



February 16, 2011

Will Atkin, Regional Engineer
1780 North Research Parkway, Suite 104
North Logan, UT 84341

RE: Letter of Inquiry – Mink Water Consumption Rate

Dear Mr. Atkin,

This letter of inquiry pertains to the current State of Utah water consumption value for mink. Currently the consumption rate is 0.00005 acre-feet per year. The purpose of this inquiry is to seek information from the Division of Water Rights to answer three questions:

1. Is the mink consumption rate provided by the State of Utah a per mink value, which implies that the rate is applied to adults and kits, or does the consumption rate pertain to adult mink only, which would account for the consumption of the kits?
2. Should use on a mink farm water right or change application be expressed in adult mink or total mink, which includes adults and offspring?
3. The attached literary review titled “Mink Water Requirement Literary Review and Calculations” recommends that the water consumption rate per adult mink be changed to 0.00032 ac-ft/year. Does the Division of Water Rights concur with the literary review, if not please provide data supporting the 0.00005 ac-ft/year consumption rate?

The three questions above prove critical in preparing a correct change application for a mink farm operation. Mr. Cody Mathews the owner of Blackridge Farms, a mink farm located near Hyrum, Utah, hired Civil Solutions Group to assist him in transferring irrigation shares to an underground water well on his farm. Answers to the above questions are needed prior to completing the change application to transfer additional acre-feet of water to water right #25-6742.

Mr. Mathews also hired Civil Solutions Group to complete a literary review of the current published mink water consumption studies. The report investigated current mink water consumption studies and compiled the data into a technical memorandum titled “Mink Water Requirement Literary Review and Calculations”. This report is based upon four separate mink water consumption studies and the report is attached to this letter for your review.

In summary the literary review found that the average water consumption for a three kg male is 0.000109 acre-feet per year and 0.000086 acre-feet per year for a two kg female. These water consumption values do not account for offspring, which are called kits. Page seven of the report lists the “average mink kit water requirement” of 0.00004 ac-ft/year and the “average adult mink water requirement” of 0.000097 ac-ft/year. The “average adult mink water requirement” is an average of the male and female mink water requirements.

From the average values listed on page seven of the report a “total yearly water requirement for adult mink” was recommended as 0.00032 ac-ft/year. This value includes the average adult water requirement and the water requirement for 5.5 mink kits. See report for further details. The findings of the report support the

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notion that the current State of Utah mink water consumption value is either too low for an adult mink (which includes offspring) or the rate should be applied to all mink, adult and offspring, on a given farm.

In review the technical memorandum presents multiple literary sources and the associated mink water consumption values and water needs. Based upon the findings of the report Civil Solutions Group recommends that the water consumption need for mink be changed to 0.00032 ac-ft per year per adult mink to be in line with the published literary studies pertaining to mink. The current water consumption rate of 0.00005 ac-ft per year per mink does not account for water consumption of mink kits, additional water needs during summer months, and other factors outlined in the technical memorandum.

Once again the three questions stated above will assist Cody Mathews in completing an accurate change application to transfer additional acre-feet of water to water right #25-6742. If you have any questions or comments pertaining to the letter of inquiry please call or contact me at 435.760.7488 or danny@civilsolutionsgroup.net.

Sincerely,

Danny Macfarlane, P.E.
Civil Solutions Group, Inc.

Cc: Cody Mathews, Owner Blackridge Farms
Scott Rawlings, R Scott Rawlings and Associates (email)
Kerry Carpenter, P.E., Enforcement Engineer, Division of Water Rights (email)

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Technical Memorandum

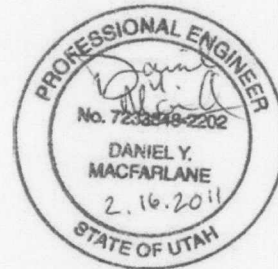
Mink Water Requirement Literary Review And Calculations

Prepared For:

Mr. Cody Mathews
Blackridge Farms
181 East 6400 South
Hyrum, Utah 84319

Prepared By:

Civil Solutions Group, Inc.
Danny Macfarlane, P.E.
2 North Main Suite 7
Providence, Utah 84332



Original Submittal: January 2011
Revision No. 1: February 2011

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Introduction

The purpose of this technical memorandum is to explore the literary studies and technical research that has been completed pertaining to water consumption and the water requirements of mink (*Mustela vison*). Currently the State of Utah Division of Water Rights lists the allowable water use for mink as 0.00005 acre-feet per year (Utah Division, 2011). This value has been under dispute by mink farmers in the State of Utah during the past. The farmers protested that the value is unrealistically low. Mr. Paul K. Westwood (Water Right 51-6814), a mink farmer in Utah, protested the amount of water allowed per mink during the years 2000-2002, stating that the amount of water allowed is not adequate for mink farming. The Utah Fur Breeders Agriculture Co-operative (FBAC) also protested the amount of water allowed per mink in a letter dated September, 7, 2001 in regard to Mr. Westwood's protest (Water Right 51-6814).

Mr. Cody Mathews, owner of Blackridge Farms located in Hyrum, Utah contacted Civil Solutions Group, Inc. to provide water rights consultation in light of a recent decision by the State of Utah Engineer dated January 28, 2010. At that time the State of Utah Engineer quantified his water right as 0.25 acre-feet with a flow rate of 0.015 cubic feet per second (cfs). The 0.25 acre-feet is based upon the approved beneficial use of 5,000 mink at a water use value of 0.0005 acre-feet per year (Water Right 25-6742 (a35830)). Mr. Cody Mathews has expressed a believe that the allowed water use per mink of 0.0005 acre-feet per year is not realistic nor does it represent what mink consume or require.

This technical memorandum presents the findings from the literary review along with calculations of water requirements of male, female and kit (baby) mink. This memorandum also presents existing water usage data as measured and estimated for Blackridge Farms. This literary review data along with the existing water usage data shows a large discrepancy between the allowed water usage in mink farms in Utah and the actual usage based upon accepted mink farming practices.

Literary Review

A literary review of available books, journals, reports, technical opinions, etc. was completed through Utah State University Library, online research, and review of existing documentation from previous mink farm protests. The review focused on water consumption and water requirements of mink. The majority of the books written pertaining to mink farming and fur breeding are published in Europe, Canada and England.

A few important factors related to water consumption of mink deal water consumption sources, dry feed versus wet feed, mink body weight, atmospheric temperature, lactation period, amount of water available and other factors. A brief description of these issues is provided here:

- Water consumption of mink is considered 70% from dietary sources (feed mixture), 27% from drinking water, and 3% from metabolic sources (Beard, 2000). The amount of water consumed in the feed mixture can vary depending on whether a dry mix feed or wet mix feed is used. Wet mix feed can have a water content varying from 55-75% depending on the mixture (Mink Production, 1985, Chris Falco, personal communication, January 2011).
- Many of the literary sources used a 2 kilogram (kg) weight for males and 1 kg weight for females (Mink Production, 1985, Mink Biology, Health & Disease, 1996). Dr. Richard Beard from Utah State University listed an average weight of 2.42 pounds (lb) (Beard, 2000). It has been stated that mink farms utilize selective breeding to breed for size. The average sized male in Utah Mink Farms is approximately 3 kg and the 2 kg for female mink (Chris Falco, personal communication, January 2011 and Cody Mathews, personal communication, December 2010).
- It was noted in many of the studies that temperature plays a key role in the water consumption requirements of mink. Mink use drinking water for thermoregulation of body temperature. During cold weather months with temperature ranging between 34-44 degrees F, adult males consume 1 to 1.8 ounces of water per day and females consume 1 to 1.6 ounces of water per day. During summer months when temperatures range from 68-86 degrees F, adult (male) mink consume 11 to 15.8 ounces of water per day and females consume 10.2 to 14 ounces of water per day (Beard, 2000).
- Many of the literary sources stated that female mink consume increased amounts of water during lactation period. The growth of kits during the first three weeks of life depends upon energy supplied by the dam's milk, and to a declining extent, this demand continues until weaning. Consequently, the lactating female must receive additional energy for milk production, the amount required increasing with the increasing demands of the developing kits for energy and nutrients (Nutrient Requirements of Mink and Foxes, 1982). The most critical periods (for plentiful water access) are lactation and the first period after the kits have begun to eat solid feed in addition to suckling (Mink Production, 1985).
- Another important factor in water consumption of mink is the amount of water available. Caged female mink, receiving fresh, clean, unrestricted drinking water have better performance in terms of litter size, low barren percentage, higher milk production, kits reared per female, kits opening eyes earlier, kits exhibiting superior

growth performance, and better fur quality (Beard, 2000). Clean fresh water should be available at all times (Nutrient Requirements of Mink and Foxes, 1982) and it is impossible to emphasize too strongly the importance of giving the mink easy access to a good and plentiful supply of drinking water throughout the year (Mink Production, 1985).

The above factors relating to mink water consumption create the backdrop for the next section of information from the literary review. Four literary sources provided water consumption estimates for mink. Table 1 shows the Adult Mink Water Consumption values from the literary sources.

Table 1. Adult Mink Water Consumption

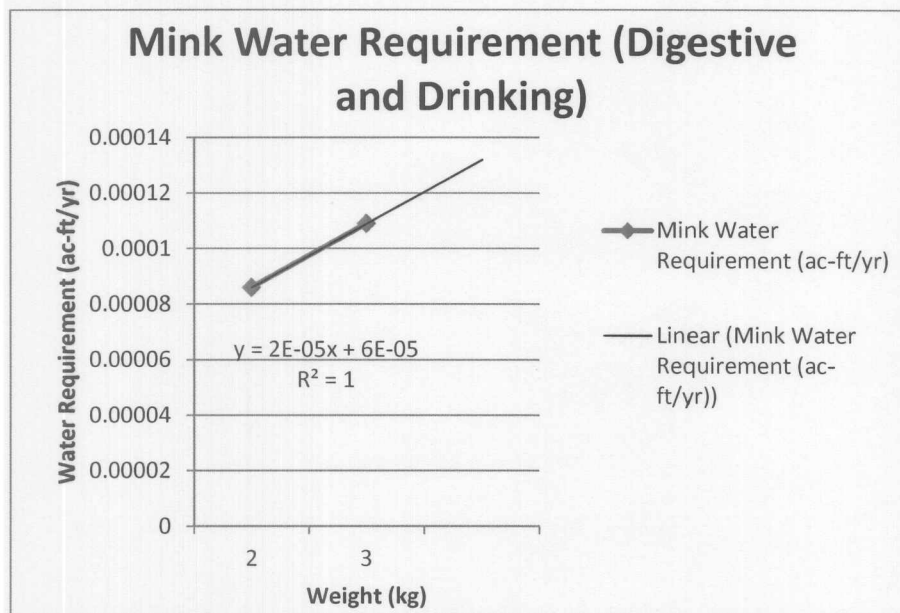
Adult Mink Water Consumption								
Literary Source	Sex	Weight (lb)	Weight (kg)	Required Water/Day	Units	Required Water/Day (Gallons)	Total Water Requirement/Year (Gallons)	Ac-ft per Year
Mink Production ¹	Male	4.41	2	260	grams	0.07	25.08	0.000077
	Female	2.20	1	190	grams	0.05	18.33	0.000056
Dr. Richard Beard, Utah State University ¹	Male ²	2.42	1.1	7.4	oz	0.06	21.10	0.000065
	Female ²	2.42	1.1	6.7	oz	0.05	19.11	0.000059
Mink Biology, Health, and Disease ¹	Male	4.41	2	260	grams	0.07	25.08	0.000077
	Female	2.20	1	190	grams	0.05	18.33	0.000056
Dr. Legrande Ellis, Utah State University ¹	Male	4.41	2	1.4	oz	0.01	3.99	0.000012
	Female	2.20	1	1.02	oz	0.01	2.91	0.000009
The "Mink Production", "Mink Biology, Health, and Disease" and Dr. Richard Beard list water requirement as the total consumption from feed mixture and drinking water. Dr. Legrande Ellis lists a survival water requirement not a typical mink consumption requirement. The calculated averages below omit Dr. Ellis's values due to the outlying nature of his data compared to the other sources.								
Footnotes:								
1. See references in technical memorandum.				Average Male (2 kg) Water Requirement (ac-ft/year)				0.000073
2. Dr. Richard Bear listed the weight of an average mink at 2.42 lbs.				Average Female (1 kg) Water Requirement (ac-ft/year)				0.000057
3. The adjustment to the average water consumption was made to account for the average weight of mink on Blackridge Farms.				Weight Adjustment for 3 kg Male (ac-ft/year) ³				0.000109
				Weight Adjustment for 2 kg Female (ac-ft/year) ³				0.000086

It is important to note that the water consumption values listed in Table 1 consider the water from dietary sources and drinking water, which represents the total water consumption of the mink. The water consumption values provided by Dr. Legrande Ellis were not used in the calculations of the average water consumption requirement due to the outlying nature of his data. From the literary research it could be extrapolated that Dr. Legrande Ellis used the minimum water requirement during cold temperature portions of the year and did not account for hot temperatures, lactation periods or other fluctuating factors.

Dr. Beard cited 1 to 1.8 ounces and 1 to 1.6 ounces for male and females respectively as the water consumption of mink during cold temperatures ranging from 34 to 44 degrees F (Beard, 2000). These water consumption values are similar to Dr. Ellis's, but Dr. Beard also provided hot temperature water consumption values resulting in an average water consumption for mink that are similar to the other literary source values.

Table 1 shows the average water consumption requirement for a 2 kg male and 1 kg female to be 0.000073 acre-feet per year and 0.000057 acre-feet per year respectively. An adjustment for the current average size of male and females resulted in 0.00011 acre-feet per year for 3 kg males and 0.000086 acre-feet per year for 2 kg females. It is important to note that all water consumption requirements listed in this paragraph exceed the State of Utah Water Use recommendation for mink of 0.00005 acre-feet per year per mink.

Figure 1 shows the adjusted average water consumption requirement for adult mink on a scatter plot with a linear trendline.



Analysis

It has been shown above through the available literary review that the average water consumption requirement, even without the adjustment for weight, exceeds the State of Utah Water Use recommendation for mink. It is important to note that these average water consumption requirement values are for a single adult mink and do not take into account the water consumption needs of the kits of each female.

Female mink typically have their litter during the last half of April. Kits depend upon the dam's milk during the first three weeks and to a declining extent the demand continues until weaning (Nutrient Requirements of Mink and Foxes, 1982). Weaning typically occurs at six weeks or 45 days following birth. At this time kits begin to drink and eat on their own.

An analysis of the water consumption requirements of mink following weaning was completed to adequately understand the amount of water being consumed by kits. Kits typically are weaned during the first part of June at 45 days following birth. This results in water consumption by the kits from June to November when the kits are harvested. Production on Blackridge Farms has averaged 5.5 kits per female (Cody Mathews, personal communication, December 2010). Table 2 illustrates the water consumption requirement of kits from the end of weaning to harvest.

Table 2. Mink Kit Weight and Water Consumption

Mink Female Kits Weight by Days					
Age (days)	Weight (lb)	Weight (kg)	Estimated Water Req./Day (gallons)	Average Monthly Water Req./Month (gallons)	
30	0.44	0.2	0	0	
45	0.83	0.375	0.060260	0	
60	1.32	0.6	0.064277	0.95	June (Half)
90	2.05	0.93	0.070169	2.05	July
120	2.54	1.15	0.074097	2.20	August
150	2.71	1.23	0.075526	2.28	September
180	2.76	1.25	0.075883	2.31	October
210	2.71	1.23	0.075526	2.31	November
Total Female Mink Water Requirement/Year (gallons)				12.10	gallons/yr
Total Female Mink Water Requirement/Year (ac-ft)				0.000037	ac-ft/yr
Mink Male Kits Weight by Days					
Age (days)	Weight (lb)	Weight (kg)	Estimated Water Req./Day (Gallons)	Average Monthly Water Req./Month (gallons)	
30	0.44	0.2	0	0	
45	0.95	0.43	0.061242	0	
60	1.81	0.82	0.068205	0.99	June (Half)
90	3.15	1.43	0.079097	2.25	July
120	4.23	1.92	0.087846	2.55	August
150	4.87	2.21	0.093023	2.76	September
180	4.96	2.25	0.093738	2.85	October
210	4.94	2.24	0.093559	2.86	November
Total Male Mink Water Requirement/Year (gallons)				14.24	gallons/yr
Total Male Mink Water Requirement/Year (ac-ft)				0.000044	ac-ft/yr

The weights listed in Table 2 are found in Figure 2 of the Nutrient Requirements of Mink and Foxes handbook, which illustrates the weight for mink kits at different days of growth. The linear equation found on Figure 1 of this memorandum was used to determine the water consumption requirement of the kits at the weights listed above. The total water consumption requirement is listed as gallons per month per kit. The summary of male and female mink kits lists the total acre-feet per year per kit. It is calculated that male mink kits consume 0.000044 acre-feet per year and female mink kits consume 0.000037 acre-feet per year.

The water consumption of mink kits is important to define the total water use on a mink farm. The stockwatering values listed on the Utah Division of Water Rights water use page are for adult animals. It is imperative that the value listed by the State take into account water usage for not only the adult animals, but the offspring of the respective animal. Currently Blackridge farms has approximately 8,000 females, 1,000 to 2,000 breeder males and with an average yield of 5.5 kits per female the farm could have 44,000 kits. The kits need to consume water between the months of June to November as shown in Table 2. Table 3 below shows a recommended water use value per mink utilizing the data from the literary review and the analysis contained in this memorandum.

Table 3. Mink Water Consumption Requirement

Mink Water Requirement Summary		
Average Mink Kit Water Requirement	0.000040	ac-ft/yr
Average Adult Mink Water Requirement	0.000097	ac-ft/yr
Total Yearly Water Requirement Adult Mink (including water requirement for 5.5 kits)	0.00032	ac-ft/yr

The average mink kit water consumption requirement in Table 3 is an average of the male and female kit water consumption as is the average adult mink water consumption requirement. The total yearly water consumption requirement value listed at the bottom of Table 3 is the recommended water use value for an adult mink. This value is based upon the average adult mink water consumption requirement plus the water consumption requirement of 5.5 kits.

Recommendation

It is recommended that 0.00032 acre feet per mink per year be used in place of the current Division of Water Right value of 0.00005 acre-feet per mink per year. This recommendation is based upon the literary review data and analysis contained in this report along with the professional judgment and experience of Civil Solutions Group.

One major discrepancy between current mink farm practices and the current allowable water usage is the additional water that is being used above and beyond the mink water consumption amount. As listed in the literary review an important factor in water consumption of mink is the amount of water available. Caged female mink, receiving fresh, clean, unrestricted drinking water have better performance in terms of litter size, low barren percentage, higher milk production, kits reared per female, kits opening eyes earlier, kits exhibiting superior growth performance, and better fur quality (Beard, 2000). Clean fresh water should be available at all times (Nutrient Requirements of Mink and Foxes, 1982) and it is impossible to emphasize too strongly the importance of giving the mink easy access to a good and plentiful supply of drinking water throughout the year (Mink Production, 1985).

Many mink farmers including Blackridge Farms provide water to the mink by running a continuous stream of fresh water in a trough in front of each mink cage. This additional water combined with the water required for wash down of equipment, wash down of feed silos, employee restrooms, employee emergency shower, and employee drinking water is not permitted within the allowed water use per mink. There is a need to approve water uses incidental to the operation of a mink farm.

For example Blackridge Farms is currently using 22.4 acre-feet of water per year based upon the existing uses. The farm currently has 8,000 females and 1,000 to 2,000 breeder males. Applying the recommended water use rate of 0.00032 acre-feet per mink per year would provide a beneficial use of 3.2 acre-feet per year, resulting in a difference of 19.2 acre-feet of incidental water use. Civil Solutions Group recommends that incidental water use be allowed as part of future change applications for mink farms along with the recommended water use value of 0.00032 acre-feet per mink per year.

References

Falco, Chris. January 2011. Personal conversation with Chris Falco, Executive Director, Utah Fur Breeders Association, and D. Macfarlane, Civil Solutions Group Civil Engineer, regarding average weight of male and female mink in Utah. 2011.

Hunter, D.B., and L. Lemieux. 1996. *Mink...biology, health, and disease*. Canadian Mink Breeders Association, Rexdale, Ontario.

Joergensen, Gunnar. 1985. *Mink Production*. Scientifur, Hilerod, Denmark.

Mathews, Cody. December 2010. Personal conversation with Cody Mathews, Owner and D. Macfarlane, Civil Solutions Group Civil Engineer, regarding average weight of male and female mink in Utah. 2010.

National Research Council. 1982. *Nutrient Requirements of Mink and Foxes*. Second Edition. National Academy Press, Washington, D.C.

Utah Division of Water Rights. Diversion and Depletion Values. Waterrights. 24 June 2003. Web. 2011. <http://www.waterrights.utah.gov/wrinfo/policy/wateruse.asp>

Appendix

1. Mink Drinking Requirement, Richard Beard Ph.D.
2. Mink Drinking Requirement, LeGrande Ellis Ph.D.

From: Richard Beard <rbeard@cc.usu.edu>
To: <deanm@ext.usu.edu>
Date: 10/13/00 4:44pm
Subject: Mink Water Requirements

Mink Drinking Water Requirements

Mink with an average body weight of 2.42 pounds and maintained at a constant temperature, will consume an average of 6.7 ounces of water during a period of 24 hours. This water consumption is 70% from dietary (feed mixture) sources, 27 % from drinking water, and 3 % from metabolic sources.

Thermoregulation:

Mink use drinking water for thermoregulation of body temperature. During cold weather months with temperatures ranging between 34 and 44B F, adult males consume 1 to 1.8 ounces of water per day and females consume 1 to 1.6 ounces of water per day. During summer months when temperatures range from 68 to 86B F, adult mink consume 11 to 15.8 ounces of water per day and females consume 10.2 to 14 ounces of water per day. During hotter temperatures mink consume more water. Also, when water temperature is warmer such as 70B F, rather than cooler such as 40B F, mink consume more water.

Mink Water Consumption:

During temperatures of 68 to 86B F, a mink farm with 1000 adult animals will require 600 to 865 gallons of water each week for drinking and dietary needs. On warmer days more water will be consumed. Water is also needed for cleaning equipment, cages, and personnel.

Recommendation:

Allow mink voluntary water consumption via freeze proof watering systems.

Research Shows:

Caged female mink, receiving fresh, clean, unrestricted drinking water have better performance in terms of litter size, low barren percentages, higher milk production, kits reared per female, kits opening eyes earlier, kits cutting their earlier, kits exhibiting superior growth performance, and better fur quality.

Note:

Bathing trays for female mink have demonstrated no effect on female or kit weight.

Source:

Richard Beard, USU Extension, rbeard@cc.usu.edu, 435.797.0573

October 13, 2000

Richard Beard
Utah State University

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UTAH STATE UNIVERSITY

DEPARTMENT OF BIOLOGY
College of Science
Logan, UT 84322-5305

December 10, 1996

Mr. Cooper (Scot) McLachlan
P.O. Box 433
American Fork, UT 84003

Dear Scot:

- According to the scientific literature for mink here in the U.S., an average sized male mink weighing 2 kg or 4.4 lbs on a diet such as you and members of the Co-op feed would require 41.6 ml or 1.4 fluid oz. of water per day to survive on an average day (assuming that the decreased need for water in the winter would be offset by the increased need in summer). Similarly, an average sized female mink weighing 1 kg or 2.2 lbs would require 30.4 ml or 1.02 fluid oz. of water per day to survive under the same conditions as stated above for a male mink.

I trust that the above information is what you need. If you need additional information, please do not hesitate to call. It is a pleasure to work with you mink farmers and I wish you continued success in your endeavors.

Sincerely,

LeGrande C. Ellis, Ph. D.
Professor of Physiology

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128.08 = 1 gal.



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