SPF WATER ENGINEERING

April 29, 2020

Dan Nelson
Idaho Department of Water Resources
322 East Front Street
Boise, ID 83702-7371
Sent by email to Dan.Nelson@idwr.idaho.gov

Subject: 63-34765 – Supplement to Beneficial Use Field Report

Dear Dan:

In response to your email of April 17, 2020, please consider this letter as a supplement to the Beneficial Use Field Report for permit 63-34765 that was submitted to you on April 11, 2020.

The Beneficial Use Field Report noted the existence of a 0.1-acre pond that is used to store water for irrigation, aesthetics, wildlife, and fire protection, all authorized under the domestic use umbrella. The pond is filled with water from the spring that is not diverted to the home, yard-hydrants, and pressurized landscape irrigation. From the pond, water can be pumped for landscape irrigation.

Diversions to the pond fluctuate seasonally as irrigation demands and spring flow vary. During early spring, when irrigation demands are minimal, most of the spring flow (1.5 gpm) is diverted to the pond. The pond then fills and may even spill in March or April. As the weather warms, pressure irrigation demands increase, which depletes the flow to the pond. In addition, water can be diverted for irrigation from storage in the pond. Concurrently, spring flow declines during summer. As spring flows decline, water is pumped from storage, and evaporation increases, the volume of water stored in the pond is depleted. The pond can then recover in the fall and winter when water demands and evaporation rates are low.

Table 1 is an example of how this can work. The pond reaches capacity (approximately ½ acre foot) in March and April, and begins to spill. Pond volume begins to be depleted in May and is essentially emptied in August, before beginning to refill in September. Every year is different, but this reflects the general pattern of water availability and use. Annual water use in this example is 1.6 acre feet, but actual use likely ranges from 1 to 2 acre feet depending on the water year.

Daily water use does not exceed 13,000 gallons. Using Table 1 as an example, the highest use months (May and June) have 2000 gpd direct diversion from the spring, supplemented by an average diversion rate from pond storage of 1000 gpd. The pond diversions from storage can

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be concentrated to one day a week (7,000 gallons), for a peak-day total diversion rate of 9,160 gallons while remaining within the 13,000 gallons per day limit.

Table 1. Example Monthly Water Use Calculations

Month	Spring Flow Rate (gpd)	Monthly Diversion (gallons)	Pressure System Use (gpd)	Overflow to Pond (gpd)	Accrual to Pond (gpd)	Use from Pond (gpd)	Evaporation (mm/day)	Evap Loss (gpd)	Pond Volume (gallons)
April	2160	64,800	500	1660	1426		2.19	234	162,925
May	2160	66,960	2000	160	-133	1000	2.74	293	127,798
June	2160	64,800	2000	160	-343	1000	4.70	503	87,514
July	1440	44,640	1200	240	-346	1000	5.48	586	45,780
August	1440	44,640	1200	240	-256	1000	4.64	496	6,832
September	1440	43,200	1000	440	121		2.98	319	10,468
October	1000	31,000	500	500	337		1.52	163	20,927
November	1000	30,000	250	750	863		-1.06	-113	46,829
December	1000	31,000	250	750	944		-1.81	-194	76,082
Jan	1000	31,000	250	750	947		-1.84	-197	105,434
Feb	1000	28,000	250	750	854		-0.97	-104	129,339
March	1440	43,200	250	1190	1130		0.56	60	164,372
Total Gallons		523,240							
Annual Acre Feet		1.6							

I have attached pond spreadsheets for reference. Evaporation was based on the Arrowrock Dam weather station. I assumed that there is essentially no seepage loss because the pond is lined with bentonite.

Please contact me with any additional questions.

Sincerely,

Terry M. Scanlan

Terry M. Scanlan, P.E., P.G.
Principal Engineer/Hydrogeologist

Cc: Kip and Christine Losey

Enclosures

SPF file number: 1502.0010

Evaporation Loss Calculations

This spreadsheet has been designed by Idaho Department of Water Resources to estimate the annual evaporation losses from a pond.

FILE NUMBER	TBD
REVIEWER	SPF Water Engi
DATE	4/27/2020

User Input
Calculated value
Formula Explanations

The acronyms used on the Kimberly Research Center website are defined below:
P = Precipitation
ET= Evapotranspiration
P_d = Precipitation deficit
P_d =ET-P

USING THIS SPREADSHEET

Use the link below to access the Kimberly Research Center website. This website provides the Precipitation Deficit for a station most representative of the pond under examination. The Precipitation Deficit is the total amount of free water surface evaporation minus the precipitation for a given area, which gives the total amount of evaporative losses incurred by the pond. There are several weather sites that are used throughout the state. IDWR staff can find the nearest site using Arc Map. The shape file containing the sites can be found at X:/Spatial/Climate/ETIdahostations.shp.

Instructions:

1. Use the link below to navigate to ET Idaho 2012.
2. Select the station which is most representative to your pond location.
3. Click Submit Query.
4. Under "Land Covers with Evapotranspiration Estimates," select "Open Water - Shallow Systems (ponds, streams)" or "Open Water - small stock ponds" depending on the pond size.
5. Click the link to "Precipitation Deficit."
6. Reference and copy (ctrl + C) the first subheading "Mean" values.
7. Click the "Paste Values from ET Idaho" button. The table will automatically enter a zero (0) for any negative precipitation deficit values.

Found at: http://data.kimberly.uidaho.edu/ETIdaho/

Precipitation Deficit

Station: Arrowrock Dam

Month	mm/day[1]	*Days per month*	mm/Month
Jan	-1.84	31	0.00
Feb	-0.97	28	0.00
March	0.56	31	17.36
April	2.19	30	65.70
May	2.74	31	84.94
June	4.70	30	141.00
July	5.48	31	169.88
August	4.64	31	143.84
September	2.98	30	89.40
October	1.52	31	47.12
November	-1.06	30	0.00
December	-1.81	31	0.00

Total mm/year =	759.24

PLEASE NOTE: The seasonal average for precipitation deficit should not be used for calculations because precipitation often exceeds evaporation during wetter months of the year. If the pond is kept full, excess precipitation during wetter months does not serve to refill the pond during drier months.

For example, see Sandpoint KSPT (NWS -- 108137), the annual precipitation deficit is -106 mm. However, April through September have positive precipitation deficit values. To properly estimate the annual volume of water necessary to refill a pond due to evaporation losses, the table will automatically enter a zero (0) for each month that the precipitation value is reported as a negative value.

As described above, precipitation offsets evaporation in winter months, so the net effect is that wintertime precipitation deficit is usually zero.

[(mm/yr) ÷ (convert to feet)] X (Surface area of pond, in acres) = Evaporation Loss in Acre Feet

(759.24 ÷ 304.8) X 0.10 = 0.2 AFA

Seepage Loss Calculations

This spreadsheet has been designed by Idaho Department of Water Resources to estimate the total annual seepage losses from a pond.

FILE NUMBER	TBD
REVIEWER	SPF Water Engineering
DATE	4/27/2020

User Input
Calculated value
Formula Explanations

INPUTS

Pond Surface Area (AC.)	0.1	AC.
Pond Surface Area (SQ. FT.)	4356	SQ. FT.

I used the following method to obtain my Soil Classification information:	NRCS Web Soil Survey	
My Soil Classification is	Lined	
Suggested Seepage Rate (FT./DAY)	0.0000	FT./DAY

Formula: (Surface Area X Seepage Rate) X 7.48 = Gallons Per Day Loss

Convert to GPD	0	GPD
Total Seepage Loss (AFA)	0.0	AFA

Though sand and gravel seepage rates may actually be higher, the maximum allowable rate is 0.2 ft/day, pursuant to Administrative Memo "Seepage Loss Standards for Ponds and Reservoirs."

Suggested Seepage Rates for Different Soil Types:
GW, GP, GM, GC, SW, SP and SM (silty sand, sand silt mixtures and gravel mixtures) = **0.2 ft per day**
OL and ML (inorganic silts - very fine sands, silty, or clayey fine sands) = **0.02 ft per day**
SC (clayey sands, sand clay mixtures) = **0.007 ft per day**
CL (Low to medium plasticity clays) = **0.003 ft per day**
MH, OH, PT and CH (high plasticity clays) = **0.0003 ft per day**
LINED PONDS (liners can be chemical, fabric, or bentonite) = **0 ft per day**
Ponds Intercepting Groundwater (excavated ponds filled by ground water) = **0 ft per day**

PLEASE NOTE: The initial basis for the Suggested Seepage Rates in the table above is found on Page 16 of Seepage from Fish Ponds, Bulletin 599, August 1989 Alabama Agricultural experiment Station, Auburn University, Auburn University Alabama. If you don't know the soil type, please refer to the map provided at the NRCS Web Soil Survey (Tab #1) , an ArcMap Soil Classification Map (Tab #1.1), or published NRCS Soil Survey (Tab #1.2) . Use "0" if the pond fill relies on the water table.

Total Storage Calculations

FILE NUMBER	TBD
REVIEWER	SPF Water Engineer
DATE	4/27/2020

This spreadsheet has been designed by Idaho Department of Water Resources to estimate the total seepage, evaporation and fill capacity required for a pond.

User Input
Calculated value
Formula Explanations

Surface Area (AC.)	0.1	"Surface Area" is automatically carried over from the "Seepage Loss" sheet.
Average Pond Depth (FT.)	5	"Average Pond Depth" depicts the actual depth of the pond either measured or estimated. Note: If you know the maximum depth and not the average depth, the Field Examiner's Handbook suggests multiplying the maximum depth by 0.4 to get the average depth, or you can use any method that seems reasonable to attain average depth.
Pond Capacity (AF)	0.8	Pond Capacity is calculated by multiplying the Pond Surface Area by the Average Pond Depth. If you know the capacity, divide the capacity by surface area and enter the average pond depth in the space above. Note: If pond capacity is determined using a method shown on the "Pond Capacity" sheet, the user may need to modify the value of "Pond Capacity" (cell B9) manually. Note that if the value is modified manually, the formula will be altered for future use.
Multiple Fill Volume Above Initial Fill to Fulfill From Storage Needs- "Multiple Fills" (AF)	0	The "Multiple Fill Volume Above Initial Fill" is the acre-feet of water required to meet a *from storage* component if the *from storage* component exceeds a one time fill. This section should not include the amount of water needed to fill the pond initially or the amount of water needed to maintain the pond level due to evaporation or seepage. For example: if a pond has a capacity of 5 acre feet and 2.5 acre feet of seepage and evaporation, but the pond is used for irrigation that requires 10 acre feet of from storage for the irrigation use, then you would insert 5 acre feet into this location (10 acre feet needed - 5 acre feet from the initial fill = 5 acre feet of additional storage needed). Note: You must have a "From Storage" component exceeding the initial fill on the permit to include a volume in this space.
Estimated Seepage Loss (AF)	0.0	The "Estimated Seepage Loss" is automatically carried over from the "Seepage Loss" sheet.
Estimated Evaporation Loss (AF)	0.2	The "Estimated Evaporation Loss" is automatically carried over from the "Evaporation Loss" sheet.
Total Volume Required (AF)	1.0	The "Total Volume Required" is calculated by adding the Pond Capacity, Multiple Fills, Seepage Loss, and Evaporation Loss amounts to determine the total amount of storage required.

Flow Rate into Pond (CFS)	**0.003**	The "Flow Rate into Pond" depicts the actual flow, either measured or estimated, into the pond. For offstream facilities, this will be equivalent to "diversion to storage" rate.
Highest Daily Evaporation Rate From Evaporation Tab. (mm/Day)	5.48	This number is carried over from the "Evaporation Loss" sheet. It is the highest recorded number in the "Precipitation Deficit Table".
Required Daily Maintenance Volume (AF/Day)	0.002	"Required Daily Maintenance Volume" is the maximum volume of water needed on any given day during the year to maintain pond volume. It is calculated by adding the highest daily evaporation loss to the average daily seepage loss in acre feet. The average daily seepage loss is calculated by dividing the "Estimated Seepage Loss" by 365 days. This is acceptable, since the seepage rate shouldn't vary throughout the season unless the pond completely freezes over during the winter months. The highest daily evaporation loss is calculated by dividing the Highest Daily Evaporation Rate by the 304.8 conversion factor and multiplying this number by the pond surface area to attain a combined daily acre feet requirement.
Minimum Maintenance Flow (CFS)	0.001	The "Minimum Maintenance Flow" is the minimum amount of flow required to maintain the level of the pond. This number is determined by dividing the "Maximum Required Daily Maintenance Volume" by 1.9835. This flow can be used to determine if the flow rate into the pond is adequate to maintain the pond level.
Days Required to Fill the Pond	193	The "Days Required to Fill the Pond" is calculated by dividing the "Pond Capacity" by the "Flow Rate" minus "Minimum Maintenance Flow" multiplied by 1.9835. This section will assist you in determining if the flow rate being diverted to the pond is adequate to fill the pond while maintaining the pond level. The length of time to fill the pond will help determine if the flow rate is adequate for the size of pond being proposed. If this number is *approximately* 6 months (180 days) or more, the reviewer should have a discussion with the applicant to make sure he/she understands that it will take a significant length of time to fill the pond.
Days Required to Fill the Pond at 13,000 Gallons per Day	21	Some water users may want to fill a pond under the 13,000 gallons per day domestic exemption. The "Days Required to Fill the Pond at 13,000 Gallons per Day" is calculated by converting the "Pond Capacity" and the "Required Daily Maintenance Volume" to gallons. The "Pond Capacity" is then divided by 13,000 gallons minus the "Required Daily Maintenance Volume" in gallons to determine the number of days to fill pond. If this number is *approximately* 6 months (180 days) or more, the reviewer should have a discussion with the applicant to make sure he/she understands that it will take a significant length of time to fill the pond. Negative values indicate that the supply of 13,000 gallons per day is not enough volume to overcome the required daily maintenance volume; the pond will never fill.