	14.000	11.926	1.037	1797
16"	16.000	13.630	1.185	2346
18"	18.000	15.334	1.333	2969

SDR 11 — 160 psi

3"	3.500	2.864	.318	135
4"	4.500	3.682	.409	223
5"	5.563	4.551	.506	342
6"	6.625	5.421	.602	484
7"	7.125	5.829	.648	561
8"	8.625	7.057	.784	821
10"	10.750	8.796	.977	1275
12"	12.750	10.432	1.159	1794
14"	14.000	11.454	1.273	2164
16"	16.000	13.090	1.455	2827
18"	18.000	14.728	1.636	3576

NOTE: Approximate ID = DP — 2t

SDR (Standard Dimension Ratio) = $\frac{Dp}{t}$

Pressure rating computed on the basis of the following:

$$P = \frac{2S}{SDR-1} \quad @\ 73.4°F$$

Where:

Dp = Nominal OD of Pipe, Inches

t = Minimum Wall Thickness

S = Hydrostatic Design Stress, 800 psi

P = Pressure Rating, psi @ 73.4°F

AR301033

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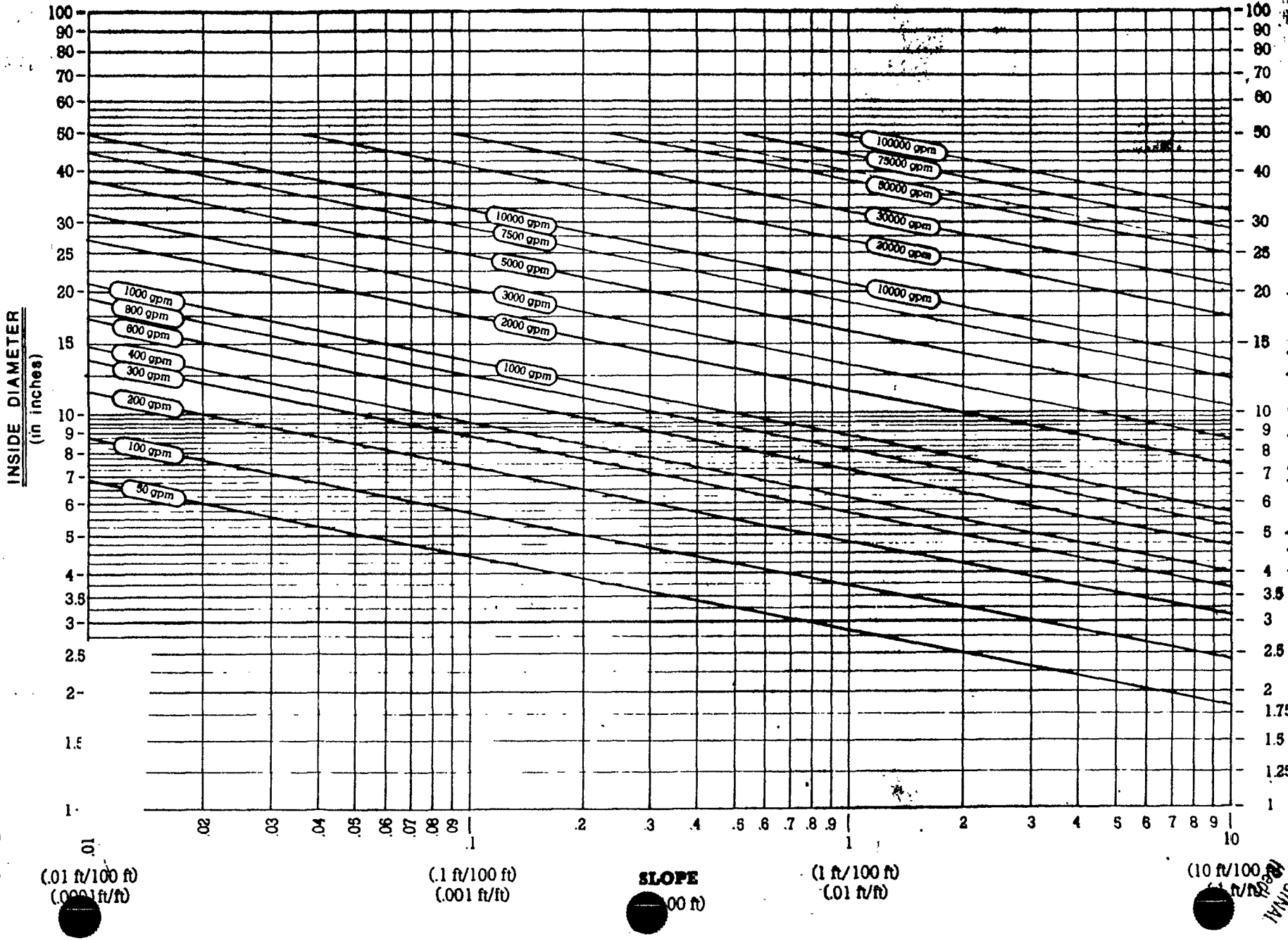
CHART 7

INSIDE DIAMETER VERSUS FLOW RATE AT A GIVEN SLOPE

GRAVITY FULL FLOW: WATER



SOURCE: DRISCOPIPE SYSTEMS DESIGN MANUAL (1981) PHILLIPS DRISCOPIPE, INC.

SHT 21 OF 37

ORIGINAL

AR301034

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

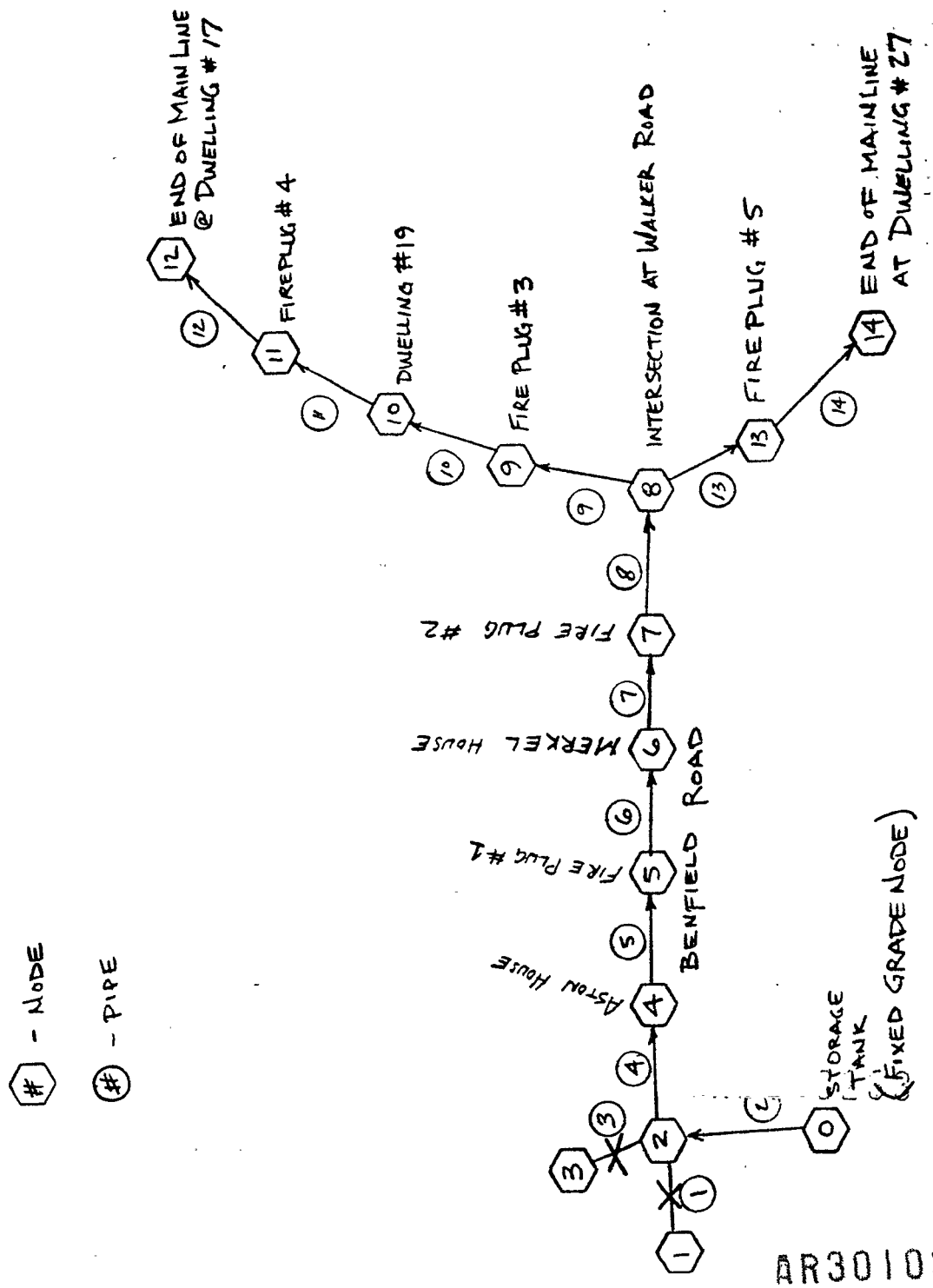
Sheet No. 22 of 37

Drawing No.

Computed by LJS Checked By JRS Date 5/31/88

(15) COMPUTER HYDRAULIC SYSTEM ANALYSIS

PROGRAM: KENTUCKY PIPES (KPIPE300)



AR301035

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT RI/FS SITE
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 23 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

– KENTUCKY PIPE INPUT DATA –

LOCATION	SURFACE ELEVATION ON MAIN LINE (FT)	SURFACE ELEVATION ON SERVICE LINE (FT)	DISTANCE ON MAIN (FT)	PRESSURE OR GRAVITY	DISTANCE ON SERVICE LINE (FT)	AREA OF SYSTEM
BOTTOM OF WELLS	600'	—	—	P	—	WELL FIELD
TOP OF WELLS	800'	—	—	P	—	
WELLS TO BOOSTER PUMP BLDG.	800'	—	SAY 300'	P	—	
BOOSTER PUMP BLDG	800'	—	0	P	—	
STORAGE TANK FOUNDATION	1070'	—	SAY 4,600'	P	—	STORAGE TANK
DWELLING #1	1020'	~~1040'~~ 1034'	1,300'	G	150'	SECTION A
#2	1018'	1026'	80'	G	100'	
FIRE PLUG #1	1010'	1013'	180'	G	10'	
#3	1002'	1010'	60'	G	100'	
#4	989'	992'	130'	G	100'	
#5	982'	987'	120'	G	100'	
#10	980'	972'	80'	G	100	
#6	979'	988'	110'	G	150'	

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 24 of 37

Drawing No.

Computed by LJS Checked By TBS Date 5/25/88

- KENTUCKY PIPE INPUT DATA -

LOCATION	SURFACE ELEVATION ON MAIN (FT)	SURFACE ELEVATION ON SERVICE (FT)	DISTANCE ON MAIN LINE (FT)	DISTANCE ON SERVICE LINE (FT)	PRESSURE OR GRAVITY	
#11	980'	973'	140'	130'	G	SECTION A
#7	982'	990'	50'	150'	G	
FIRE PLUG #2	984'	984'	40'	10'	G	
#12	982'	978'	20'	110'	G	
#8	983'	986'	20'	130'	G	
#13	981'	982'	120'	130'	G	
#9	978'	976'	30'	70'	G	
TEE BRANCH	972'		120'		G	(DISTANCES ON MAIN FROM TEE
[redacted] TEE BRANCH	972'	—	0'	—	—	SECTION B
FIRE PLUG #3	980'	982'	40'	10'	G	
#20	992'	996'	170'	120'	G	
#19	990'	1006'	50'	150'	G	
#14	976'	960'	220'	200'	G	

AR301037

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 25 of 34

Drawing No.

Computed by LJS Checked By TRS Date 5/25/88

LOCATION	SURFACE ELEVATION ON MAIN (FT)	SURFACE ELEVATION ON SERVICE (FT)	DISTANCE ON MAIN LINE (FT)	DISTANCE ON SERVICE LINE (FT)	PRESSURE OR GRAVITY	
FIRE PLUG #4	972'	974'	30'	10'	G	SECTION B
#15	970'	964'	130'	110'	G	
#16	970'	968'	30'	130'	G	
#18	970'	975'	40'	30'	G	
#17	972'	974'	100' *	70'	G	END OF MA SECTION B
TEE BRANCH	972'	—	0'	-	G	SECTION C (DISTANCE ON MAIN FROM TE
#21	966'	970'	60'	60'	G	
#22	965'	966'	20'	100'	G	
#23	954'	956'	240'	70'	G	
#24	947'	950'	240'	80'	G	
FIRE PLUG #5	947'	948'	40' *	10'	G	
#26	947'	969'	130'	180'	G	
#25	947'	940'	20'	120'	G	
#27	952'	975'	130' *	190'	G	END OF MAIN IN

AR301038

AR301039

Baker Engineers

S.O. No. 15438-17-SPI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 26 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

KPIPE RUN # 1 - SIMULATES

- PLASTIC PIPE SYSTEM 8"Ø MAINS TO LAST FIRE PLUGS, 6"Ø MAINS TO END OF SYSTEM.
- FIRE DEMAND AT PLUG # 1
- MAXIMUM DAILY FLOW ELSEWHERE

KPIPE RUN #2 - SIMULATES

- PLASTIC PIPE 8"Ø & 6"Ø MAINS
- FIRE DEMAND AT PLUG #5
- MAXIMUM DAILY FLOW ELSEWHERE

KPIPE RUN #3 - SIMULATES

- CAST IRON MAINS 8"Ø AND 6"Ø
- FIRE DEMAND AT PLUG #5
- MAXIMUM DAILY FLOW ELSEWHERE

Baker Engineers

S.O. No. 15438-17-SR ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 27 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

KPIPE RUN # 1

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	1	2	4700.0	4.0	155.0	.00	
2	0	2	300.0	8.0	155.0	.00	1106.00
3	2	3	300.0	8.0	155.0	.00	
4	2	4	1000.0	8.0	155.0	.00	
5	4	5	260.0	8.0	155.0	.00	
6	5	6	390.0	8.0	155.0	.00	
7	6	7	340.0	8.0	155.0	.00	
8	7	8	310.0	8.0	155.0	.00	
9	8	9	40.0	6.0	155.0	.00	
10	9	10	220.0	6.0	155.0	.00	
11	10	11	250.0	6.0	155.0	.00	
12	11	12	300.0	6.0	155.0	.00	
13	8	13	600.0	6.0	155.0	.00	
14	13	14	280.0	6.0	155.0	.00	

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES			
1	.00	800.00	1			
2	.00	1052.00	1	2	3	4
3	.00	1052.00	3			
4	2.50	1040.00	4	5		
5	502.50	1010.00	5	6		
6	10.00	980.00	6	7		
7	7.50	984.00	7	8		
8	10.00	972.00	8	9	13	
9	.00	980.00	9	10		
10	5.00	990.00	10	11		
11	2.50	972.00	11	12		
12	10.00	972.00	12			
13	10.00	947.00	13	14		
14	7.50	952.00	14			

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD
5 VALUES ARE OUTPUT FOR MAXIMUM AND MINIMUM PRESSURES

THIS SYSTEM HAS 14 PIPES WITH 14 JUNCTIONS , 0 LOOPS AND 1 FGNS

8

AR301040

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (REDO)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 28 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00000

BERKS SAND PIT RI/FS SITE
PUBLIC WATER SUPPLY SYSTEM
PLASTIC PIPE-FIRE AT #1; M.D.F. 5/31/88

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	1	2	.00	.00	.00	.00	.00	.00
2	0	2	567.50	1.39	.00	.00	3.62	4.62
3	2	3	.00	.00	.00	.00	.00	.00
4	2	4	567.50	4.62	.00	.00	3.62	4.62
5	4	5	565.00	1.19	.00	.00	3.61	4.58
6	5	6	62.50	.03	.00	.00	.40	.08
7	6	7	52.50	.02	.00	.00	.34	.06
8	7	8	45.00	.01	.00	.00	.29	.04
9	8	9	17.50	.00	.00	.00	.20	.03
10	9	10	17.50	.01	.00	.00	.20	.03
11	10	11	12.50	.00	.00	.00	.14	.02
12	11	12	10.00	.00	.00	.00	.11	.01
13	8	13	17.50	.02	.00	.00	.20	.03
14	13	14	7.50	.00	.00	.00	.09	.01

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
1	.00	1106.61	800.00	132.87
2	.00	1106.61	1052.00	23.67
3	.00	1106.61	1052.00	23.67
4	2.50	1102.00	1040.00	26.86
5	502.50	1100.80	1010.00	39.35
6	10.00	1100.77	980.00	52.34
7	7.50	1100.75	984.00	50.59
8	10.00	1100.74	972.00	55.79
9	.00	1100.74	980.00	52.32
10	5.00	1100.73	990.00	47.98
11	2.50	1100.73	972.00	55.78
12	10.00	1100.73	972.00	55.78
13	10.00	1100.72	947.00	66.61
14	7.50	1100.72	952.00	64.45
	MAXIMUM PRESSURES			
1	.00	1106.61	800.00	132.87
13	10.00	1100.72	947.00	66.61
14	7.50	1100.72	952.00	64.45
8	10.00	1100.74	972.00	55.79
11	2.50	1100.73	972.00	55.78
	MINIMUM PRESSURES			
2	.00	1106.61	1052.00	23.67
3	.00	1106.61	1052.00	23.67
4	2.50	1102.00	1040.00	26.86
5	502.50	1100.80	1010.00	39.35
10	5.00	[illegible]	[illegible]	[illegible]

SDWIUEMA

Baker Engineers

S.O. No. 15438-17-SRI ORIGIN (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 29 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

THE NET SYSTEM DEMAND = 567.50
SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
2	567.50

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 567.50
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

CONCLUSION

KPIPE RUN #1 INDICATES ACCEPTABLE PRESSURES CAN BE MAINTAINED FOR THE FLOW DEMAND CONDITIONS SPECIFIED.

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 30 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

KPIPE RUN #2

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	1	2	4700.0	4.0	155.0	.00	
2	0	2	300.0	8.0	155.0	.00	1108.00
3	2	3	300.0	8.0	155.0	.00	
4	2	4	1000.0	8.0	155.0	.00	
5	4	5	260.0	6.0	155.0	.00	
6	5	6	390.0	8.0	155.0	.00	
7	6	7	340.0	6.0	155.0	.00	
8	7	8	310.0	6.0	155.0	.00	
9	8	9	40.0	6.0	155.0	.00	
10	9	10	330.0	6.0	155.0	.00	
11	10	11	250.0	6.0	155.0	.00	
12	11	12	300.0	6.0	155.0	.00	
13	8	13	600.0	6.0	155.0	.00	
14	13	14	280.0	6.0	155.0	.00	

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES			
1	.00	800.00	1			
2	.00	1052.00	1	2	3	4
3	.00	1052.00	3			
4	2.50	1040.00	4	5		
5	2.50	1010.00	5	6		
6	10.00	980.00	6	7		
7	7.50	984.00	7	8		
8	10.00	972.00	8	9	13	
9	.00	980.00	9	10		
10	5.00	990.00	10	11		
11	2.50	972.00	11	12		
12	10.00	972.00	12			
13	510.00	947.00	13	14		
14	7.50	952.00	14			

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD
5 VALUES ARE OUTPUT FOR MAXIMUM AND MINIMUM PRESSURES

THIS SYSTEM HAS 14 PIPES WITH 14 JUNCTIONS , 0 LOOPS AND 1 PGNS

AR301043

Baker Engineers

S.O. No. 15438-17-SBT

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 31 of 37

Drawing No.

Computed by LJS Checked By JRS Date 5/31/88

ORIGINAL (Red)

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .0000

BERKS SAND PIT RI/FS SITE
PUBLIC WATER SUPPLY SYSTEM
PLASTIC PIPE-FIRE WITH M.D.F. 5/31/88

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	1	2	.00	.00	.00	.00	.00	.00
2	0	2	567.50	1.33	.00	.00	3.62	4.62
3	2	3	.00	.00	.00	.00	.00	.00
4	2	4	567.50	4.62	.00	.00	3.62	4.62
5	4	5	565.00	1.13	.00	.00	3.61	4.58
6	5	6	562.50	1.77	.00	.00	3.59	4.54
7	6	7	552.50	1.43	.00	.00	3.53	4.40
8	7	8	545.00	1.33	.00	.00	3.48	4.29
9	8	9	17.50	.00	.00	.00	.20	.03
10	9	10	17.50	.01	.00	.00	.20	.03
11	10	11	12.50	.00	.00	.00	.14	.02
12	11	12	10.00	.00	.00	.00	.11	.01
13	8	13	517.50	3.48	.00	.00	5.87	15.81
14	13	14	7.50	.00	.00	.00	.09	.01

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
1	.00	1106.61	800.00	132.87
2	.00	1106.61	1052.00	23.67
3	.00	1106.61	1052.00	23.67
4	2.50	1102.00	1040.00	26.86
5	2.50	1100.80	1010.00	33.35
6	10.00	1093.03	980.00	51.56
7	7.50	1087.54	984.00	43.20
8	10.00	1096.21	972.00	53.82
9	.00	1096.21	980.00	50.36
10	5.00	1096.20	990.00	46.02
11	2.50	1096.20	972.00	53.82
12	10.00	1096.19	972.00	53.82
13	510.00	1086.72	947.00	60.55
14	7.50	1086.72	952.00	58.38

MAXIMUM PRESSURES

1	.00	1106.61	800.00	132.87
13	510.00	1086.72	947.00	60.55
14	7.50	1086.72	952.00	58.38
8	10.00	1096.21	972.00	53.82
11	2.50	1096.20	972.00	53.82

MINIMUM PRESSURES

2	.00	1106.61	1052.00	23.67
3	.00	1106.61	1052.00	23.67
4	2.50	1102.00	1040.00	26.86
5	2.50	1100.80	1010.00	33.35
10	5.00	1096.20	990.00	46.02

AR301044

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 32 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

THE NET SYSTEM DEMAND = 567.50
SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

PIPE NUMBER	FLOWRATE
2	567.50

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 567.50
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

CONCLUSION

KPIPE RUN #2 INDICATES ACCEPTABLE PRESSURES CAN BE MAINTAINED FOR THE FLOW DEMAND CONDITIONS SIMULATED.

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 33 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

KPIPE RUN #3

FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

PIPE NO.	NODE NOS.		LENGTH (FEET)	DIAMETER (INCHES)	ROUGHNESS	MINOR LOSS K	FIXED GRADE
1	1	2	4700.0	4.0	130.0	.00	
2	0	2	300.0	8.0	130.0	.00	1108.00
3	2	3	300.0	8.0	130.0	.00	
4	2	4	1000.0	8.0	130.0	.00	
5	4	5	260.0	8.0	130.0	.00	
6	5	6	390.0	8.0	130.0	.00	
7	6	7	340.0	8.0	130.0	.00	
8	7	8	310.0	8.0	130.0	.00	
9	8	9	40.0	6.0	130.0	.00	
10	9	10	220.0	6.0	130.0	.00	
11	10	11	250.0	6.0	130.0	.00	
12	11	12	300.0	6.0	130.0	.00	
13	8	13	600.0	6.0	130.0	.00	
14	13	14	280.0	6.0	130.0	.00	

JUNCTION NUMBER	DEMAND	ELEVATION	CONNECTING PIPES			
1	.00	800.00	1			
2	.00	1052.00	1	2	3	4
3	.00	1052.00	3			
4	2.50	1040.00	4	5		
5	2.50	1010.00	5	6		
6	10.00	980.00	6	7		
7	7.50	984.00	7	8		
8	10.00	972.00	8	9	13	
9	.00	980.00	9	10		
10	5.00	990.00	10	11		
11	2.50	972.00	11	12		
12	10.00	972.00	12			
13	510.00	947.00	13	14		
14	7.50	952.00	14			

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD
5 VALUES ARE OUTPUT FOR MAXIMUM AND MINIMUM PRESSURES

THIS SYSTEM HAS 14 PIPES WITH 14 JUNCTIONS , 0 LOOPS AND 1 FGNS

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT WATER SUPPLY SYSTEM CONCEPTUAL DESIGN

Sheet No. 34 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00000

BERKS SAND PIT RI/FS SITE
PUBLIC WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN 15642-17-SRI LJS 5/26/88

PIPE NO.	NODE NOS.		FLOWRATE	HEAD LOSS	PUMP HEAD	MINOR LOSS	VELOCITY	HL/1000
1	1	2	.00	.00	.00	.00	.00	.00
2	0	2	567.50	1.92	.00	.00	3.62	6.40
3	2	3	.00	.00	.00	.00	.00	.00
4	2	4	567.50	6.40	.00	.00	3.62	6.40
5	4	5	565.00	1.65	.00	.00	3.61	6.35
6	5	6	562.50	2.45	.00	.00	3.59	6.29
7	6	7	552.50	2.07	.00	.00	3.53	6.09
8	7	8	545.00	1.84	.00	.00	3.48	5.94
9	8	9	17.50	.00	.00	.00	.20	.04
10	9	10	17.50	.01	.00	.00	.20	.04
11	10	11	12.50	.01	.00	.00	.14	.02
12	11	12	10.00	.00	.00	.00	.11	.01
13	8	13	517.50	13.14	.00	.00	5.87	21.89
14	13	14	7.50	.00	.00	.00	.09	.01

JUNCTION NUMBER	DEMAND	GRADE LINE	ELEVATION	PRESSURE
1	.00	1106.08	800.00	132.63
2	.00	1106.08	1052.00	23.43
3	.00	1106.08	1052.00	23.43
4	2.50	1099.68	1040.00	25.86
5	2.50	1098.03	1010.00	38.15
6	10.00	1095.58	980.00	50.08
7	7.50	1093.51	984.00	47.45
8	10.00	1091.67	972.00	51.86
9	.00	1091.67	980.00	48.39
10	5.00	1091.66	990.00	44.05
11	2.50	1091.65	972.00	51.85
12	10.00	1091.65	972.00	51.85
13	510.00	1078.53	947.00	57.00
14	7.50	1078.53	952.00	54.83
	MAXIMUM PRESSURES			
1	.00	1106.08	800.00	132.63
13	510.00	1078.53	947.00	57.00
14	7.50	1078.53	952.00	54.83
8	10.00	1091.67	972.00	51.86
11	2.50	1091.65	972.00	51.85
	MINIMUM PRESSURES			
2	.00	1106.08	1052.00	23.43
3	.00	1106.08	1052.00	23.43
4	2.50	1099.68	1040.00	25.86
5	2.50	1098.03	1010.00	38.15
10	5.00	1091.66	990.00	44.05

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 35 of 37

Drawing No.

Computed by LJS Checked By TRS Date 5/31/88

ORIGINAL (Red)

THE NET SYSTEM DEMAND = 567.50
SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED

PIPE NUMBER	FLOWRATE
2	567.50

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODI
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE N

CONCLUSION

KPIPE RUN # 3 INDICATES ACCEPTABLE PRESSURES FOR THE FLOW CONDITIONS SIMULATED.

CONCLUSION: 8"Ø MAIN LINE PIPE WILL FUNCTION PROPERLY AND CAN BE EITHER CAST IRON OR PLASTIC.

AR301048

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 36 of 37

Drawing No.

Computed by LJS Checked By TRS Date 6/1/88

ORIGINAL (Red)

(16) ELECTRICAL REQUIREMENTS OF SYSTEM

LOAD	SOURCE
26,700 WATTS	30 HP PUMP MOTORS
2,700 WATTS	LIGHTING / RECEPTICALS
17,800 WATTS	10 HP WELL PUMP MOTORS
47,200 WATTS	TOTAL

SAY 48 TO 50 KW

NEED 3-PHASE 480 VOLT FOR 30 HP MOTORS.

UTILITY COMPANY MAY NEED TO RUN SPECIAL 3-PHASE LINE TO SITE; COULD BE EXPENSIVE, ALLOW $10,000 FOR THIS TASK.

USE 45 KVA TRANSFORMER 3-Φ 40V 54A
STEP DOWN

3 SECTION MOTOR CONTROL CENTER (MCC)

SECTION 1 - SERVICE BOX / DISCONNECT

2 - MOTOR STARTERS (2) - 30 HP MOTORS

3 - FEEDER / BREAKERS TO WELL PUMP MOTORS (2) @ 10 HP

PLUS STEP DOWN TRANSFORMER 3Φ 480V TO 208/120 V

ALLOW FOR 1 WOOD UTILITY LINE POLE (~$500)

AR301049

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN

Sheet No. 37 of 37

Drawing No.

Computed by LJS Checked By TRS Date 6/1/88

FEEDER LINES:

- UTILITY LINE TO PUMP/TRMT BUILDING - PRIMARY
  67 AMP 4 WIRE No 4 SERVICE WIRE 1 1/4" CONDUIT
- 2nd FEEDERS TO 30 HP MOTORS FROM MCC
  3 WIRE No. 8 1" CONDUIT
- 2nd FEEDERS TO 10 HP MOTORS FROM MCC
  3 WIRE No. 10 WIRE 3/4" CONDUIT

PUMP CONTROLLERS:

- LOCATE IN WEATHERPROOF BOX AT WELL HEADS
- 10 HP COST ~ $500 EACH

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERK'S SAND PIT
PUBLIC WATER SUPPLY SYSTEM Sheet No. 1 of 4
FS - O&M COSTS Drawing No.

Computed by LJS Checked By TRS Date 6/17/88

① OPERATING LABOR

ASSUME 1 MAN-DAY/WEEK x 52 WK/YR = 416 HR.

AT $50/HR METER READING
CHECK PUMPS, BLDG., ETC.
COLLECT WATER SAMPLES

② TREATMENT CHEMICALS

$4,000/YEAR EPA-600/8-84-010 OCT. 1984 (p. 14
CHLORINE ONLY FIG. 2-7 LOW DOSAGE, AND p. 13 TEXT).

INCLUDES MAT'LS, LABOR, EQUIP
(*2 FOR Fl, & Fe/Mn REMOVAL)

③ FIRE HYDRANT MAINTENANCE

TEAR DOWN ONCE/YEAR, GREASE, ETC.

1 DAY/HYD. x 5 = 5-DAYS

MEANS/SITE/CREW A-1A $198.40/DAY

④ STORAGE TANK

PAINT 1/5-YEARS

AREA = $2\pi(20' \times 50') + \pi/4(20^2) = 6{,}600$ SFT

AT 600 SFT/GAL = 11 GAL. PAINT

5 DAYS TO SANDBLAST, PRIME, PAINT
MEANS/SITE/CREW B-9 $785.60/DAY

PRIMER $16/GAL PAINT $20/GAL

AR301051

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS SAND PIT
P.W.S. SYSTEM
FS - O&M COSTS

Sheet No. 2 of 4

Drawing No.

Computed by LJS Checked By TRS Date 6/12/88

MATERIALS

$11 \times (16 + 20) = \frac{\$396}{5} \equiv \$80/YR$

LABOR

$5 \text{ DAYS} \times (785.60/\text{DAY}) \equiv \frac{\$4,000}{5} = \$800/YR$

(5) PUMP REPLACEMENT

REPLACE EACH 10 YEARS

$\frac{\$4,210 \text{ @}}{10} + \frac{\$250 \text{ INST.}}{10} \equiv \$450/YR$

(6) ELECTRIC SERVICE

$(2 \times 6.1 \text{ KW}) \times 16/24 \text{ HR/DAY} \times 365 \equiv 3,000 \text{ KW-HR/YR.}$

$(1 \times 23.1 \text{ KW}) \times 12/24 \text{ HR/DAY} \times 365 \equiv 4,300 \text{ KW-HR/YR}$

7,300 KW-HR/YR

USE $0.07 / KW-HR

(7) MAINTENANCE ON PUMPS

ALLOW $500/YR MAT'L, LABOR, EQUIP.

(8) WATER LINE BREAKS & REPAIR

1 REPAIR / 5-YEARS

100' PIPE CREW B-6 $591.60/DAY X 5 DAYS

$73.44/LF

AR301052

Baker Engineers

S.O. No. 15438-17-SAI

Subject: BERKS SAND PIT
PWS SYSTEM
FS - O & M COSTS

Sheet No. 3 of 4

Drawing No.

Computed by LJS Checked By TRS Date 6/17/88

(9) DISPOSAL

10 CYD/YR SLUDGE x $100/CYD LANDFILL COST
$1000/YR

(10) ADMINISTRATION

BILL PREPARATION (MONTHLY)

BILL COLLECTOR 16 HR/MONTH x 12 x $45/HR
= 192 HRS ($8,640)

SECRETARY 16 HR/MONTH x 12 x $25/HR
= 192 HR ($4,800)

(11) ANALYTIC COSTS

MONTHLY	PER TEST
ACIDITY	$5.00
Cl-RESIDUAL	28.00
CONDUCTIVITY	5.00
COLOR	16.00
FLOURIDE	20.00
HARDNESS	6.00
NITRATE	12.00
pH	5.00
DISS. SOLIDS	8.00
FECAL COLIF.	20.00
TOC	25.00

$150 x 12 = $1,800/YR

RESULTS SHOULD BE REVIEWED BY ENGINEER

AR301053

Baker Engineers

S.O. No. 15438-17-SRI OPTIONS IRCM

Subject: BERKS SAND PIT
PWS SYSTEM
FS - O&M COSTS

Sheet No. 4 of 4

Drawing No.

Computed by LJS Checked By TRS Date 6/17/88

(12) SALVAGE VALUE - NONE

(13) DECOMMISSIONING - NONE

AR301054

BERKS SAND PIT RI FS PUBLIC WATER SUPPY SYSTEM CAPITAL COSTS
INPUT FILE:BERKPWS2.WK1

ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	REFERENCE SOURCE	ITEM TOTAL ($)
1) EQUIPMENT MOBILIZATION	1	EA	$15,000.00	ASSUMED	15,000
2) SITE PREPARATION					
CLEAR AND GRUB (LIGHT TREES)	5	ACRES	$1,660.00	MEANS/SITE/021-104-0010	8,300
3) PUMPS, SUBMERSIBLE,6"DIA.	2	EA	$2,000.00	MEANS/CONS/026-704-3000	4,000
4) DRILLING, 8"DIA. HOLE					
DRILLED,CASED,CONSTRUCTED	400	VLF	$17.92	MEANS/CONS/026-704-0200	7,168
5) DRILLING, NX CORE	200	VLF	$29.30	MEANS/SITE/020-123-1050	5,860
6) PIPE, 3/4"DIA.POLYETHYLENE	800	LF	$0.10	MEANS/SITE/151-551-7310	80
7) PIPE FITTINGS, 3/4" - VARIOUS	100	EA	$12.42	MEANS/SITE/151-558-5560	1,242
8) SURGE TANK,10000 GAL.IN PUMP BLDG.	1	EA	$5,425.00	MEANS/SITE/155-671-0220	5,425
9) SURGE TANK ACCESSORIES	1	EA	$1,024.00	MEANS/SITE/155-671-0500	1,024
10)CONCRETE, FOR WELLHEAD PADS	5	CYD	$93.00	MEANS/SITE/033-130-4650	465
11)TRENCHING, 4 PIPE,6-FT X 2-FT	400	LF	$4.17	MEANS/SITE/12.3-110-1340	1,668
12)BEDDING, FOR 3/4" PIPE	400	LF	$1.17	MEANS/SITE/12.3-310-1460	468
13)PUMP/TREATMENT BUILDING, PRE-ENG.	900	SF-FLR	$8.76	MEANS/CONS/051-235-0200	7,884
14)FOUNDATION, PUMP/TRMT. BUILDING	20	CYD	$148.30	MEANS/CONS/033-130-4050	2,966
15)BOOSTER PUMP, 300 GPM, 50 HP	1	EA	$3,150.00	VENDER QUOTE	3,150
16)PROFESSIONALS - ON SITE					
(A) GEOLOGIST	120	HOUR	$70.00	ESTIMATED	8,400
(B) ENGINEER - CONST. INSPECTION	500	HOUR	$60.00	ESTIMATED	30,000
(INCLUDES:WAGE,SUBSITENCE,TRAVEL)					
17)PIPE, 4"DIA. CAST IRON	4,800	LF	$10.68	MEANS/CONS/151-300-2160	51,264
18)TRENCHING, 4"DIA. PIPE	4,800	LF	$4.17	MEANS/SITE/12.3-110-1340	20,016
19)BEDDING, 4" DIA. PIPE	4,800	LF	$1.17	MEANS/SITE/12.3-310-1460	5,616
20)PUMP INSTALLATION AND FOB-SITE	2	EA	$250.00	VENDER QUOTE	500

21 WATER STORAGE TANK 50,000 GAL.	1	EA	$57,000.00	MEANS/CONS/132-051-0900	57,000
22)FOUNDATION,10-FT DIA. CONCRETE RING	25	CYD	$148.00	MEANS SITE/033-130-4050	3,700
23,STORAGE TANK INSTALLATION					0
(A) STEEL RING AND ANCHOR BOLTS	1	EA	$2,000.00	ASSUMED	2,000
(B) CRANE MOB/DEMOB 25-TON	1	EA	$4,000.00	ASSUMED	4,000
(C) CRANE RENTAL, TRUCK MOUNT	1	WK	$1,964.00	MEANS/CONS/016-460-2500	1,964
(D) WELDING CREW	5	DAY	$797.20	MEANS/CONS/CREW E-4	3,986
(E) WELDING SUPPLIES	1	EA	$1,000.00	ASSUMED	1,000
24)PIPE, 8"DIA. PLASTIC MAIN LINE	4,500	LF	$23.44	MEANS/SITE/027-166-5020	105,480
25)TRENCHING, MAIN LINE PIPE SLOPE 0:1, 2-FT.WIDE, 6-FT.DEEP	4,500	LF	$4.17	MEANS/SITE/12.3-110-1340	18,765
26)BEDDING, MAIN LINE PIPE SLOPE 0:1, 2-FT.WIDE,8"DIA.PIPE	4,500	LF	$1.17	MEANS/SITE/12.3-310-1460	5,265
27)BITUMINOUS PAVING - ROAD REPAIR 4" PAVEMENT 4" GRAVEL BASE	375	LF	$61.45	MEANS/SITE/12.5-111-1550	23,044
28)DEMOBILIZATION - AT 100% OF MOB.	1	EA	$15,000.00	ASSUMED	15,000
29,WATER SERVICE CONNECTIONS					
COPPER TAPS LINE,10-FT.OFFSET,6-FT.	27	EA	$470.00	MEANS SITE [illegible]	12,690
WATER SUPPLY METERS,BRONZE,1" DIA.	27	EA	$[illegible].96	MEANS/SITE/[illegible]-160-2100	3,156
PIPE,1"DIA. PVC SERVICE LINE	3,500	LF	$1.26	MEANS SITE/026-674-1120	4,410
FITTINGS - CLAMP RINGS	60	EA	$1.86	MEANS/SITE/026-674-2240	112
FITTINGS - COUPLINGS	400	EA	$[illegible].4	MEANS SITE 026-674-2320	[illegible]
FITTINGS - 90 DEG. ELBOWS	100	EA	$8.33	MEANS SITE 026-674-2420	833
30)ELECTRICAL SYSTEMS AND EQUIPMENT					
(A) WOODEN UTILITY POLE	2	EA	$500.00	ASSUMED	1,000
(B) 3-PHASE PRIMARY -UTILITY CO.	1	EA	$10,000.00	ASSUMED	10,000
(C) M.C.C. - SIZE 3, 24" HIGH	1	EA	$1,215.00	MEANS/ELEC/163-110-0300	1,215
(D) PILOT LIGHTS, FOR M.C.C.	3	EA	$81.80	MEANS/ELEC/163-110-1700	245
(E) PUSH BUTTONS, FOR M.C.C.	3	EA	$58.80	MEANS ELEC/163-110-1800	176
(F) PUMP CONTROLLERS	3	EA	$500.00	ASSUMED	1,500
(G) SERVICE FEEDER -PRIMARY	200	LF	$6.12	MEANS/ELEC/89.1-310	1,224
(H) 10-HP MOTOR FEEDER WIRE	900	LF	$4.65	MEANS/ELEC/89.2-720-0360	4,185
(I) 30-HP MOTOR FEEDER WIRE	100	LF	$5.31	MEANS ELEC/89.2-720-0520	531
(J) CONDUIT - 1" PVC	900	LF	$2.35	MEANS/ELEC/160-205-9120	2,115
(K) CONDUIT - 3/4" PVC	100	LF	$1.97	MEANS/ELEC/160-205-9110	197
(L) HAND HOLES-FOR WIRE PULLING	6	EA	$469.00	MEANS/ELEC/167-110-0600	2,814
(M) UTILITY TRENCHING/BACKFILL	900	LF	$2.24	MEANS SITE/12.3-110-1320	2,016
(N) CONCRETE - CONDUIT BEDDING	100	CYD	$45.70	MEANS/SITE/033-122-0010	4,570
31,(Intentionally Blank)					0

32)WELL DEVELOPMENT- 5 HR/WELL (INCLUDES LABOR,EQUIP.,MATL)	10	HOUR	$175.00	VENDER QUOTE	1,750
33)PUMP TESTS- 2 WELL,72-HR.EACH (INCLUDES LABOR,EQUIP.,MATL)	144	HOUR	$150.00	VENDER QUOTE	21,600
34)(Intentionally Blank)					
35)(Intentionally Blank)					0
36)OTHER ELECTRICAL/INSTRUMENTATION					
(A) WEATHER-PROOF ENCLOSURES AT WELLHEAD,CONT. PROTECT.	2	EA	$500.00	ASSUMED	1,000
(B) INTERIOR LIGHTING/RECEPTACLES FOR PUMP BUILDING	900	SFT	$4.12	MEANS/MECH/171-400-2900	3,708
(C) WATER LEVEL CONTROLS	3	EA	$200.00	MEANS/MECH/156-290-5000	600
(D) ELECTRIC UTILITY,SUPPLY TANK	1	EA	$3,000.00	ASSUMED	3,000
(E) NO.10 WIRE,INSTRUMENTS	50	CLF	$28.95	MEANS/ELEC/161-165-0040	1,448
(F) CONDUIT,3/4" PVC	5,000	LF	$1.97	MEANS/ELEC/160-205-9210	9,850
(G) INSTRUMENTATION AT PUMPS FLOW OR PRESSURE SENSORS	1	EA	$2,000.00	ASSUMED	2,000
37)TRENCH/BED 1 DIA. SERVICE LINES 4-FT.DEEP,2-FT. WIDE	3,500	LF	$4.12	MEANS,SITE 022.3-1101-010	14,420
38)(Intentionally Blank)					
39)(INTENTIONALLY BLANK)					
40)MAIN LINE VALVES, 6"DIA. IRON	6	EA	$410.00	MEANS/SITE/151-960-6070	2,460
41)DISINFECTION, CHLORINE FEEDER	2	EA	$175.00	MEANS,MECH/153-150-2600	350
42)IRON REMOVAL, 77 GPM, 2.5"DIA.PIPE	2	EA	$4,815.00	MEANS,MECH/152-184-8360	9,630
					0
43)BOREHOLE GEOPHYSICS	1	EA	$5,000.00	ASSUMED	5,000
					0
44)GEOTECHNICAL LABORATORY TESTS	1	EA	$2,000.00	ASSUMED	2,000
45)LONG-TERM PUMP TEST (ONE TEST)	720	HR	$50.00	ASSUMED	36,0
46)WATER ANALYTICS - TO EVALUATE TREATMENT REQUIREMENTS	1	EA	$500.00	ASSUMED	0 500
A) SUB-TOTAL (A)					593,269

AR301057

ORIGINAL (Red)

B) SUBCONTRACTORS WORK ESTIMATED AT 35% OF SUB-TOTAL					118,654
C) FEE AT 10% OF SUBCON. WORK					11,865
D) SUB-TOTAL (B) = (A) PLUS FEE					605,134
E) CITY INDEX COST ADJUSTMENT AT 0.949 AVERAGE FOR READING, PENNSYLVANIA APPLIED TO SUB-TOTAL (B)				BASED ON MEANS/SITE/CITY COST INDEX,APPENDIX(1988)	574,272
F) TOTAL ADJUSTED DIRECT COSTS (TADC)					574,272
G) INDIRECT CONTRACTOR COSTS AT 35% OF TADC				BASED ON MEANS/SITE/APPX.	200,995
H) CONTRACTOR PROFIT AT 10% OF TADC + INDIRECT					77,527
I) TOTAL FIELD COST (TFC)					852,794
J) HEALTH AND SAFETY COST ALLOWANCE AT 5% OF TFC					42,640
K) CONTINGENCY COST AT 20% OF TFC					170,559
L) ENGINEERING COST AT 10% OF TFC					85,279
M) TOTAL CAPITAL COST TFC PLUS H PLUS CONT. PLUS ENG.					$1,151,272

AR301058

SYSTEM: PUBLIC WATER SUPPLY OPPWS2.WK1

BERMS SAND PIT ANNUAL OPERATION COSTS

NO.	ITEM DESCRIPTION	ANNUAL QUANTITY	UNITS	UNIT COST	ANNUAL COST
1)	OPERATING LABOR				$0
	(A) OPERATOR	416.00	HR	$25.00	$10,400
	(METER READING,				$0
	SAMPLING,ETC)				$0
	(B)				$0
					$0
					$0
	(C)				$0
					$0
2)	MAINTENANCE MATERIALS				$0
	(A) PAINT-STORAGE TANK	0.20	EA	$400.00	$80
					$0
					$0
	(B) PIPE - BROKEN MAIN	20.00	LF	$24.00	$480
					$0
					$0
	C				$0
					$0
					$0
3)	MAINTENANCE LABOR				$0
	- PAINTING CREW	0.50	DAY	$800.00	$400
					$0
					$0
	(B) PUMP REPLACEMENT	0.50	EA	$500.00	$250
					$0
					$0
	(C) WATER MAIN REPAIR	0.50	DAY	$592.00	$296
					$0
	C TREATMENT REPLACEMENT	40.00	HR	$25.00	$1,000
					$0
4)	AUXILIARY MATERIALS/LABOR				$0
	(A) REPLACE PUMPS	0.10	EA	$4,500.00	$450
					$0
					$0
	(B) TRMT. CHEMICALS	1.00	EA	$8,000.00	$8,000
					$0
					$0
	(C)				$0
					$0
5)	PURCHASED SERVICES				$0
	(A) ELECTRICAL POWER	7,500.00	KW-HR	$0.07	$525
					$0
					$0

AR301059

ORIGINAL (Red)

				$0
				$0
				$0
				$0
				$0
				$0
(D)				$0
				$0
				$0
(E)				$0
				$0
6) DISPOSAL				$0
(A) SLUDGE AND DEBRIS	10.00	CYD	$100.00	$1,000
				$0
				$0
(B)				$0
				$0
				$0
(C)				$0
				$0
7) ADMINISTRATION				$0
(A) FEE ADMINISTRATOR	192.00	HR	$45.00	$8,640
				$0
(B) OFFICE CLERICAL	192.00	HR	$25.00	$4,800
				$0
8) INS.,PLACE,TAXES,LICENSES				$0
(A) INSURANCE	1.00	EA	$2,000.00	$2,000
(B) PROPERTY TAXES	1.00	EA	$1,000.00	$1,000
(C)				$0
				$0
				$0
				$0
				$0
9) OTHER COSTS				$0
(A) WATER QUALITY TESTING	12.00	MONTH	$150.00	$1,800
				$0
				$0
(B) ENGINEERING	40.00	HR	$70.00	$2,800
				$0
				$0
(C) EQUIPT. COMPONENTS REPL.	1.00	EA	$1,996.00	$1,996
				$0
				$0
A) SUBTOTAL (A)				$45,917
B) CONTINGENCY COST AT 20% OF SUBTOTAL(A)				$9,183

AR301060

ORIGINAL (Red)

C) SALVAGE AND DECOMMISSION: AT 100% CAPITAL COSTS INCURRED AT 30-TH YEAR, INTEREST = 10% ANNUAL SINKING PAYMENT	$0			$0
D) ANNUALIZED CAPITAL COST				$55,100
E) PRESENT WORTH AT 10% INTEREST AT 30 YEARS				$519,427

Baker Engineers

S.O. No. 15438-17-SRI

ORIGINAL Red.

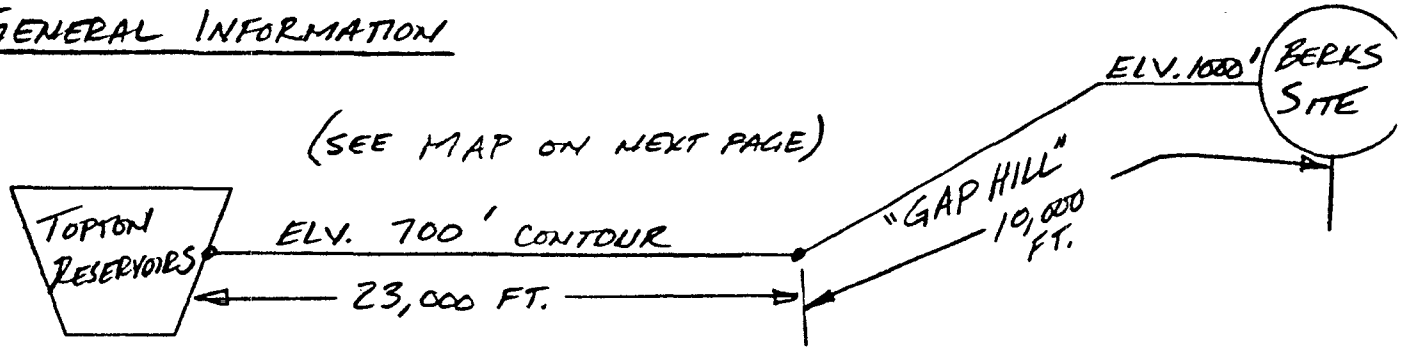
Subject: BERKS FS
ALTERNATE WATER SUPPLY — Sheet No. 1 of 8
TOPTON, PA SOURCE — Drawing No.

Computed by LJS — Checked By RPA — Date 10/11/88

THE PURPOSE OF THESE CALCULATIONS IS TO PROVIDE A VERY PRELIMINARY COST ESTIMATE TO PROVIDE WATER TO BERK'S SITE FROM TOPTON, PA MUNICIPAL AUTHORITY.

GENERAL INFORMATION

(SEE MAP ON NEXT PAGE)



TOTAL DISTANCE ≈ 33,000 FT. (6 1/4 MILES)

ELEVATION DIFFERENCE ≈ 300 FT.

FLOW REQUIRED:

@ 135 DESIGN POPULATION @ 181 GPCD
24,500 GPD 17 GPM

PIPE SIZING

DRISCOPIPE MANUAL (1981)

$$ID = 0.639\sqrt{\frac{Q}{V}}$$ ASSUME V = 3 FPS

NEED: MINIMUM ID = 1.52 INCHES

FOR: DRISCOPIPE 1000 HDPE PE 3408 PIPE
@ SDR 17 @ 100 PSI RATING

USE: NOMINAL DIAMETER 3-INCH
SMALLEST COMMERCIAL SIZE

AR301062

Baker Engineers

S.O. No. 15438-17-SRI

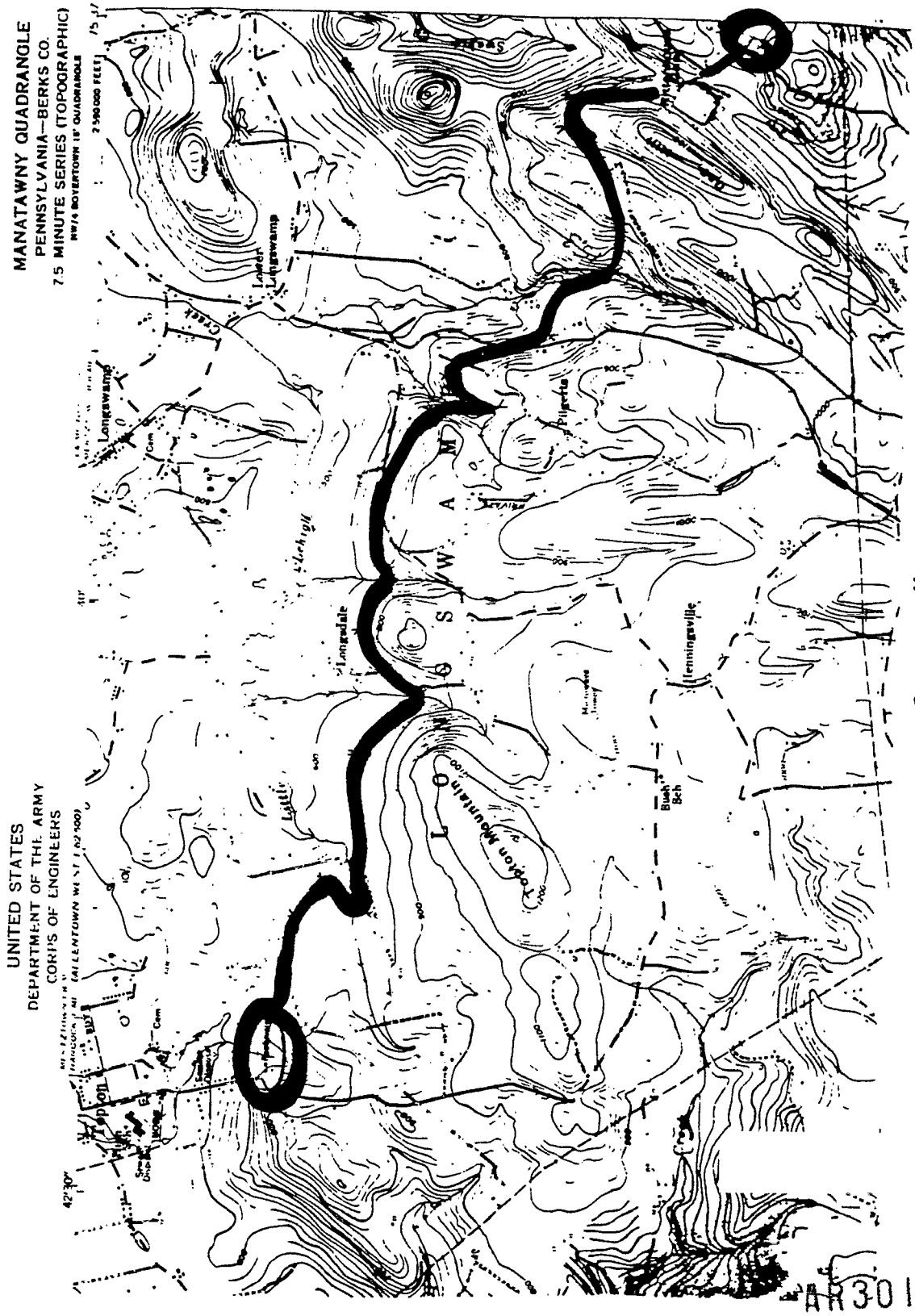
ORIGINAL (Red)

Subject: BERKS RI/FS
ALTERNATE WATER SUPPLY
TOPTON, PA

Sheet No. 2 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88



AR301063

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS FS
A. W. S.
TOPTON

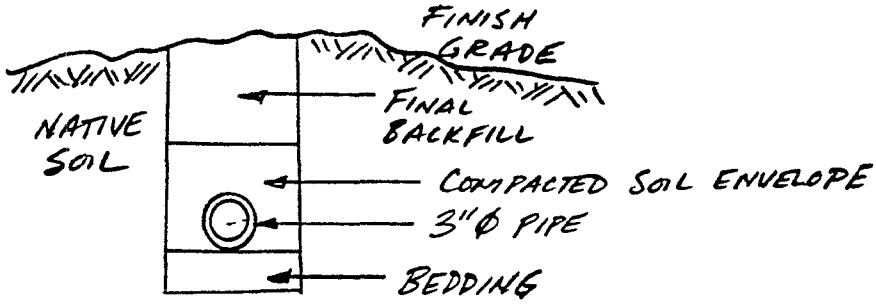
Sheet No. 3 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

ORIGINAL

PIPE TRENCHING & BEDDING



MEANS 1988 SITE COST DATA:

(a) TRENCHING 12.3-110-1330
BACKHOE 0:1 SIDESLOPES 2' WIDE 4' DEEP
$ 2.95/LF

(b) BEDDING 12.3-310-1460 $ 1.17/LF

UNIT TOTAL $ 4.12/LF TRENCH & BED BARE COST

(c) PIPE 3"Ø PVC CLASS 160 SDR 26
626-678-2160 $ 3.36/LF BARE COST
(DOES NOT INCLUDE DELIVERY COSTS)

UNIT TOTAL/LF FOR PIPE, TRENCH, & BED $7.48/LF
BARE COST

(33,000 LFT x $ 7.48/LF) ≅ $ 246,900.00

INCLUDES EQUIPMENT & LABOR COSTS

AR301064

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS FS
A.W.S.
TOPTON

Sheet No. 4 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

PIPING DELIVERY COSTS

ASSUME PIPE IS SHIPPED IN 10-FT. SECTIONS

$(33{,}000/10) = 3{,}300$ SECTIONS

$A = \frac{0.0625 \text{ SQFT}}{\text{PIPE}} \times 3{,}300 = 206$ SQFT

ASSUME TRUCK IS 7' WIDE × 7' HIGH = 49 SQFT

$(206/49) \approx 5$ TRUCK LOADS (EXTRA ROOM FOR FITTINGS, ETC.)

ASSUME \$1,500/TRUCK TO SHIP PIPE

∴ PIPE DELIVERY COST \$7,500 F.O.B. TOPTON, PA

PUMP REQUIREMENTS

(a) STATIC HEAD = 300 FT.

(b) FRICTION LOSS:

$$\Delta P_{100} = 452\, Q^{1.85} / C^{1.85} D^{4.86} \quad \text{(psi loss/100 ft.)}$$

$Q = 17$ GPM
$C = 155$
$D = 3.088$ INCHES

$\Delta P_{100} = 0.0316$ psi/100 FT.

$\Delta P = \left(0.0316 \times \frac{33{,}000'}{100}\right) = 10.42$ PSI

AR301065

Δ HEAD $= (10.42 \text{ psi} \times 144)/62.4 = 24$ FT. FRICTION LOSS

Baker Engineers

S.O. No. 15438-17-SRI ORIGINAL (Red)

Subject: BERKS FS
A.W.S.
TOPTON

Sheet No. 5 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

(c) MINOR HEAD LOSSES

ASSUME: 6 FT

(d) TOTAL HEAD REQUIRED

$(300 + 24 + 6) \cong 330$ FT.

(e) HYDRAULIC H.P.

$(17 \text{ GPM} \times 8.345 \text{ lb/GAL}) \cong 142 \text{ lb/MIN.}$

$$\left(\frac{142 \times 330 \text{ FT. HEAD}}{33{,}000}\right) = 1.42 \text{ HYD. HP.}$$

(f) BRAKE H.P.

ASSUME PUMP EFFICIENCY OF 60%

$$\left(\frac{1.42}{0.60}\right) \cong 2.4 \text{ BHP}$$

(g) ESTIMATED PUMP COST:

VENDER QUOTE PITTSBURGH, PA:

NEED TO INCREASE FLOW TO Q = 100 GPM TO GET REASONABLE OPERATION AT TDH = 330 FT.

COST $ 2,000 FOB BERKS SITE

(20 HP MOTOR, IRON PUMP)

NOTE: THIS WOULD INCREASE PIPE SIZE TO 4-INCH NOMINAL

AR301066

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS F.S.
A.W.S.
TOPTON

Sheet No. 6 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

CLEAR & GRUB FOR PIPE TRENCH

ASSUME 20-FT WIDTH OF SWATCH FOR MOVING MACHINES & PLACING TRENCH

$$\left(\frac{20' \times 33{,}000'}{43{,}560}\right) = 15 \text{ ACRES}$$

MEANS 1988 SITE WORK COST DATA:

021-104-0200 MEDIUM TREES TO 12"Ø CUT/CHIP
$ 2,375/ACRE BARE COST

($2,375/AC × 15 AC) ≅ $ 35,700 CLEAR & GRUB

CAPITAL COST ESTIMATE (ITEMS MARKED WITH * REFER TO PREVIOUS A.W.S. CALCULATION

$ 35,700	CLEAR & GRUB
246,900	PIPE INSTALLATION
49,400	FITTINGS, THRUST BLOCKS, ETC. (AT 20% OF PIPE INSTALLATION)
7,500	PIPE DELIVERY (FOB BERKS SITE)
2,000	PUMP (FOB BERKS SITE)
2,000	PUMP INSTALLATION, HOUSING, WIRING, ETC. (AT 100% OF PUMP)
57,000 *	WATER STORAGE TANK (100,000 GAL/STEEL)
11,900 *	FOUNDATION FOR STORAGE TANK

AR301067

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS FS
A.W.S.
TOPTON

Sheet No. 7 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

$ 13,000 *	STORAGE TANK INSTALLATION
106,000 *	PIPE, 8"Ø MAIN
24,000 *	TRENCH & BED 8"Ø MAIN
23,000 *	ROAD REPAIR PAVING
30,000 *	MOB/DEMOB COSTS
24,500 *	WATER SERVICE CONNECTIONS
14,500 *	TRENCH/BED 1"Ø SERVICE LINES
4,000 *	MAIN LINE VALVES
$ 651,400	SUB-TOTAL COSTS
13,000	SUB-CONTRACTOR FEES @ 10% OF 20% OF SUB-TOTAL
$ 664,400	SUB-TOTAL
630,500	CITY COST INDEX ADJUSTMENT @ 0.949 FOR READING, PA
$ 630,500	TOTAL ADJUSTED DIRECT COSTS (TADC)
220,700	CONTRACTOR OVERHEAD @ 35% OF TADC
85,100	CONTRACTOR PROFIT @ 10% OF (TADC + OVERHEAD)
$ 936,300	TOTAL FIELD COST (TFC)

AR301068

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS FS
A.W.S.
TOPTON

Sheet No. 8 of 8

Drawing No.

Computed by LJS Checked By RPA Date 10/11/88

$ 936,300	T.F.C.
-0-	HEALTH & SAFETY COST ALLOWANCE
187,300	CONTINGENCY COST AT 20% OF TFC
93,600	ENGINEERING COST AT 10% OF TFC
$ 1,217,000	TOTAL CAPITAL COSTS

AR301069

S.O. No. 15438-17-SRI

Subject: BERKS FS.
A.W.S.
TRAILER PARK

Sheet No. 1 of 5

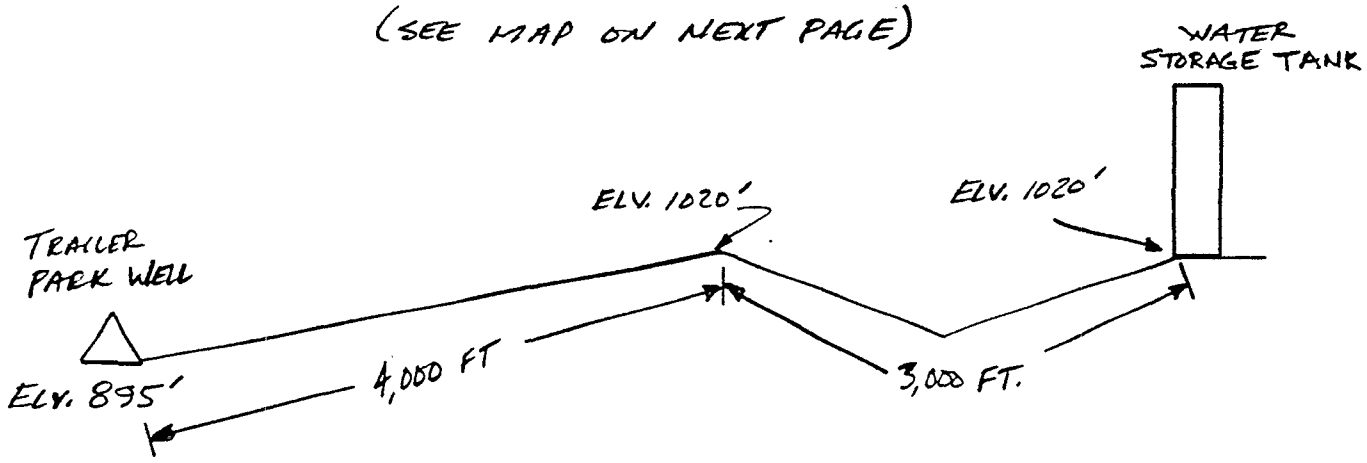
Drawing No.

Computed by LJS Checked By RPA Date 10/13/88

THE PURPOSE OF THIS CALCULATION IS TO PROVIDE A VERY PRELIMINARY COST ESTIMATE TO PROVIDE WATER TO THE BERK'S SITE FROM THE EXISTING TRAILER PARK WATER SUPPLY.

GENERAL INFORMATION

(SEE MAP ON NEXT PAGE)



TOTAL DISTANCE ≈ 7,000 FEET (1 1/3 MILES)

ELEVATION DIFFERENCE = (1020 - 895) = 125 FT.

FLOW REQUIRED: 24,500 GPD (17 GPM)

@ 135 DESIGN POPULATION @ 181 GPCD

PIPE SIZING

USE PLASTIC PIPE DRISCOPIPE 3" NOMINAL DIAMETER AT VELOCITY. ASSUMED AT 3 FPS, C=155

DRISCOPIPE 1000 HDPE PE 3408 PIPE

@ SDR 17 @ 100 PSI RATING

AR301070

Baker Engineers

S.O. No. 15438-17-SRI

ORIGINAL (Red)

Subject: BERKS A.W.S. TRAILER PARK

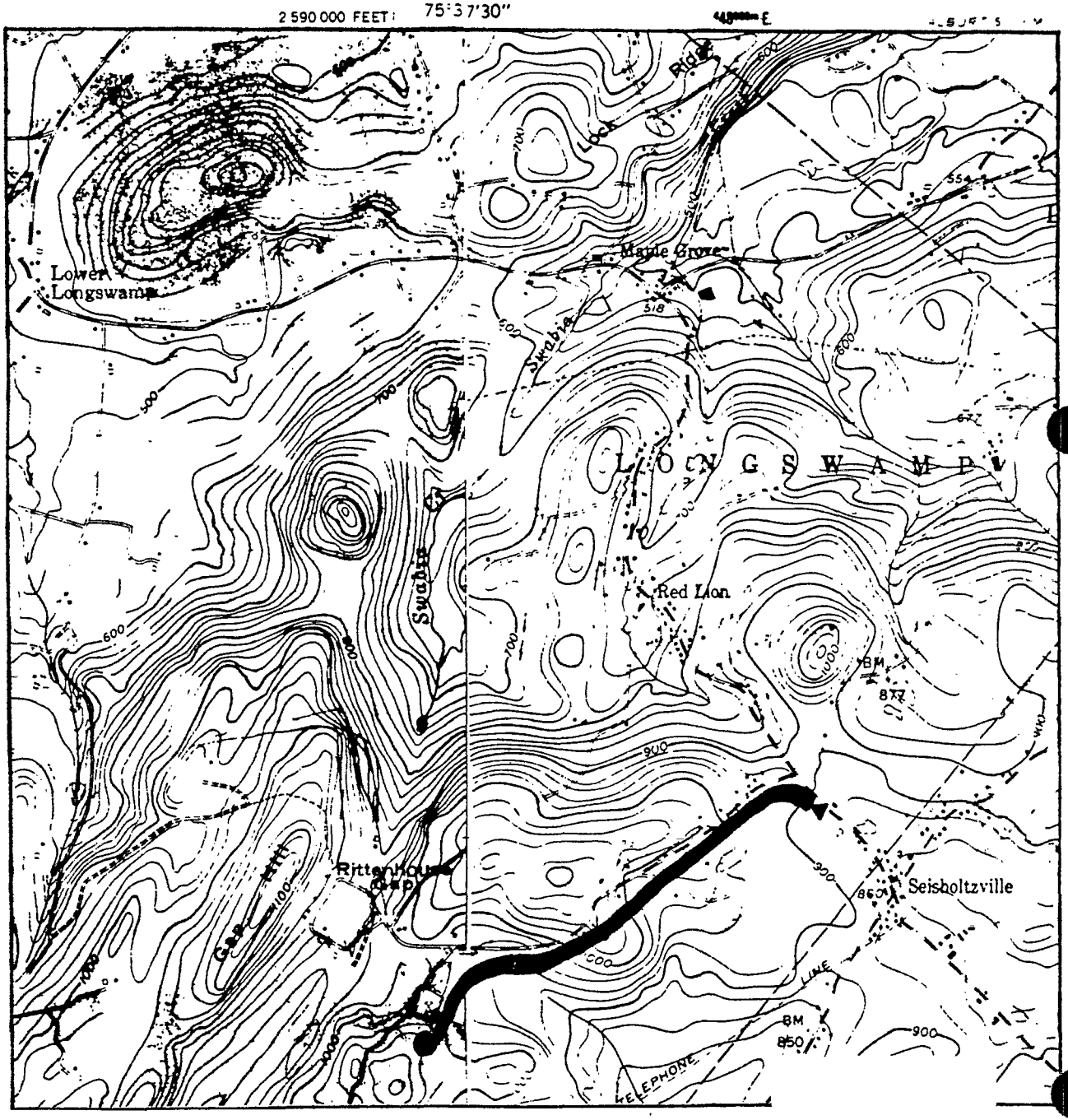
Sheet No. 2 of 5

Drawing No.

Computed by LJS Checked By RPA Date 10/13/88

MANATAWNY QUADRANGLE
PENNSYLVANIA—BERKS CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 BOYERTOWN 15' QUADRANGLE

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



APPROXIMATE SCALE 1" = 2,000 FEET

● - STORAGE TANK ▼ - TRAILER

AR301071

Baker Engineers

S.O. No. 15438-17-SRI (ORIGINAL)

Subject: BERKS FS
A. W. S.
TRAILER PARK

Sheet No. 3 of 5

Drawing No.

Computed by LJS Checked By RPA Date 10/13/88

PIPE TRENCHING AND BEDDING

(REFER TO A.W.S. CALCULATIONS FOR TOPTON, PA SOURCE)

$7.48/LF TO: TRENCH
BED
PURCHASE PIPE
EQUIPMENT & LABOR INCLUDED

($7.48/LF x 7,000) ≅ $52,400

PIPE DELIVERY COSTS

(7,000/10) = 700 SECTIONS OF PIPE x 0.0625 FT² / SECTION = 44 SQ FT.

44 < 49 SQFT PER TRUCK LOAD (∴ NEED 1 TRUCK LOAD)

($1,500/TRUCK LOAD x 1) = $1,500 TO FOB PIPE AT SITE.

PUMP REQUIREMENTS

ASSUME PUMP COST IS SAME AS FOR TOPTON, PA A.W.S.

$2,000

CLEAR AND GRUB FOR PIPE TRENCH

USE SAME ASSUMPTIONS AS TOPTON, PA A.W.S.

$\left(\frac{20' \times 7,000'}{43,560}\right)$ = (3.2 ACRES x $2,375/AC)

AR301072

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS FS
A.W.S.
TRAILER PARK

Sheet No. 4 of 5

Drawing No.

Computed by LJS Checked By RFA Date 10/13/88

CAPITAL COST ESTIMATE (* REFERS TO PREVIOUS A.W.S. COST ESTIMATES)

$ 7,700	CLEAR & GRUB TRENCH LINE
52,400	PIPE INSTALLATION
10,500	FITTINGS, THRUST BLOCKS, ETC. (AT 20% OF PIPE INSTALLATION COST)
1,500	PIPE DELIVERY (FOB BERKS SITE)
2,000	PUMP (FOB BERKS SITE)
2,000	PUMP INSTALLATION, WIRING, HOUSING, ETC (AT 100% OF PUMP COST)
57,000 *	WATER STORAGE TANK (50,000 GAL STEEL)
11,900 *	FOUNDATION FOR TANK
13,000 *	TANK INSTALLATION
106,000 *	PIPE, 8" Ø MAIN
24,000 *	TRENCH & BED MAIN
23,000 *	ROAD REPAIR PAVING
24,500 *	WATER SERVICE CONNECTIONS
14,500 *	TRENCH/BED 1" Ø SERVICE
4,000 *	MAIN LINE VALVES
20,000 *	MOB/DEMOB (REDUCED TO REFLECT SIZE OF PROJECT)
$ 374,000	SUB-TOTAL COSTS

AR301073

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS FS
A.W.S.
TRAILER PARK

Sheet No. 5 of 5

Drawing No.

Computed by LJS Checked By RPA Date 10/13/88

$ 374,000	SUB-TOTAL COSTS
7,500	SUB-CONTRACTOR FEES AT 10% OF 20% OF SUB-TOTAL
381,500	SUB-TOTAL
362,000	CITY COST ADJUSTMENT 0.949 READING, PA
362,000	TOTAL ADJUSTED DIRECT COSTS (TADC)
126,700	CONTRACTOR OVERHEAD AT 35% OF TADC
48,900	CONTRACTOR PROFIT AT 10% OF TADC + OVERHEAD
537,600	TOTAL FIELD COST (TFC)
-0-	HEALTH AND SAFETY ALLOWANCE
107,500	CONTINGENCY AT 20% OF TFC
53,800	ENGINEERING AT 10% OF TFC

$ 699,000 TOTAL CAPITAL COSTS

AR301074

SEDIMENT EXCAVATION

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Berks Sand Pit Sediment Excavation, Transport and Disposal

Sheet No. 1 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/12/88

REVISION #1

- Assume 5 seeps will be excavated, transported and incinerated
- Excavation by ½ CY wheel mounted Backhoe
- 4WD Pick-up for crew & drum transport (on-site)
- 2 CY per seep
- 1 operator
  2 Laborers
  1 Geologist/Engineer
  1 Health and Safety Officer
- Containerize soil in 55 gal drums
- Allow ¼ CY per drum

1. Excavation:
   1 Hours to mobilize to seep
   3 Hours to excavate and containerize soils and to stage drum

   4 hours per seep

   5 seeps × 4 hours/seep = 20 hours
   USE 24 hours or 3 days

2. Equipment: Crew B-6 Means Site Cost pg VIII
   2 Laborers
   1 light equip operator
   1 Backhoe Loader, 48 Hp
   Bare Cost 591.60/Day

   4WD Pickup: $170/wk

   For 3 days: (3 days × 591.60/day) + $170 = $1944.80
   USE $1945

AR301076

Baker Engineers

S.O. No. 15438-17-SR1

Subject: Beaks Sand Pit
Sediment Excavation, Transport and Disposal

Sheet No. 2 of 2

Drawing No.

Computed by RPA Checked By PJW Date 9/12/88

REVISION #1

3. Professional

1 Geologist for 40 hrs at $70/hr = $2800

1 Health & Safety for 40 hrs at $70/hr = $2800

4. Drums:

5 seeps x 2 CY/seep = 10 CY

and

4 DRUMS/CY x 10 CY = 40 DRUMS

5 Transport

Assume $4.00 load-mile at 200 miles and 1 load

200 mi x 4.00 load mile = $800 load

6. Incineration $650/drum x 40 drums = $26,000 (vendor quote)

7. Analytics Assume $850/sample

Take one composite sample per seep

$850/sample x 5 samples = $4250.

8. No O&M or Decommissioning

AR301077

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
SEEP EXCAVATION & DISPOSAL

Sheet No. 1 of 3

Drawing No.

Computed by DKS Checked By LJS Date 6/20/83

REVISED 9/12/88
Delete

8 SEEPS ARE TO BE EXCAVATED, DRUMMED & DISPOSED BY INCINERATION.

ASSUMPTIONS

1. EXCAVATION BY ≈1/2 CY, WHEEL MOUNTED BACKHOE
2. PICKUP 4WD FOR CREW AND CARRYING DRUMS IN AND OUT
3. 1 OPERATOR
   2 LABORERS
   1 ENGINEER
   1 HEALTH & SAFETY
4. 2 CY PER SEEP
5. EXCAVATED SOIL IS DRUMMED & HAULED TO INCINERATION

ALLOW (1) 7 CF SOIL PER DRUM

$$\frac{2\,CY}{SEEP} \times \frac{27\,CF}{CY} \times \frac{DRUM}{7\,CF} = \frac{8\,DRUMS}{SEEP}$$

(2) 2 HRS TO MOBILIZE TO SEEP
2 HRS TO EXCAVATE DRUM & LOAD DRUMS & CLEAN AREA.

FOR 8 SEEPS ASSUME 4 HRS OR 1/2 DAY PER SEEP.

$$8\,SEEPS \times \frac{1}{2}\,\frac{DAY}{SEEP} = 4\,DAY$$

FOR COSTS ASSUME 5×8 HOUR DAYS OR 1 WEEK TO DO ALL 8 SEEPS

AR301078

Baker Engineers

S.O. No. F438-17-XX

Subject: BERICS
SEEP EXCAVATION & DISPOSAL

Sheet No. 2 of 3

Drawing No.

Computed by DKS Checked By LJS Date 6/20/88

REVISED 9/12/88
Delete

REF. MEANS SITE WORK COST DATA

4WD PICKUP TRUCK.

016-420-7200 $170/WK

BACKHOE:

USE CREW B-6 PAGE VIII, MEANS SITE COST

2 LABORERS
1 OPERATOR (LIGHT)
1 BACKHOE LOADER, 48 HP

BARE COST = 591.60/DAY

FOR 5 DAY 591.60/DAY × 5 DAY = $2958.00

ENGINEER

40 HRS @ $85/HR = $3400

HEALTH & SAFETY

40 HRS @ $85/HR = $3400

— NO DECOMMISSIONING

AR301079

Baker Engineers

S.O. No. 15438-17-SRE

Subject: BERKS SAND PIT
SEEP EXCAVATION & DISPOSAL

Sheet No. 3 of 3

Drawing No.

Computed by DKS Checked By LJS Date 6/20/88

REVISION DATE: 6/29/88

Delete

		UNIT	QUANTITY	UNIT COST	TOTAL COST
1	MOBILIZATION/DEMOB. ASSUMED	LS	~~EA~~	2000	2000
2	4WD PICKUP TRUCK	WEEK	1	170	170
3	BACK HOE & CREW 1 OPERATOR + 2 LABORERS (MEANS CREW B-6)	DAYS	5	591.60	2958
4	DRUMS ASSUME 8 PER SEEP	EA	64	$25	1600
5	HAUL DRUMS TO INCINERATOR 200 LOAD MILE ASSUMED 1 LOAD	LOAD MILE	200	$3.50	700
6	INCINERATE DRUM TESTING INCLUDED	DRUM	~~64~~ 8	1000	64000
7	ENGINEER	DAY	5	680	3400
8	HEALTH & SAFETY	DAY	5	680	3400
					77,228

AR301080

BERAC DRUM PIT PI PI SEEPS EXCAVATION CAPITAL COSTS
SCH.DATE-17-SEP BERAEXCL.WK1

ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	REFERENCE SOURCE	ITEM TOTAL $
1) EQUIPMENT MOBILIZATION	1	EA	$2,000.00	BASED ON VARIOUS MEANS	2,000
2) DEMOBILIZATION EQUIPMENT & SITE CLEANUP	1	EA	$2,000.00	ASSUMED	2,000
3) SITE PREPARATION CLEAR AND GRUB (LIGHT TREES)	2	ACRES	$1,660.00	MEANS/SITE/021-104-0010	3,320
4) EXCAVATE SOIL AT SEEPS 2-CYD/SEEP,8 SEEPS	3	DAYS	$591.60	MEANS/SITE/CREW B-6	1,775
5) LIGHT TRUCK RENTAL FOR DRUM EQUIP. TRANSPORT	1	WK	$170.00	MEANS/SITE/016-420-7200	170
6) ENGINEER ON-SITE INCLUDES ALL COSTS	[illegible]	HR	$[illegible].00	ASSUMED	2,800
7) HEALTH & SAFETY OFFICER ON-SITE	[illegible]	HR	$70.00	ASSUMED	[illegible]
8) DRUM DISPOSAL DUE TO STEEL	[illegible]	EA	$[illegible].00	ASSUMED	[illegible]
9) DRUM TRANSPORTATION TO INCINERATOR	200	LOAD-MILE	$4.00	ASSUMED	800
10) DRUM INCINERATION TESTING ANALYSIS INCLUDED	[illegible]	SAMPLES	$850.00	ASSUMED	4,250
11) ANALYSIS, SURFACE WATER/SEDIMENTS	25	TESTS	$150.00	ASSUMED	3,750
12) (INTENTIONALLY BLANK)					
A) SUB-TOTAL (A)					$24,665
B) SUBCONTRACTORS WORK ESTIMATED AT 20% OF SUB-TOTAL					$4,933
FEE AT 10% OF SUB. WORK					$493
C) SUB-TOTAL (B) = (A) + FEE					$
D) CITY COST INDEX ADJUSTMENT				BASED ON MEANS/SITE/CITY	

AT 1.049 AVGERAGE FOR READING, PENNSYLVANIA APPLIED TO SUBTOTAL B			COST INDEX APPENDIX [illegible] FOR READING, PA	$[illegible]
E) TOTAL ADJUSTED DIRECT COSTS (TADC)				$23,875
F) INDIRECT CONTRACTOR COSTS AT 35% OF TADC			BASED ON MEANS/SITE/APPX.	$8,356
G) CONTRACTOR PROFIT AT 10% OF TADC + INDIRECT				$3,223
H) TOTAL FIELD COST (TFC)				$35,454
I) HEALTH AND SAFETY COST ALLOWANCE AT 5% OF TFC				$1,773
J) CONTINGENCY COST AT [illegible]% OF TFC				$[illegible]
K) ENGINEERING COST AT [illegible]% OF TFC				$[illegible]
L) TOTAL CAPITAL COST TFC + H&S + CONT + ENG				$47,[illegible]

CARBON ADSORPTION TREATMENT SYSTEM

ORIGINAL

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT FS
REVISION #1
GAC TREATMENT

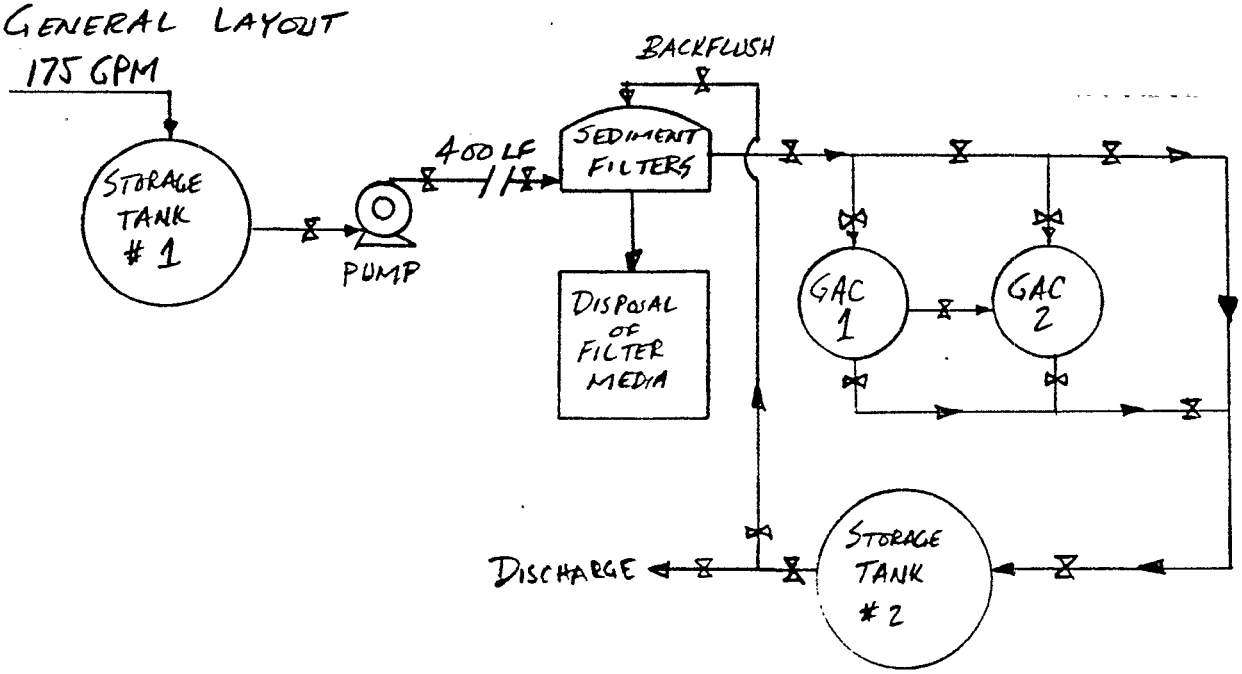
Sheet No. 1 of 3

Drawing No.

Computed by LJS Checked By RPA Date 10/19/88

THESE CALCULATIONS REVISE THE 6/22/88 FS DESIGN FOR THE GRANULAR ACTIVATED CARBON TECHNOLOGY (GAC):

(1) GENERAL LAYOUT



(2) STORAGE TANKS 1 & 2

Q = 175 GPM PROVIDE 1/2 DAY DETENTION TIME

$$\text{VOLUME} = \left(\frac{175\ \text{GPM} \times 60 \times 12\ \text{HR/DAY}}{7.481\ \text{GAL/CFT}}\right) \equiv 16{,}850\ \text{CFT}$$

(126,000 GALLONS)

USE:

MEANS/SITE 1988/132-051-0900 100,000 GALLON TANK-STEEL CIRCULAR CYLINDER

$ 84,000 (13,367 LBS)

ASSUME TANK HEIGHT IS 15 FEET; AREA = 891 SQFT

D = 34 FT.

AR301084

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT FS
REVISION #1
GAC

Sheet No. 2 of 3

Drawing No.

Computed by LJS Checked By. RPA Date 10/19/88

TANK FOUNDATION:

ADD 2-FT TO D=34; D=36 AREA = 1,018 SQ FT.

$$\left(100{,}000\ GAL \times \frac{8.345\ lb/GAL}{2000} / 1{,}018\right) \equiv 0.41\ TON/SQ\ FT.$$

BEARING LOAD

ASSUME 2-FT THICK REINFORCED CONCRETE WILL BE SUFFICIENT TO SUPPORT BEARING LOAD.

$$\text{CONCRETE VOLUME: } \frac{(2' \times 1{,}018)}{27} \equiv 75\ CYD$$

MEANS/SITE/633-130-4050 \$148.30/CYD INSTALLED REINFORCED CONCRETE

(3) PIPING

Q = 175 GPM DRISCOPIPE 8600 HDPE ASSUME VELOCITY = 5 FPS

$$ID = 0.639\sqrt{\frac{175}{5}} = 3.78''$$ USE 4" Ø NOMINAL PIPE

ACTUAL ID = 3.920" SDR 15.5

(4) PUMP

Q = 175 GPM ELEVATION HEAD = (960 - 930) = 30 FT.

$$\Delta P_{100}^{3.920''} = \frac{452\,(175^{1.85})}{(155^{1.85})(3.920^{4.86})} = 0.74\ PSI/100\ FT.$$

$$\left(0.74 \times \frac{400}{100}\right) \equiv \frac{3\ PSI \times 144}{62.4} \equiv 7\ FT.$$ HEAD LOSS TO PIPE FRICTION

MINOR LOSSES: ASSUME 3-FT.

TOTAL DYNAMIC HEAD ≡ 40 FT.

ASSUME PUMP COST \$2,000 BASED ON EXPERIENCE

AR301085

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S.O. No. 5438-17-SRI

Subject: BERKS SAND PIT FS
REVISION #1
GAC

Sheet No. 3 of 3

Drawing No.

Computed by LJS Checked By RPA Date 10/19/88

(5) FILTERS

Q = 175 GPM = 10,500 GPH

3 UNITS AT 3,480 GPH EACH

MEANS/MECH/152-184-8960 $4,525 EACH

(6) GAC UNITS

2 ON-LINE IN SERIES Q = 175 GPM EACH

CALGON CORP-VENDER QUOTE

MODEL No. 7½ SKID MOUNTED

$90,000 PURCHASE 10,000 lb. CARBON EACH

Q_{MAX} = 350 GPM IN SERIES

(7) PIPING REQUIREMENTS

USE 4"Ø PVC NEED: 400', 265', 120', 135' } 920 FT.

(8) FITTINGS - ESTIMATED QUANTITIES

17 GLOBE VALVES
5 CHECK VALVES
92 COUPLINGS @ 10'
4 TEES
30 90° ELBOWS

} ALL 4"Ø

(9) ELECTRICAL, BUILDING, AND FENCING:

— AS IN 6/23/88 CALCULATIONS —

AR301086

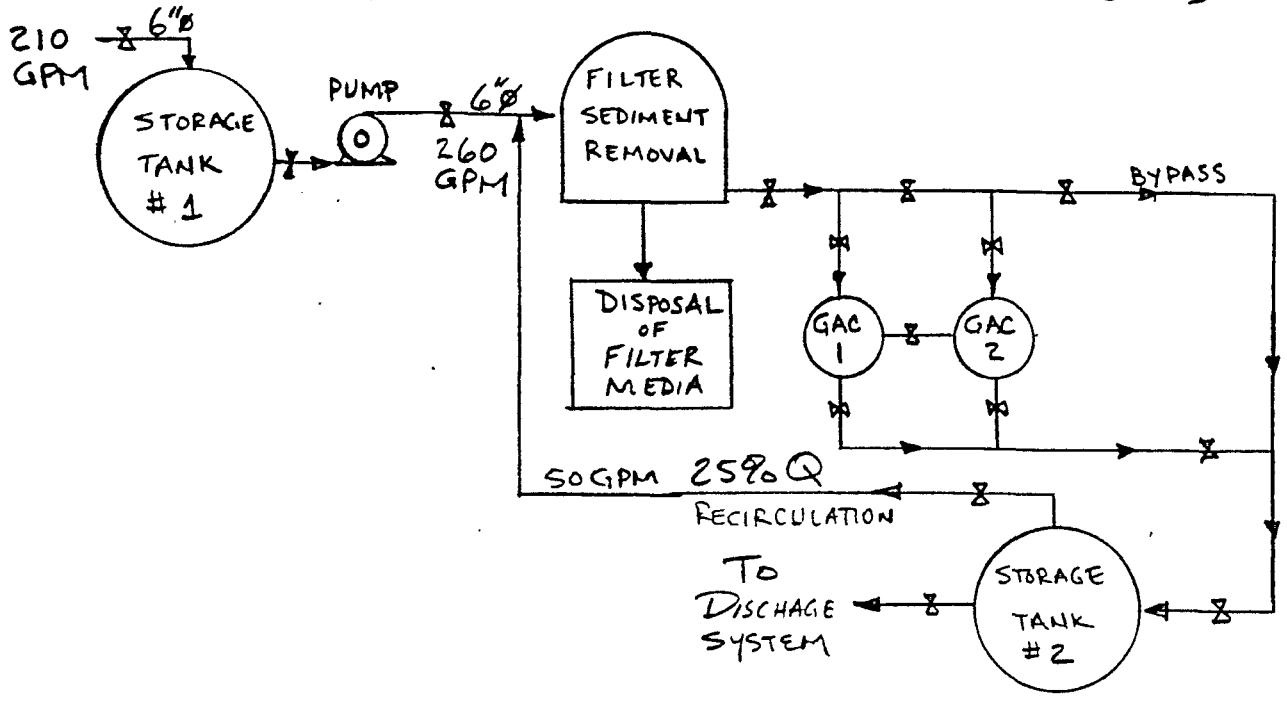
S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TREATMENT
FS- DESIGN

Sheet No. 1 of 10
Drawing No.

Computed by LJS Checked By RAK Date 6/22/88

(1) GENERAL LAYOUT - GRANULAR ACTIVATED CARBON (GAC) TRMT.



(2) STORAGE TANKS #1 AND #2

(a) Q = 210 GPM

DT = 1/2 DAY MINIMUM

$$V = \left(\frac{210 \times 60 \times 12 \text{ HR/DAY}}{7.481}\right) = 20,200 \text{ CFT MINIMUM}$$

(151,200 GAL)

(750 CYD)

(b) TANKS

STEEL, ABOVE GROUND; 250,000 GALLON (0.83 DAYS STORAGE)

MEANS/SITE/132-051-1000 @ H=25' D=41'

SAY $95,000 NOT INCLUDING FOUNDATION, PROFIT

(c) FOUNDATIONS: ASSUME 15' HIGH TANK AREA = 2,228 SFT

CIRCULAR 3' THICK MAT ~250 CYD MAT

MEANS/SITE/033-130-4050 $148.30/CYD

AR301087

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TREATMENT
FS - DESIGN

Sheet No. 2 of 10

Drawing No.

Computed by LJS Checked By Date 6/22/88

(3) PUMP SIZING

$Q = 210$ GPM $\times$ 1.25 RECIRCULATE $\equiv$ 260 GPM

ELV. HEAD $= (960' - 930') = 30'$ HEAD

400' PIPE: PUMP AT STORAGE TANK #1 TO FILTER UNIT

DRISCOPIPE 8600

VELOCITY = 5 FPS

$ID = 0.639 \sqrt{\frac{260}{5}} = 4.608''$

USE 6"Ø NOMINAL

ACTUAL ID = 5.771" SDR 15.5

$\Delta P_{100}^{5.771''\phi}$ $Q = 260$ GPM $= 0.40$ PSI/100'

$\Delta H_{100} = 0.924$ FT/100' PIPE

FRICTION HEAD $= \left(\frac{400}{100} \times 0.924\right) = 3.7$-FT HEAD

MINOR LOSSES = SAY 2 FT.

$\therefore$ TDH $\equiv 36'$ HEAD

AT 65% PUMP EFFICIENCY

BHP = 3.6 HP

AT 85% MOTOR EFFICIENCY

KW MOTOR LOAD = 3.2 KW

AR301088

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TREATMENT
FS- DESIGN

Sheet No. 3 of 10

Drawing No.

Computed by LJS Checked By RAK Date 6/22/88

(4) FILTERS - SEDIMENT REMOVAL

Q = 260 GPM = 15,600 GPH

FIVE UNITS AT 3,480 GPH EACH

MEANS/MECH/152-184-8960 $4,525 EA

(5) GRANULAR ACTIVATED CARBON UNITS

2 ON-LINE IN SERIES

Q = 260 GPM TOTAL

CALGON - VENDER QUOTE

MODEL # 7½ NO BACKWASH NEEDED W/FILTERS

SKID MOUNTED 7½'Ø x 11' 2 VESSELS/SKID

$90,000 PURCHASE FOR BOTH VESSELS

10,000 lb. CARBON EACH $Q_{MAX} \approx 350$ GPM

SERIES OPERATION

(6) PIPING REQUIREMENTS

MATERIAL: DRISCOPIPE 8600 POLYETHYLENE

(a) PUMP AT STORAGE TANK #1 TO FILTER UNIT

L = 400 LF 6"Ø NOMINAL

AR301089

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S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TREATMENT
FS- DESIGN

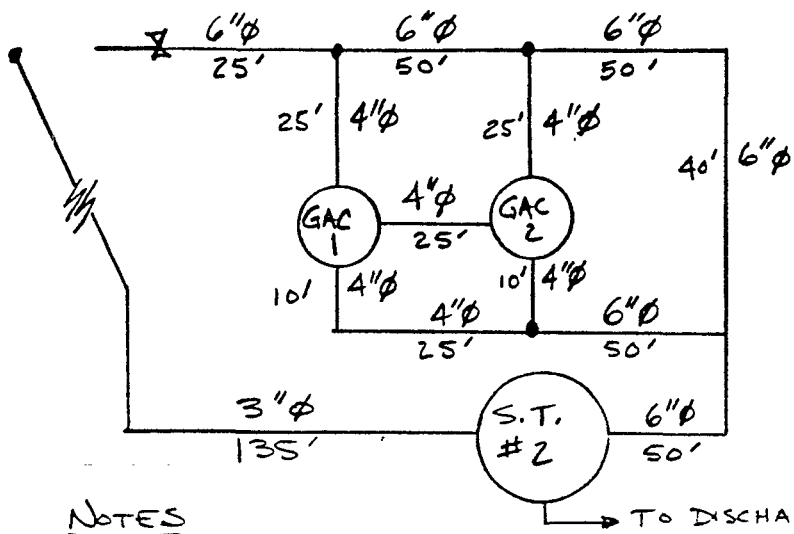
Sheet No. 4 of 10

Drawing No.

Computed by LJS Checked By RK Date 6/23/88

PIPING

(b) FILTER UNIT TO GAC UNITS



PIPE SCHEDULE

ϕ	L
6"	265'
4"	120'
3"	135'

NOTES

- ALL PIPE LENGTHS ARE ASSUMED CONSERVATIVELY.
- STORAGE TANK #1 IS LOCATED NEAR THE EXTRACTION WELLS.
- OTHER TRMT. COMPONENTS (INCLUDING STORAGE TANK #2) ARE LOCATED IN CLOSE PROXIMITY TO EACH OTHER, POSSIBLY IN A BUILDING.
- 4"ϕ PIPE FOR ½Q = 105 GPM
- 3"ϕ PIPE FOR ~¼Q ≡ 50 GPM

(c) FITTINGS (ESTIMATED)

(8) VALVES GLOBE 6"ϕ
(5) VALVES GLOBE 4"ϕ
(2) VALVES GLOBE 3"ϕ
(5) CHECK VALVES 6"ϕ
(5) CHECK VALVES 4"ϕ
(1) CHECK VALVES 3"ϕ
(5) TEES 6"ϕ
(80) COUPLINGS 6"ϕ
(15) COUPLINGS 4"ϕ
(10) ELBOWS 90° 6"ϕ
(10) ELBOWS 90° 4"ϕ
(10) ELBOWS 90° 3"ϕ

AR301090

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S.O. No. 15438-17-SRI ORIGIN. Inc.

Subject: BERKS SAND PIT
GAC TREATMENT
FS - DESIGN

Sheet No. 5 of 10

Drawing No.

Computed by LJS Checked By PAL Date 6/23/88

(7) PUMPS - VENDER QUOTE

DESIGN
Q = 260 GPM TDH = 36'

GOULD'S PUMP MODEL # 6 BF-211-35

TOTALLY ENCLOSED MOTOR 10 HP

AT Q = 260 GPM @ 60 FT. HEAD 60% EFFICIENCY

5 1/8" Ø IMPELLER

TYPE 3 x 4 x 7 4" INLET 3" DISCHARGE

BRASS FITTED 3 PHASE 230/460 V

COSTS
$ 1,245 PUMP

40	HEATERS (3)
+ 250	FOB-SITE & SET-UP.
$ 1,535	TOTAL PER PUMP

(8) ELECTRICAL SYSTEM

(a) TREATMENT SYSTEM IS TO SUPPLY ALL POWER NEEDS OF ALTERNATIVES

REFER TO EXTRACTION WELL SYSTEM DESIGN CALCULATIONS PP. 13/17 TO 17/17

FOR MORE DETAILED DESIGN INFO--

UTILITY CO. SHOULD COVER MOST COSTS UP TO SWITCHGEAR, BUT TRANSFORMER, PRIMARY, ETC. ADDED IN ABOVE REFERENCED CALC'S TO BE CONSERVATIVE.

AR301091

Baker Engineers

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TREATMENT
FS - DESIGN

Sheet No. 6 of 10

Drawing No.

Computed by LJS Checked By GAK Date 6/23/88

(b) QUANTITIES/COSTS ELECTRICAL

UNIT COST	#	ITEM	QUANITY	UNIT	MEANS/ELEC.
$ 720	1	M.C.C. 10HP SIZE 1	1	EA	163-110-0100
$ 545	2	MAG. STARTER 10HP	1	EA	89.2-730-0680
$ 94	3	PILOT LIGHT	1	EA	163-110-1700
$ 69	4	PUSH BUTTON START	1	EA	163-110-1800
$ 1,320	5	MOTOR INSTALLATION	1	EA	163-110-0680
$ 4.65	6	MOTOR FEEDER	400	LF	89.2-720-0360
$ 500.00	7	PUMP CONTROLLER	1	EA	ASSUMED

	#	ITEM	QUANTITY	UNIT	MEANS/SITE
$ 2.24	8	UTILITY TRENCH/BACKFILL	400	LF	12.3-110-1320
$ 45.70	9	CONCRETE CONDUIT BEDDING	15	CYD	033-122-0010
$ 469.00	10	HAND HOLES	3	EA	ELEC/167-110-0600

(9) PRE-ENGINEERED BUILDING

TO HOUSE: FILTER UNITS
GAC UNITS
ELECTRICAL SYSTEM UNITS
EXPOSED PIPING OF TRMT. SYSTEM

HEATED, INTERIOR LIGHTING, RECEPTACLES

26 GA. GALVANIZED R-20 FIELD INSULATION ROOF

RIGID FRAME, CLEAR SPAN EAVE "16" HEIGHT

1:12 ROOF SLOPE 15-YEAR PAINT JOB

R-30 BATT INSULATION EXTERIOR WALLS

AR301092

S.O. No. 15438-17-SRI

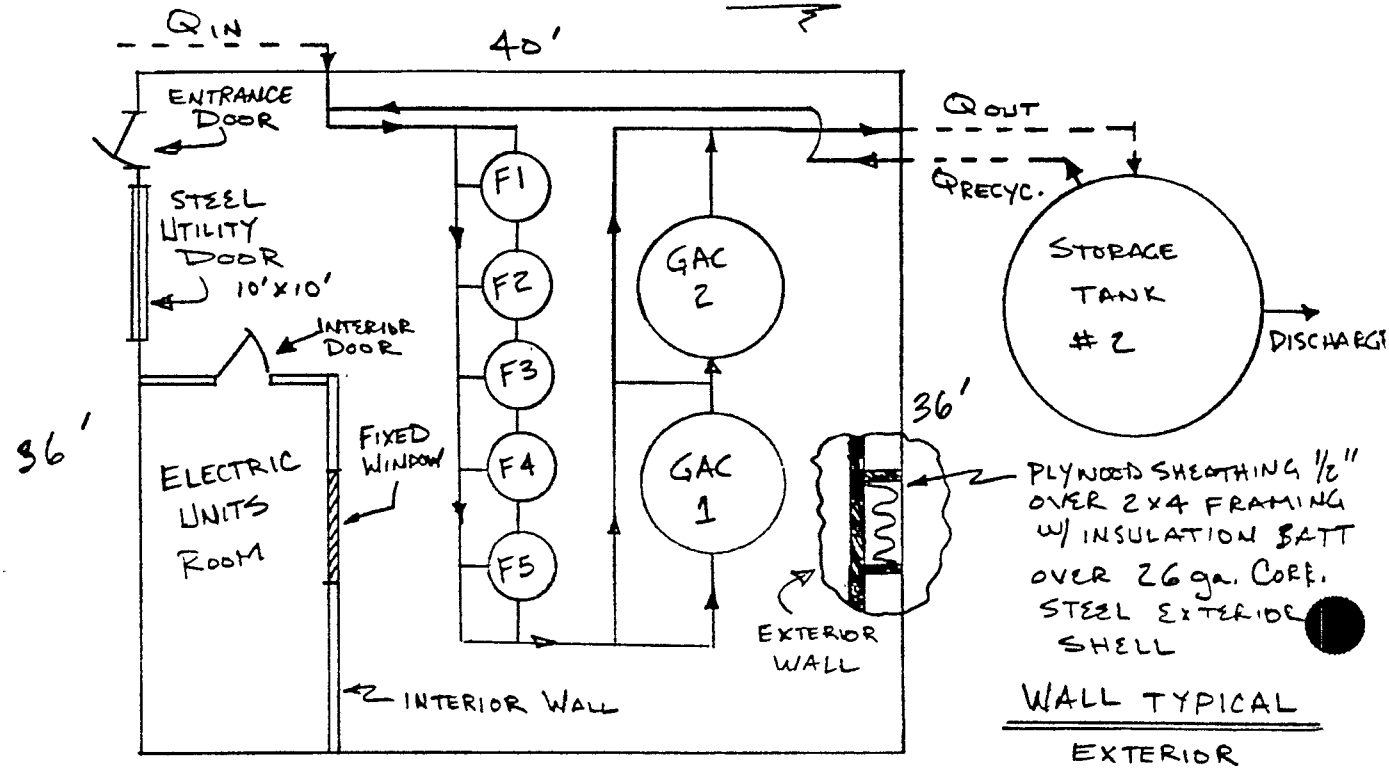
Subject: BERKS SAND PIT
GAC TRMT
FS-DESIGN

Sheet No. 7 of 10

Drawing No.

Computed by LJS Checked By PAK Date 6/23/88

BUILDING CON'T



APPX. SCALE 1" ≈ 10'

FLOOR AREA = (36' x 40') = 1,440 SFT - FLOOR (SF-FL)

#	ITEM	QUANITY	UNIT	UNIT $	MEANS/
1	SHELL SIDES/ROOF	1,440	SFFL	4.90	CON/CIRCLE 74
2	R20 FIELD INSULATION	1,440	SF-FL	2.25	CON/CIRCLE 74
3	15-YEAR PAINT	2,064	SF-SK	0.28	CON/CIRCLE 74
4	ERECTION OF SHELL	1,440	SF-FL	2.20	CON/CIRCLE 74
5	MATERIAL DELIVERY FOBSITE	12	TON	1,200	CON/CIRCLE 74
6	FOUNDATION	107	CYD	149	SITE/033-130-4050
7	SECTIONAL UTILITY DOOR	1	EA	820	CON/083-604-2650
8	ELECTRIC DOOR TROLLEY	1	EA	570	CON/083-604-27
9	UTILITY DOOR FRAME	1	EA	370	CON/081-106-0400
10	PRE-HUNG DOOR (ENTRANCE)	1	EA	178	CON/083-082-0340
11	SKYLIGHTS	4	EA	215	CON/051-235-7810

AR301093

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S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TRMT
FS DESIGN

Sheet No. 8 of 10

Drawing No.

Computed by LJS Checked By PAL Date 6/23/88

BUILDING CON'T

#	ITEM	QUANTITY	UNIT	UNIT $	MEANS/
12	ROOF VENTS 26GA 12"Ø	2	EA	145	CON/051-235-8100
13	ELEC. BASEBOARD HEAT	1,440	SF	2.13	ELEC/89.4-440-1000
14	THERMOSTATS - 3-WIRE	4	EA	35.40	ELEC/157-420-5230
15	VENTILATION - WALL EXAUST	4	EA	729	ELEC/157-290-9520
16	RECEPTACLES 4/1000 SF	1,440	SF	0.93	ELEC/89.2-522-0280
17	FLUORESCENT INTERIOR LIGHT	1,440	SF	5.31	ELEC/89.2-212-1680
18	INTERIOR DOOR	1	EA	168	CON/082-082-4440
19	INTERIOR FIXED WINDOW 6X4	1	EA	190	CON/051-235-7200
20	FRAMING - INTERIOR WALL	30	LF	7.40	CON/061-138-0600
21	SHEATHING - INTERIOR WALL	360	SF	0.68	CON/061-154-0600
22	FRAMING - EXTERIOR WALL	152	LF	7.40	CON/061-138-0600
23	SHEATHING - EXTERIOR WALL	2,064	SF	0.68	CON/061-154-0600
24	INSULATION BATT - EXTERIOR	2,064	SF	0.65	CON/072-118-0500

TOTAL COST OF "PRE-ENGINEERED" BUILDING

$ 67,278

$$\text{COST/SF} = \left(\frac{\$67,278}{1,440}\right) = \$46.72/\text{SFT}$$

AR301094

ORIGINAL (R...

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S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TRMT
FS DESIGN

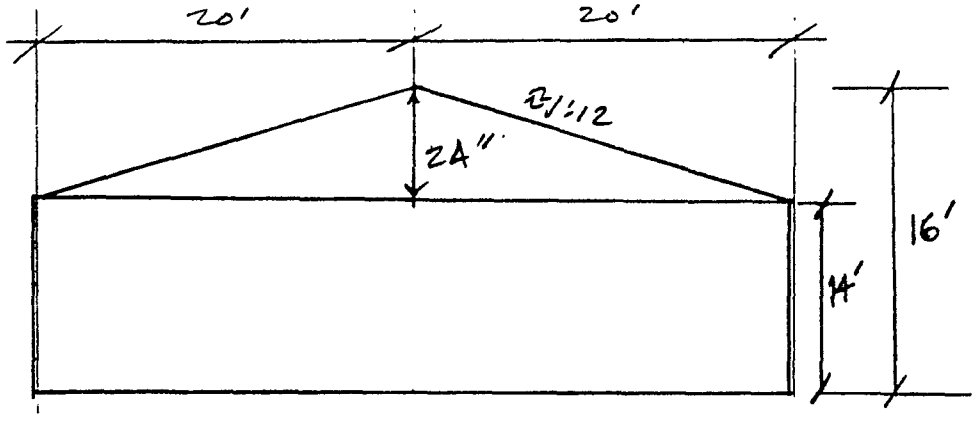
Sheet No. 9 of 10

Drawing No.

Computed by LJS Checked By RAK Date 6/23/88

BUILDING

SUPPORT CALC'S



SKIN AREA

$[(14' \times 40') + (\frac{1}{2} \times 2 \times 20)(2)] \times 2 = 1,200$ SFT

ONLY SIDES

$+ (2 \times 36 \times 12) = 864$ SFT

2,064 SFT SKIN

"APPROXIMATE" SHELL WEIGHT OF MAT'LS

(a) STEEL W 8x31 ASSUMED

$(80 + 40) \times (\frac{36}{8}) \times \frac{31 \text{ lb/LF}}{2000} = 8.37$ TON

$+$

$36 \times 4 \times \frac{31 \text{ lb/LF}}{2000} = 2.23$ TON

(b) ROOF - CORR STEEL

$40 \times 36 \times \frac{2 \text{ lb/SFT}}{2000} = 1.44$

$\Sigma = 12.04$ TON

FOUNDATION

$40 \times 36 \times \frac{2\text{-FT THICK}}{27} = 107$ CYD REINFORCED CONCRETE SLAB

INTERIOR WALL

30 LF x 12' HIGH = 360 SFT

EXTERIOR FRAMING

2'x4' ON INTERIOR 12' HIGH

AR301095

ORIGINAL

S.O. No. 15438-17-SRI

Subject: BERKS SAND PIT
GAC TRMT
FS - DESIGN

Sheet No. 10 of 10

Drawing No.

Computed by LJS Checked By RAK Date 6/23/88

(10) FENCE

AROUND BUILDING & STORAGE TANK #2

SAY: (40 + 50 + 10 + 40 + 40 + 40 + 36) = 256 LF

SAY 300 LF

CHAIN LINK INDUSTRIAL 6' HIGH 3 STRANDS BARB WIRE
W/ POSTS 10' O.C. GALV. STEEL 9 gage

MEANS / CONS / 028-308-0200 $8.57/LF

GATE: MEANS / CONS / 028-308-1400 $152/EA

AR301096

Baker Engineers

S.O. No. 15438-17-STL

Subject: BERICS
GAC TREATMENT
OPERATION & MAINTENANCE COST

Sheet No. 1 of 7
Drawing No.

Computed by IKS Checked By TRS Date 6/24/83

O & M.

1) STORAGE TANKS - ASSUME TANKS GET PAINTED EVERY — YEARS

AREA (SF) TO PAINT ON ONE TANK

H = 25' D = 41'

A = π(41') * 25' = 3220 SF

TWO TANKS = 2 × 3220 SF = 6440 SF

QUANTITY OF PAINT = 6440 SF × GAL/600 SF = 11 GAL (REF PUBLIC WATER SUPPLY)

COST → 5 DAYS TO SANDBLAST TANKS @ $785.60/DAY = $4000 EVERY 5 YEARS = $800/YR

PAINT AT $16/GAL PRIMER + $20/GAL PAINT

COST → = 11 × (16 + 20) = $396/5YR = $80/YR

TOTAL PAINT = $880/YR LABOR + MATL

2) PUMPS

a) ASSUME 10 HP (ELECTRICAL HP) (VENDOR QUOTE)

REF PAGE 1-28 "CAMERON HYDRAULIC DATA"

ELEC. HP input to motor = pump bhp / Motor efficiency

ASSUME 85% motor efficiency (-LJS)

10 Hp × (0.85) = pump bhp = 8.5 BHP

KW input = pump bhp × 0.7457 / motor effic = 8.5 BHP × 0.7457 / 0.85 =

KW input = 7.46

ASSUME PUMP RUNS 24 HRS/DAY, 365 DAY/YR = 8760 HRS/YR

AR301097

Baker Engineers

S.O. No. 15438-

Subject: BEEKS SAND PIT

GAC

O&M

Sheet No. 2 of 7

Drawing No.

Computed by DKS Checked By TPS Date 6/24

ASSUME ELEC COST @ $0.07/KW HR (BY L.W.S.)

COST → ANNUAL ELECTRIC COST = 65 350 KWHR/YR × $0.07/KWHR = $4575/YR

SAY $5000

COST → b) ALLOW $500/YR FOR MAINT ON PUMP (REF PUBLIC WATER SUPPLY ALTERNATIVE)

c) ALLOW PUMP REPLACEMENT EVERY 10 YEARS

ALLOW $1535/PUMP REPLACEMENT COST (THIS YEAR) + $250 TO DISCONNECT & REMOVE OLD PUMP

2 PUMPS

COST → = $1885 EVERY 10 YRS (REF VENDOR QUOTE & PUBLIC WATER SUPPLY ALTERNATIVE)

= $188/YR

3) PIPES - ALLOW FOR 1 MAJOR REPAIR EVERY 5 YEARS

SAY 100 LF OF PIPE IS FIXED BY CREW: B-6 FROM MEANS @ $591.60/DAY

ASSUME FIX TAKES 5 DAYS

COST → $591.60/DAY × 5 DAY = $2958/5 YR = $591.60/YR

= $2958/100' = $2958/YEAR

AR301098

Baker Engineers

S.O. No. 15438-17-51

Subject: Berks Sand P.
GAC TRMT
FS - O&M

Sheet No. 3 of 7

Drawing No.

Computed by RAK Checked By RPA Date 6/24/88

Cost of Granulated Activated Carbon Regeneration

Virgin Make-up Carbon = \$1.12 / lb.

% Returned After Regeneration = 90% = 0.90

Regenerated Carbon = \$0.55 / lb

Mass of Carbon in Adsorption Unit = 10,000 lb

Cost of Regeneration = (10,000 lb)(0.90)(\$0.55 / lb)
+ (10,000 lb)(1 - 0.90)(\$1.12)

= \$6070 per 10,000 lb Load

Time of Service = 21.5 days

∴ ≈ 17 regenerations per year

Annual Cost of Carbon = (17)(\$6070) ≅ \$103,000

AR301099

Baker Engineers

S.O. No. 15438-17-SRI

Subject: Berks Sand P. S.
GAC TRMT
FS - O&M

Sheet No. 4 of 7

Drawing No.

Computed by RAK Checked By RFA Date 6/23/88

Mass Loading of Aqueous Phase GAC

Flowrate = 210 gpm

Typical Carbon Usage Rate, mg/l Level Contamination = 1.54 lb/1000 ga

Mass of Carbon in Adsorption Unit = 10,000 lb

$$t = \left(\frac{\text{min}}{210\ \text{gal}}\right)\left(\frac{1000\ \text{gal}}{1.54\ \text{lb}}\right)\left(10{,}000\ \text{lb}\right)\left(\frac{\text{hr}}{60\ \text{min}}\right)\left(\frac{\text{day}}{24\ \text{hr}}\right)$$

$$= 21.5 \quad \text{days}$$

Typical Carbon Usage Rate, µg/l Level Contamination = 0.35 lb/1000 ga

$$t = \left(\frac{\text{min}}{210\ \text{gal}}\right)\left(\frac{1000\ \text{gal}}{0.35\ \text{lb}}\right)\left(10{,}000\ \text{lb}\right)\left(\frac{\text{hr}}{60\ \text{min}}\right)\left(\frac{\text{day}}{24\ \text{hr}}\right)$$

$$= 94.5 \quad \text{days}$$

Baker Engineers

S.O. No. 15-3-17-5 ORIGINAL (Red)

Subject: BECKS SAND PIT

GAC

O&M

Sheet No. 5 of 7

Drawing No.

Computed by DKS Checked By TRS Date 6/24/88

4) GAC UNITS.

MUST REPLACE CARBON IN UNITS ABOUT 17 TIMES PER YEAR - REF RAK CALCULATION.

COST FOR 20000 LBS OF CARBON

$12 000	BARE COST OF CARBON
$ 2500	REGENERATION FEE
$ 3700	MANIFESTING FEE
$18200	

20000 lb TRUCKLOAD

COST FOR HAULING = 2.47 / ROUNDTRIP MILE

DISTANCE ONE WAY : 255 FROM PITTSBURGH TO READING (REF) RAND McNALLY.

ROUND TRIP DISTANCE = 255 x 2 = 510 mi

HAULING COST = $2.47/mi × 510 mi = $1260

ADD $10000 FOR TESTING

EACH REGENERATION WILL COST 18200 + 1260 + 10000 = $29,460 / REGEN.

REGENERATE CARBON 17 TIMES/YEAR.

COST → COST = 17 REGEN/YEAR × $29,460/REGEN = $500,820/YR

AR301101

Baker Engineers

S.O. No. 15439-17-S (Rev) ORIGINAL

Subject: BERKS SAND PIT

GAC

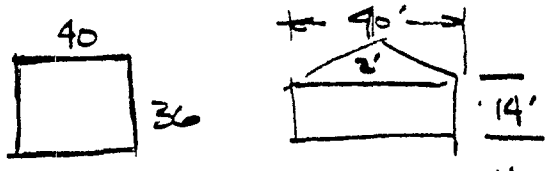
O&M

Sheet No. 6 of 7

Drawing No.

Computed by DKS Checked By TRS Date 6/24/89

5) PRE-ENGINEERED BUILDING.



TRIANGULAR AREAS $= \frac{1}{2}(\underset{\text{BASE}}{2 \times 20} \times \underset{\text{HGT}}{2}) \times 2 = 80\,SF$

TWO SIDES

SIDES $(40 \times 2 + 36 \times 2) \times 14' = 2128\,SF$

TOTAL SF TO PAINT $\approx 2200\,SF$

ASSUME PAINT EVERY 5 YEARS

MEANS SITE 099-106-2400

PAINT 2 COATS

$\$0.48/SF$

$\frac{\text{COST}}{5\,YR} = \$0.48/SF \times 2200\,SF = \frac{\$1056}{5\,YR}$

COST → $= \$210/YR$

AR301102

Baker Engineers

S.O. No. 15438-17-S (Rev)

ORIGINAL

Subject: BERKS SAND PIT

GAC

O&M

Sheet No. 7 of 7

Drawing No.

Computed by DKS Checked By TRS Date 6/24/88

REVISION DATE: 6/29/88

6 SAMPLES

ASSUME BI WEEKLY SAMPLES @ $150/WK

COST → $150/WK × ~~52~~ 26 WK/YR = $7800/YR

7. FILTRATION UNITS

5 UNITS × QUARTERLY CHANGE BED MAT'L.

= 20 BED CHANGES/YEAR

ASSUME (2) 55 GAL DRUMS/BED CHANGE

ASSUME $200/BED CHANGE FOR NEW MAT'L INC'L LABOR TO REPLACE

COST → (20 × 200) = $4,000/YR MAINTENANCE

COST → (2 DRUMS × 20 × $1,000/DRUM) = $40,000/YEAR

Revise to 10 DRUMS/YR

INCINERATE DRUMS INCL'DS TESTING

AR301103