
From: Charles G. Brockway [mailto:charles.g.brockway@brockwayeng.com]
Sent: Thursday, January 24, 2013 9:04 AM
To: Peppersack, Jeff
Cc: 'Donna Kelsey'; 'Ed Lawson'; 'Fritz Haemerle'; 'Charles E. Brockway'; Spackman, Gary
Subject: 37-8502 mitigation

Jeff,

The calculations have been reworked based IDWR's willingness to accept reduction of reservoir acreage for consumptive mitigation. Also, it is my opinion that the Clarendon weather station should be used for wind speed but not temperature or relative humidity, based on a comparison between the Hailey and Clarendon data. The attached is (hopefully) the final mitigation plan for this permit, in draft form for your review. I will call you later today or tomorrow to discuss the plan. I anticipate that we can work out any details over the phone to avoid another iteration.

Thank you,
Chuck

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All information, calculations, maps, drawings, or other documents transmitted via e-mail are preliminary unless explicitly stated in the e-mail text or in the documents themselves.

DRAFT

Final Mitigation Plan for Permit 37-8205

Brockway Engineering, PLLC
C. G. Brockway, P.E.
January 23, 2013

This mitigation plan is based on 1) revised and updated meteorological data, and 2) consumptive volume provided by reduction of acreage within the Clarendon reservoir as agreed to by IDWR.

A. Hailey-Clarendon Weather Data Comparison

A comparison was made between the Hailey airport station and the Clarendon weather station for temperature, relative humidity, and wind speed. Daily average data for these parameters were calculated for the overlap period of August 5, 2011 through October 31, 2012. Scatterplots indicate that temperature and relative humidity are nearly the same between the two stations. Wind speed, however, is very different. It is almost always lower at Clarendon and no significant correlation exists between the two stations. From this analysis the following conclusions were drawn:

1. It is reasonable to use the Hailey station for temperature and relative humidity, taking advantage of its lengthy period of record for temperature. Temperature is from the NWS station with a period of record 1893-1988. Relative humidity is from the airport station for the period 2003-2012 (the previous record of 2007-2009, used for previous submittals, was augmented for this analysis).
2. Even though its record is short, the Clarendon station should be used to calculate monthly wind speed, since orographic effects clearly cause differing wind patterns at this location compared to Hailey.

B. Revised Evaporation Calculations

The evaporation calculations described in previous reports, using the same four (4) analytical methods, were re-run using the Hailey station for temperature and relative humidity, and the Clarendon weather station for wind speed.

Evaporation of a cold-water pond was calculated to be 23.0 inches or 1.92 ac-ft/acre. The Allen & Robison (2012) value for shallow pond systems at the Hailey station is 30.8 inches. The difference can reasonably be attributed to the significantly lower wind speed at Clarendon.

C. Mitigation Available

Previous analysis submitted to the Department for the November 23, 2010 mitigation plan has shown that the reservoir surface area has been reduced by 2.2 acres. The maps used to support this number are included herein. A reduction of 2.2 acres is equivalent to 4.22 ac-ft per year of evaporation using the cold-water evaporation value of 23.0 inches. This is the amount of mitigation available from the reservoir surface area reduction. The consumptive volume will be provided by existing water right 37-4369, under which both the reservoir area and volume have already been reduced relative to historic levels. Information regarding reservoir volume is contained in the Department's files, but a summary of this information is attached. Since the reservoir volume has, like the surface area, already been reduced from historic levels, a reduction of storage volume from the current 102.4 ac-ft number on the water right is not proposed. Even if the storage volume had not already been reduced, it appears that decreasing storage volume as a means of mitigating is not hydrologically warranted in this case since the reservoir is kept full continuously, i.e. the only depletion is from evaporation; no depletion from refill occurs.

D. Mitigation Required

By trial using the evaporation calculation spreadsheet, it was found that the temperature of the pond can be 68 degrees F and the temperature of the plunge can be 85 degree F without exceeding an evaporation increase of 4.22 ac-ft/year. Total evaporation as shown on the attached spreadsheets is 6.35 ac-ft/year or an increase of 4.11 ac-ft/year over an equivalent-size cold water pond.

D. Revised Annual Volume and Flow Rate Requirement

Peak flow and monthly volume calculations are provided on the attached spreadsheets. These calculations follow the same methodology as those in the original beneficial use examination, but using the new meteorological data as described above. Recall that the peak flow was calculated assuming an air temperature of -1.7 F, which is the 80% exceedance minimum daily temperature at Hailey. Monthly volumes were calculated by using the average monthly inputs. The following results were obtained:

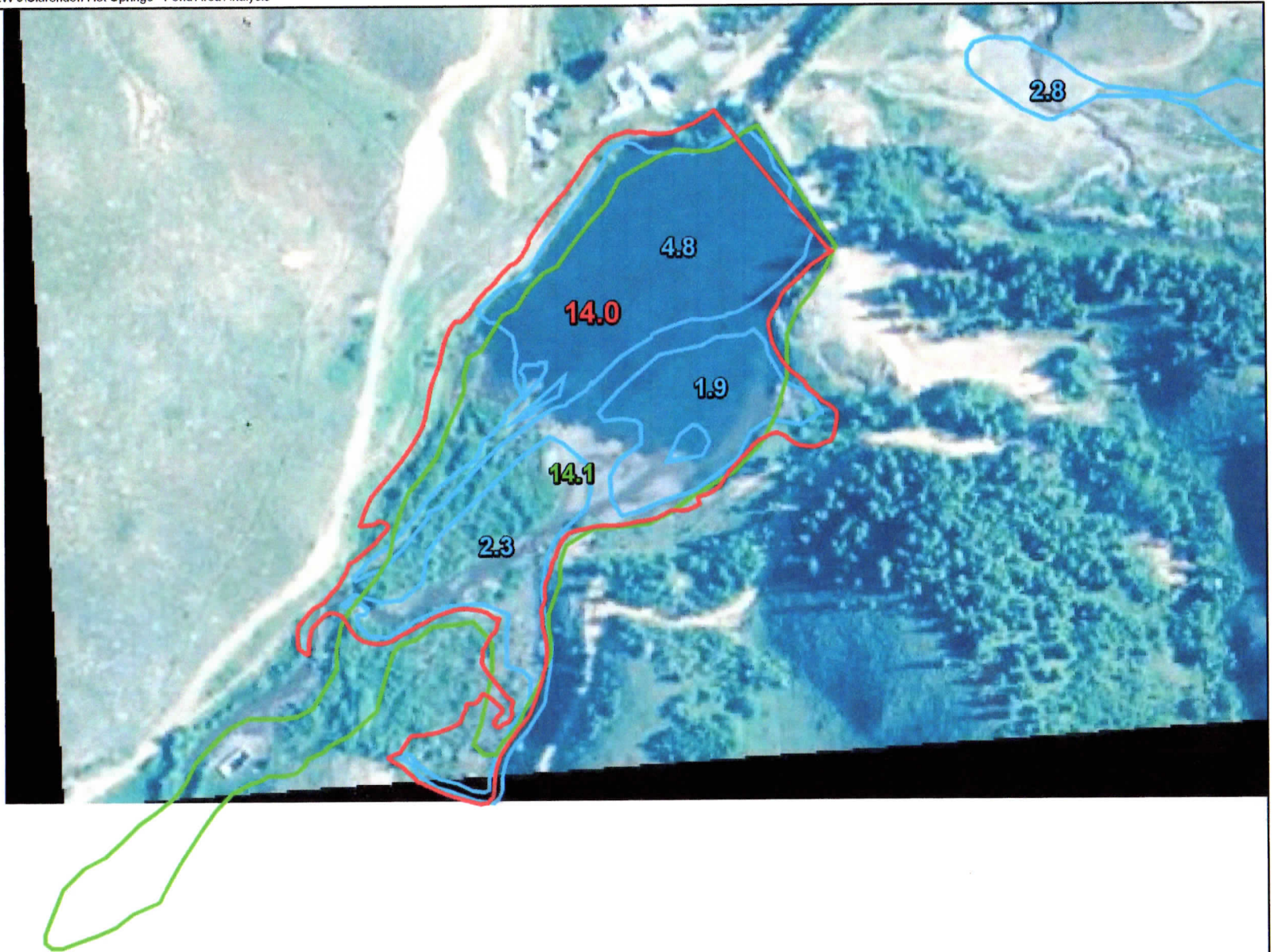
Peak flow requirement	252 gpm (0.56 cfs)
Annual volume requirement	217.6 ac-ft

E. Recommended Amounts for Licensing

For licensing purposes, the flow and volume requirements for residential and snowmelting purposes have not changed, but the flow and volume for heating of the

pond/spa should reflect the above amounts. The recommended amounts to be licensed are as follows:

	Div. Rate	Ann. Volume
Heating (residential)	0.032 cfs	17.4 afa
Heating (snowmelting)	0.81 cfs	104.7 afa
Recreation or Heating (pond / spa)	0.56 cfs	217.6 afa
TOTAL	1.40 cfs	339.7 afa

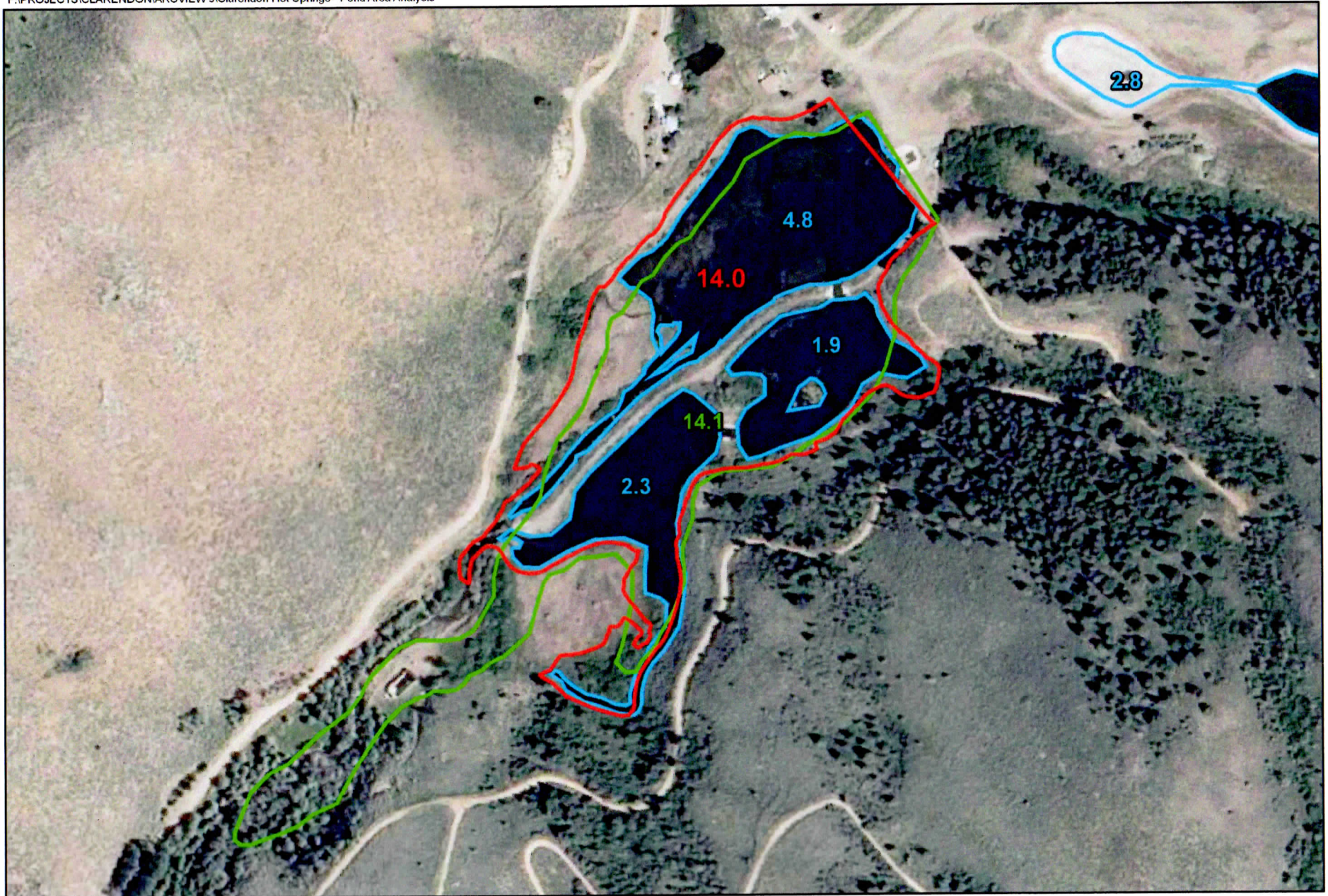


1 inch equals 300 feet

**SUN VALLEY LAND & MINERALS
HISTORIC RESERVOIR AREAS
FSA 1980 AERIAL PHOTOGRAPH**

Legend

- 5631' CONTOUR MAY 2000
- USGS Quad Reservoir
- Current Ponds



1 inch equals 300 feet

**SUN VALLEY LAND & MINERALS
HISTORIC RESERVOIR AREAS
NAIP 2009 AERIAL**

Legend

- 5631' CONTOUR MAY 2000
- USGS Quad Reservoir
- Current Ponds

Clarendon Reservoir Historic Volume

CGB 12/10/09

Late 1990s? – Computation of historic maximum reservoir volume using water surface widths, 15.1-foot depth at dam based on survey and soil test pits, zero-foot depth at upper end, constant bottom slope, side slopes 4:1 (see spreadsheet)

Volume = 143 ac-ft, basis for amended SRBA claim

9/20/2000 – Submittal of transfer application with letter reiterating historic volume of 143 ac-ft and providing an estimate of new volume with five proposed ponds:

Volume proposed = 137 ac-ft.

Approx. 8/2001 – protest resolution with Blaine Co., agreed to limit volume to **102.4 ac-ft**, which was less than historic amount. IDWR has reviewed and agrees with this volume; however, Glen Saxton went ahead and approved transfer with a condition limiting storage to 102.4 ac-ft but leaving it open for future review as to the issue of forfeiture due to siltation. Allen Merritt expressed this concern in his 9/19/01 transfer

7/12/2002 memo from Sharla at IDWR – review of dam safety files and other IDWR files, concludes that no more than 80 ac-ft storage volume has been reported in these documents. In the memo, the statement is made: “Brockway Engineering has prepared a document entitled Determination of Historical Reservoir Volume and has used the ‘claimed’ volume listed under 37-4369 as the only documentation to base the requested transfer on.” This statement is erroneous. The 143 ac-ft resulted from an actual numerical calculation. The memo apparently ignores the quantitative calculation of 143 ac-ft which was done in support of the claim.

Two rounds of aerial topographic mapping when the reservoir was largely dry: 5/30/2000 and 9/26/2000. However, work was commencing within the footprint, a large amount of material had been moved, and the center embankment either in progress (5/30/00) or complete (11/26/00). In addition, this topography would not reflect historical conditions as much of the siltation had likely not been removed. Therefore, the reservoir bottom contours could not be used to estimate the historic volume.

The 5/30/2000 mapping does appear to at least capture the edges of the old reservoir reasonably accurately before they were reworked to create the new pond system. Based on surveys of the original embankment and other information in the file, the maximum WSE was approximately 5631 feet:

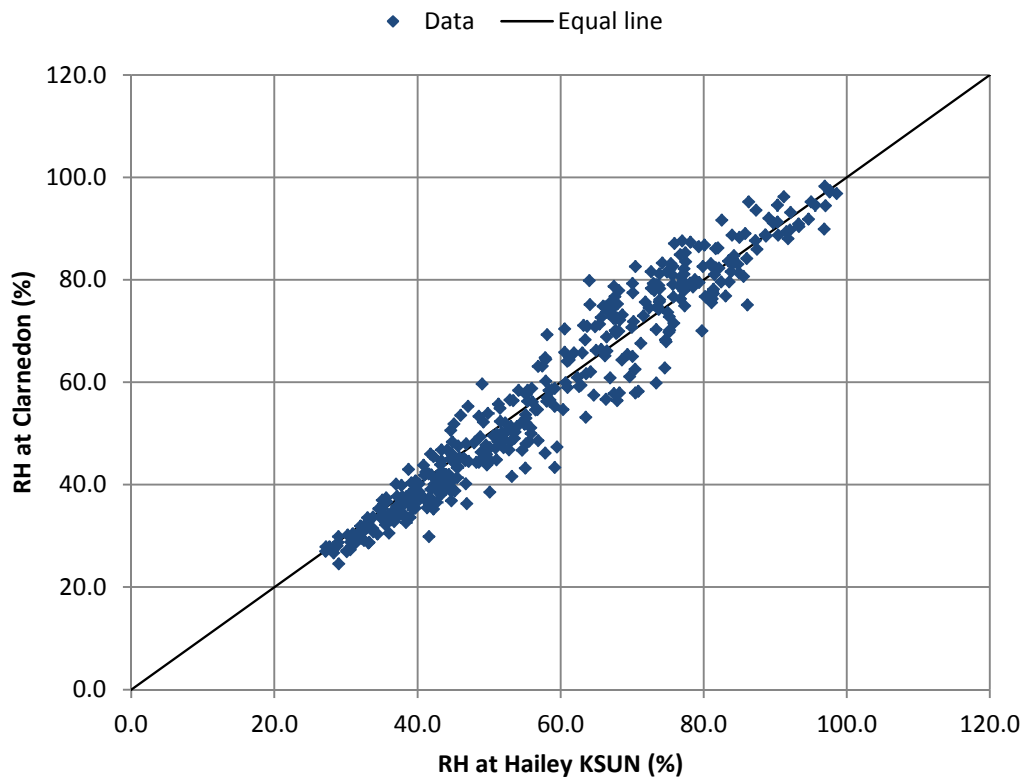
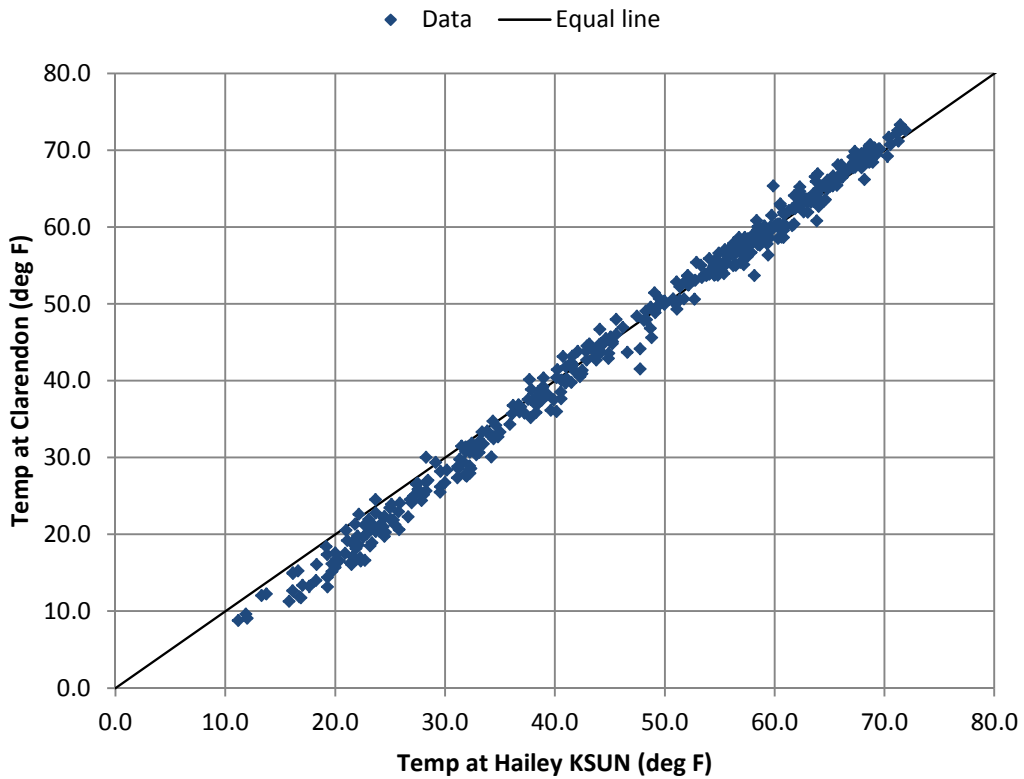
Area of 5631' contour = 13.96 acres

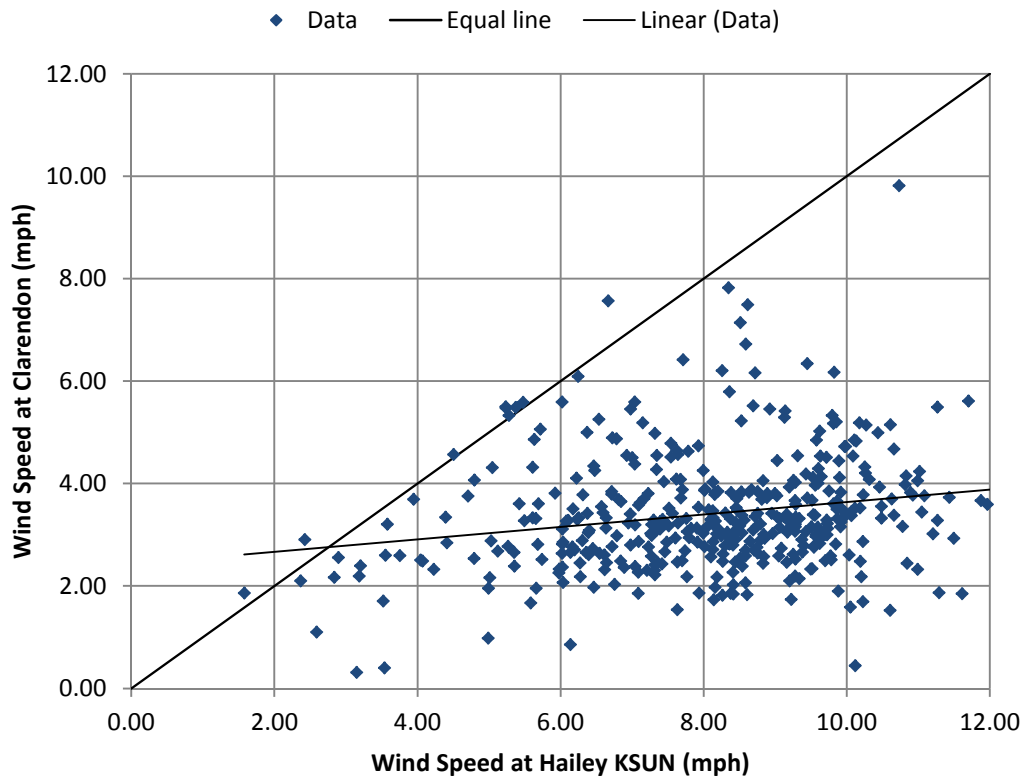
Average depth = 7.55 feet (15.1 feet at dam, zero at upper end)

Volume = 105.4 ac-ft

The above analysis ignores about 2 to 3 acres which have been silted in at the upper end, so it is a conservatively low number.

Comparison of Hailey and Clarendon Weather Data





EVAPORATIVE LOSS IN OUTDOOR POOL - NATURAL COLD WATER CONDITIONS

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB REVISED 1/22/2013

Air temperature: Hailey NWS station, 1893-1988 period
Relative humidity: Hailey airport station, 2003-2012 period
Wind speed: Clarendon station, August 2011-October 2012 period

Pond temperature 9999 deg C (9999 = natural flow temp)
a 2500 J/g a,b are coeffs in Le equation: es = saturation vapor pressure at pond surface temperature
b 2.386 J/g-C Le = a - bT ea = vapor pressure of ambient air
rho 1.00E+06 g/m^3 rho = density of water

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)	Est. pond temp (natural flow)		mph
									F	C	
January	31	-7.1	76	1.17	4.4	2489	8.4	2.8	40	4.4	2.621383
February	28	-4.4	73	1.45	4.4	2489	8.4	3.2	40	4.4	3.242704
March	31	-0.6	68	1.42	4.4	2489	8.4	4.0	40	4.4	3.169541
April	30	5.9	60	1.83	7.2	2483	10.2	5.6	45	7.2	4.094451
May	31	10.9	58	1.80	10.0	2476	12.3	7.6	50	10.0	4.020467
June	30	14.9	53	1.92	12.8	2470	14.8	8.9	55	12.8	4.292593
July	31	19.7	40	1.50	18.3	2456	21.1	9.3	65	18.3	3.357345
August	31	18.9	41	1.61	18.3	2456	21.1	8.9	65	18.3	3.592775
September	30	13.7	48	1.53	12.8	2470	14.8	7.6	55	12.8	3.430338
October	31	8.1	63	1.43	7.2	2483	10.2	6.8	45	7.2	3.206332
November	30	0.6	72	0.99	4.4	2489	8.4	4.6	40	4.4	2.221318
December	31	-5.4	78	1.27	4.4	2489	8.4	3.2	40	4.4	2.83071

Month	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Average [in]
	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	
January	24.8	9.98E-09	0.03	1.05	59.2	2.38E-08	0.08	2.51	42.8	1.72E-08	0.06	1.81	20.5	8.25E-09	0.03	0.87	1.56
February	28.1	1.13E-08	0.04	1.08	57.3	2.30E-08	0.08	2.19	41.0	1.65E-08	0.06	1.57	23.2	9.33E-09	0.03	0.89	1.43
March	23.3	9.37E-09	0.03	0.99	48.4	1.94E-08	0.07	2.05	34.6	1.39E-08	0.05	1.47	19.3	7.75E-09	0.03	0.82	1.33
April	31.4	1.27E-08	0.04	1.29	54.6	2.20E-08	0.07	2.24	39.1	1.57E-08	0.05	1.61	26.0	1.05E-08	0.04	1.07	1.55
May	31.8	1.29E-08	0.04	1.36	56.0	2.26E-08	0.08	2.38	40.1	1.62E-08	0.06	1.71	26.3	1.06E-08	0.04	1.12	1.64
June	41.9	1.70E-08	0.06	1.73	70.6	2.86E-08	0.10	2.92	50.7	2.05E-08	0.07	2.10	34.7	1.40E-08	0.05	1.43	2.05
July	66.3	2.70E-08	0.09	2.85	132.0	5.37E-08	0.18	5.67	94.3	3.84E-08	0.13	4.05	54.8	2.23E-08	0.08	2.35	3.73
August	73.4	2.99E-08	0.10	3.15	139.4	5.68E-08	0.19	5.99	99.6	4.05E-08	0.14	4.27	60.7	2.47E-08	0.08	2.61	4.00
September	41.2	1.67E-08	0.06	1.70	80.7	3.27E-08	0.11	3.33	57.6	2.33E-08	0.08	2.38	34.0	1.38E-08	0.05	1.41	2.21
October	18.0	7.27E-09	0.02	0.77	37.1	1.49E-08	0.05	1.58	26.5	1.07E-08	0.04	1.13	14.9	6.01E-09	0.02	0.63	1.03
November	14.3	5.74E-09	0.02	0.59	38.7	1.55E-08	0.05	1.59	28.3	1.14E-08	0.04	1.16	11.8	4.75E-09	0.02	0.48	0.95
December	24.7	9.93E-09	0.03	1.05	55.7	2.24E-08	0.08	2.36	40.0	1.61E-08	0.05	1.70	20.4	8.21E-09	0.03	0.87	1.49
Total				17.60	Total				Total				Total				22.97

Average evaporation from the four methods: 22.97 inches

April - October 16.21
November - March 6.77

EVAPORATIVE LOSS IN HEATED OUTDOOR POOL - PROPOSED CONDITIONS, 68 DEGREES F

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB REVISED 1/22/2013

Air temperature: Hailey NWS station, 1893-1988 period
Relative humidity: Hailey airport station, 2003-2012 period
Wind speed: Clarendon station, August 2011-October 2012 period

Pond temperature 68 deg F = 20.00 deg C (9999 = same as air)
a 2500 J/g a,b are coeffs in Le equation: es = saturation vapor pressure at pond surface temperature
b 2.386 J/g-C Le = a - bT ea = vapor pressure of ambient air
rho 1.00E+06 g/m^3 rho = density of water

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)
January	31	-7.1	76	1.17	20.0	2452	23.4	2.8
February	28	-4.4	73	1.45	20.0	2452	23.4	3.2
March	31	-0.6	68	1.42	20.0	2452	23.4	4.0
April	30	5.9	60	1.83	20.0	2452	23.4	5.6
May	31	10.9	58	1.80	20.0	2452	23.4	7.6
June	30	14.9	53	1.92	20.0	2452	23.4	8.9
July	31	19.7	40	1.50	20.0	2452	23.4	9.3
August	31	18.9	41	1.61	20.0	2452	23.4	8.9
September	30	13.7	48	1.53	20.0	2452	23.4	7.6
October	31	8.1	63	1.43	20.0	2452	23.4	6.8
November	30	0.6	72	0.99	20.0	2452	23.4	4.6
December	31	-5.4	78	1.27	20.0	2452	23.4	3.2

	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Increase frc natural			
Month	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Average [in]			
January	90.7	3.70E-08	0.13	3.90	216.2	8.82E-08	0.30	9.30	156.2	6.37E-08	0.22	6.72	74.9	3.06E-08	0.10	3.22	5.78	4.22		
February	109.5	4.47E-08	0.15	4.25	223.4	9.11E-08	0.31	8.68	159.8	6.52E-08	0.22	6.21	90.5	3.69E-08	0.13	3.52	5.66	4.23		
March	102.9	4.20E-08	0.14	4.43	213.4	8.70E-08	0.30	9.18	152.7	6.23E-08	0.21	6.57	85.1	3.47E-08	0.12	3.66	5.96	4.63		
April	122.0	4.97E-08	0.17	5.08	212.0	8.64E-08	0.29	8.82	151.8	6.19E-08	0.21	6.32	100.8	4.11E-08	0.14	4.20	6.10	4.55		
May	106.6	4.35E-08	0.15	4.58	187.4	7.64E-08	0.26	8.06	134.1	5.47E-08	0.19	5.77	88.1	3.59E-08	0.12	3.79	5.55	3.91		
June	103.9	4.24E-08	0.14	4.32	175.0	7.14E-08	0.24	7.28	125.7	5.12E-08	0.17	5.23	85.9	3.50E-08	0.12	3.57	5.10	3.06		
July	79.3	3.23E-08	0.11	3.41	157.8	6.44E-08	0.22	6.79	112.8	4.60E-08	0.16	4.85	65.5	2.67E-08	0.09	2.82	4.47	0.74		
August	87.3	3.56E-08	0.12	3.75	165.7	6.76E-08	0.23	7.13	118.3	4.83E-08	0.16	5.09	72.2	2.94E-08	0.10	3.10	4.77	0.76		
September	90.7	3.70E-08	0.13	3.77	177.7	7.25E-08	0.25	7.40	127.0	5.18E-08	0.18	5.28	74.9	3.06E-08	0.10	3.12	4.89	2.69		
October	89.0	3.63E-08	0.12	3.83	183.0	7.46E-08	0.25	7.87	130.9	5.34E-08	0.18	5.63	73.6	3.00E-08	0.10	3.16	5.12	4.10		
November	70.1	2.86E-08	0.10	2.92	189.8	7.74E-08	0.26	7.90	138.9	5.67E-08	0.19	5.78	57.9	2.36E-08	0.08	2.41	4.75	3.80		
December	95.8	3.91E-08	0.13	4.12	215.7	8.80E-08	0.30	9.27	155.1	6.33E-08	0.22	6.67	79.2	3.23E-08	0.11	3.41	5.87	4.38		
	Total				Total				Total				Total				64.02		41.05	

Average evaporation from the four methods: 64.02 inches

April - October 36.00 19.80
November - March 28.02 21.25

EVAPORATIVE LOSS IN HEATED OUTDOOR "PLUNGE" POOL - PROPOSED CONDITIONS, 85 DEGREES F

Four applicable methods as compiled by Helfrich et al. (1982), reported and discussed in Bras (1990)
CGB REVISED 1/22/2013

Air temperature: Hailey NWS station, 1893-1988 period
Relative humidity: Hailey airport station, 2003-2012 period
Wind speed: Clarendon station, August 2011-October 2012 period

Pond temperature 85 deg F = 29.44 deg C (9999 = same as air)
a 2500 J/g a,b are coeffs in Le equation: es = saturation vapor pressure at pond surface temperature
b 2.386 J/g-C Le = a - bT ea = vapor pressure of ambient air
rho 1.00E+06 g/m^3 rho = density of water

Month	Days	Avg air temp [C]	Avg RH (%)	Avg Wind (m/s)	Pond sfc temp [C]	Le [J/g]	es (mb)	ea (mb)
January	31	-7.1	76	1.17	29.4	2430	41.1	2.8
February	28	-4.4	73	1.45	29.4	2430	41.1	3.2
March	31	-0.6	68	1.42	29.4	2430	41.1	4.0
April	30	5.9	60	1.83	29.4	2430	41.1	5.6
May	31	10.9	58	1.80	29.4	2430	41.1	7.6
June	30	14.9	53	1.92	29.4	2430	41.1	8.9
July	31	19.7	40	1.50	29.4	2430	41.1	9.3
August	31	18.9	41	1.61	29.4	2430	41.1	8.9
September	30	13.7	48	1.53	29.4	2430	41.1	7.6
October	31	8.1	63	1.43	29.4	2430	41.1	6.8
November	30	0.6	72	0.99	29.4	2430	41.1	4.6
December	31	-5.4	78	1.27	29.4	2430	41.1	3.2

Month	Kohler (1954)				Meyer (1942)				Brady et al. (1969)				Ryan and Harleman (1973)				Average [in]	Increase fr natural [in]
	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]	Qe [W/m^2]	E [m/s]	[cm/d]	[in]		
January	168.4	6.93E-08	0.24	7.31	401.6	1.65E-07	0.56	17.43	290.3	1.19E-07	0.41	12.60	139.2	5.73E-08	0.19	6.04	10.84	9.28
February	205.7	8.47E-08	0.29	8.06	419.7	1.73E-07	0.59	16.45	300.1	1.24E-07	0.42	11.76	170.1	7.00E-08	0.24	6.67	10.74	9.31
March	197.0	8.11E-08	0.28	8.55	408.4	1.68E-07	0.57	17.72	292.2	1.20E-07	0.41	12.68	162.8	6.70E-08	0.23	7.07	11.50	10.17
April	243.5	1.00E-07	0.34	10.23	423.1	1.74E-07	0.59	17.77	303.0	1.25E-07	0.42	12.72	201.3	8.28E-08	0.28	8.45	12.29	10.74
May	225.9	9.30E-08	0.32	9.80	397.2	1.63E-07	0.56	17.24	284.3	1.17E-07	0.40	12.34	186.7	7.68E-08	0.26	8.10	11.87	10.23
June	231.3	9.52E-08	0.32	9.71	389.5	1.60E-07	0.55	16.36	279.7	1.15E-07	0.39	11.75	191.2	7.87E-08	0.27	8.03	11.46	9.42
July	178.9	7.36E-08	0.25	7.76	356.1	1.47E-07	0.50	15.45	254.4	1.05E-07	0.36	11.04	147.9	6.09E-08	0.21	6.42	10.17	6.44
August	193.9	7.98E-08	0.27	8.42	368.1	1.51E-07	0.52	15.97	262.8	1.08E-07	0.37	11.41	160.3	6.60E-08	0.22	6.96	10.69	6.68
September	192.4	7.92E-08	0.27	8.08	377.3	1.55E-07	0.53	15.84	269.5	1.11E-07	0.38	11.32	159.1	6.55E-08	0.22	6.68	10.48	8.28
October	184.1	7.58E-08	0.26	7.99	378.6	1.56E-07	0.53	16.43	270.8	1.11E-07	0.38	11.75	152.2	6.26E-08	0.21	6.60	10.69	9.67
November	136.0	5.60E-08	0.19	5.71	368.2	1.52E-07	0.52	15.47	269.6	1.11E-07	0.38	11.32	112.4	4.63E-08	0.16	4.72	9.30	8.35
December	179.8	7.40E-08	0.25	7.80	404.8	1.67E-07	0.57	17.57	291.1	1.20E-07	0.41	12.64	148.6	6.12E-08	0.21	6.45	11.11	9.62
Total				99.43	Total				Total				Total				131.16	108.19

Average evaporation from the four methods: 131.16 inches

April - October 77.66 61.45
November - March 53.50 46.74

**SUN VALLEY LAND & MINERALS PERMIT 37-8205 MITIGATION PLAN
SUMMARY OF POND EVAPORATION CALCULATIONS**

Brockway Engineering REVISED 1/22/2013

HEATED POND

	Area [acres]	Evap [in/yr]	Evap [ac-ft/yr]
Heated plunge area 25'x25' at 85 deg F	0.01	131.2	0.16
Main pond at 68 deg F	1.16	64.0	6.19
Total evaporation - heated pond			6.35

NATURAL COLD WATER POND

Natural cold water evaporation	22.97 in/year
Area of pond	1.17 acres
Total evaporation - cold water pond	2.24 ac-ft/yr

Increase in evaporation **4.11 ac-ft/yr**

SUN VALLEY LAND & MINERALS

OPEN POND HEAT LOSS - MONTHLY & ANNUAL VOLUME REQUIREMENT

Permit 37-8205

CGB 11/16/2010 - Reduced Heat Load for Mitigation Plan

CGB 1/23/2012 - REVISED, new met data

Average climatic conditions

Resource temperature 124.7 F

Target pond temperature: 68F (main pond), 85F (plunge)

Month	No. Days	Wind Speed (1)	Air Temp (2)	Relative Humid (3)	Average flow requirement (4)	Volume (ac-ft)
January	31	2.62	19.3	76	194.8	26.7
February	28	3.24	24.1	73	201.5	24.9
March	31	3.17	31.0	68	177.4	24.3
April	30	4.09	42.6	60	160.9	21.3
May	31	4.02	51.7	58	121.8	16.7
June	30	4.29	58.8	53	96.9	12.8
July	31	3.36	67.5	40	53.6	7.3
August	31	3.59	66.0	41	63.1	8.6
September	30	3.43	56.7	48	95.1	12.6
October	31	3.21	46.5	63	124.1	17.0
November	30	2.22	33.0	72	141.9	18.8
December	31	2.83	22.3	78	192.7	26.4
TOTAL						217.6

(1) Average monthly wind speed at Clarendon weather station [mph]

(2) Average monthly temperature at Hailey NWS [degrees F]

(3) Average monthly relative humidity at Hailey airport [%]

(4) Estimated on separate spreadsheet by OIT GeoHeat Center tool [gpm]

OPEN POND HEAT LOSS CALCULATION - PEAK FLOW REQUIREMENT

CGB 1/23/2013 - REVISED, new met data

Parameter	Value	Units	Assumptions / Remarks	
1. Resource temp	124.7	F	Measured mixed temperature 10/13/09	
2. Length	370	ft	Pond length avg	
3. Width	138	ft	Pond width avg	
4. Water temp in pond	68	F	Pleasant temperature for bathing/swimming	
5. Wind velocity	2.62	mph	Average January at Clarendon station	
6. Air temp	-1.7	F	80% exceedance minimum Jan temp at Hailey	
9. Relative humidity	78	%	Average January humidity at Hailey airport	
7. Cover thickness	0	in	No pond cover	
8. Cover "k"	0.4	btu in/hr sqft F	Value irrelevant since thickness = 0	
10. Calculated water vap pres	0.330	psia		
1. Evaporative Loss	1757245	btu/hr	34.4	btu/hr sqft
2. Convective Loss	2265087	btu/hr	44.4	btu/hr sqft
3. Radiant Loss	2776555	btu/hr	54.4	btu/hr sqft
4. Conductive Loss	111435	btu/hr	2.2	btu/hr sqft
5. Total Loss	6910322	btu/hr	135.3	btu/hr sqft
6. Required flow rate	243.8	gpm		
ha	0.63646		Pond surface area	51060 ft2
x/k	0			1.17 acres
p. press	0.024			
area	51060			
surf temp	68			
U	0.63646			
Total - plunge and pond	251.6	gpm		
	0.56	cfs		

SUN VALLEY LAND & MINERALS

OPEN POND HEAT LOSS CALCULATION - PEAK FLOW REQUIREMENT

Permit 37-8205

OIT Geoheat Center Tools

CGB 11/16/2010 - Reduced Heat Load for Mitigation Plan

CGB 1/23/2013 - REVISED, new met data

HEATED "PLUNGE" AREA - 85 DEGREES F

Parameter	Value Units	Assumptions / Remarks
1. Resource temp	124.7 F	Measured mixed temperature 10/13/09
2. Length	25 ft	Pond length avg
3. Width	25 ft	Pond width avg
4. Water temp in pond	85 F	Pleasant temperature for bathing/swimming
5. Wind velocity	2.62 mph	Average January at Clarendon station
6. Air temp	-1.7 F	80% exceedance minimum Jan temp at Hailey
9. Relative humidity	78.0 %	Average January humidity at Hailey airport
7. Cover thickness	0 in	No pond cover
8. Cover "k"	0.4 btu in/hr sqft F	Value irrelevant since thickness = 0
10. Calculated water vap pres	0.589 psia	
1. Evaporative Loss	54142 btu/hr	86.6 btu/hr sqft
2. Convective Loss	48535 btu/hr	77.7 btu/hr sqft
3. Radiant Loss	44609 btu/hr	71.4 btu/hr sqft
4. Conductive Loss	8066 btu/hr	12.9 btu/hr sqft
5. Total Loss	155353 btu/hr	248.6 btu/hr sqft
6. Required flow rate	7.8 gpm	

ha	0.895693	Pond surface area	625 ft2
x/k	0		0.01 acres
p. press	0.024		
area	625		
surf temp	85		
U	0.895693		