

June 13, 2011

Township Supervisor
12050 Old Belding Road
Belding, MI 48809-9318

July 2010 – April 2011 Monthly Rainfall/Evaporation Correction

Dear Frank,

In July 2010, Infrastructure Alternatives began establishing a rough formula to provide a general theoretical break-down of the components that impact the lagoon volume on a monthly total basis. This calculation was not and is not required by the State of Michigan MDNRE, nor has it been used in any of the quarterly and monthly reporting to the State of Michigan MDNRE. The rainfall data has been based on information obtained from the Grand Rapids Airport and it not necessarily representative of the precipitation at the Grattan Township WWTF. The formula accounts for evaporation, snow melt, and ice melt through deduction from the known variables. The formula was not designed to make any projections based on a particular itemized component of this monthly formula. Nonetheless, there was an error in the total surface area value that determined the volume from rainfall (as determined by the Grand Rapids Airport). This error does not affect the individual and total monthly lagoon volumes, as the lagoon volumes are calculated from their depth in correlation to fixed transfer structures using a chart established by Prein & Newhof’s survey. The erroneous total lagoon surface area of 280,000 ft² had been used for calculating the amount of rainfall volume (in MG), when the recently calculated value of 523,472 ft² is the correct number. This value is calculated by the following information:

$$\begin{aligned} \text{Lagoon \#1: } & (668' \times 104' \times 0.5) + (668' \times 286') = 225,784 \text{ ft}^2 \\ \text{Lagoon \#2: } & 520' \times 248' = 128,960 \text{ ft}^2 \\ \text{Lagoon \#3: } & 322' \times 262' = 84,364 \text{ ft}^2 \\ \text{Lagoon \#4: } & 322' \times 262' = 84,363 \text{ ft}^2 \\ \text{Total Lagoon Volume: } & \mathbf{523,472 \text{ ft}^2} \end{aligned}$$

It is Infrastructure Alternative’s on-going objective to present data that will assist the township board and residents through historical analysis and professional projection. Although the incorrect surface area value did not affect the individual and total monthly lagoon volumes, it did affect the break-down of the amount of theoretical water volume from rainfall and, correspondingly, the amount of volume of evaporation/snow-melt/localized rainfall correction. The monthly water itemization formula corrections are listed below:

July 2010 Rainfall/Evaporation Correction (4.66” Rainfall):

$$-3.450\text{MG (Tot. Lag. Dec.)} = 1.031\text{MG (Inf.)} + 1.520\text{MG (Rain)} - 3.240\text{MG (Irr.)} - 2.761\text{MG (Evap.)}$$

August 2010 Rainfall/Evaporation Volume Correction (1.74” Rainfall):

$$-3.130\text{MG (Tot. Lag. Dec.)} = 0.916\text{MG (Inf.)} + 0.568\text{MG (Rain)} - 4.118\text{MG (Irr.)} - 0.496\text{MG (Evap.)}$$

September 2010 Rainfall/Evaporation Volume Correction (4.28” Rainfall):

$$-3.450\text{MG (Tot. Lag. Dec.)} = 0.823\text{MG (Inf.)} + 1.397\text{MG (Rain)} - 2.756\text{MG (Irr.)} - 2.914\text{MG (Evap.)}$$

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October 2010 Rainfall/Evaporation Volume Correction (2.61" Rainfall):

-0.570MG (Tot. Lag. Dec.) = 0.799MG (Inf.) + 0.609MG (Rain) – 0.969MG (Irr.) – 1.009MG (Corr/Evap)

November 2010 Rainfall/Evaporation Volume Correction (2.81" Rainfall):

1.57MG (Tot. Lag. Incr.) = 0.782MG (Inf.) + 0.917MG (Rain) – 0.000MG (Irr.) - 0.182MG (Corr/Evap)

December 2010 Rainfall/Evaporation Volume Correction (1.78" Rainfall):

1.920+MG (Tot. Lag. Incr.) = 0.822MG (Inf.) + 0.581MG (Rain) – 0.000MG (Irr.) + 0.517MG (Ice/snow)

January 2011 Rainfall Volume Correction (1.31" Rainfall):

1.500+MG (Tot. Lag. Incr.) = 0.892MG (Inf.) + 0.427MG (Rain) – 0.000MG (Irr.) + 0.181MG (Ice/snow)

February 2011 Rainfall/Evaporation Volume Correction (2.96" Rainfall):

1.460+MG (Tot. Lag. Incr.) = 0.892MG (Inf.) + 0.966MG (Rain) – 0.000MG (Irr.) - 0.398MG (Ice/snow)

March 2011 Rainfall/Evaporation Volume Correction (4.01" Rainfall):

1.950+MG (Tot. Lag. Incr.) = 1.181MG (Inf.) + 1.308MG (Rain) – 0.000MG (Irr.) + 0.539MG (Ice/snow)

April 2011 Rainfall/Evaporation Volume Correction (7.19" Rainfall):

2.190+MG (Tot. Lag. Incr.) = 1.513MG (Inf.) + 2.346MG (Rain) – 0.000MG (Irr.) – 1.669MG (Corr./Evap.)

Once again, this data did not affect the individual and monthly lagoon volumes as reported in the monthly operations reports. The breakdown of the component water itemization of the monthly total increase or decrease, does not take in to consideration localized weather as the rainfall data is collected from the weather station at the Grand Rapids Airport. A rain gauge (i.e. tipping bucket) and data recorder has been installed at the Grattan WWTP site for use beginning the month of June 2011. Additionally, the turbine flow meter at the Grattan WWTF has also been replaced with a more accurate magnetic flow meter. A magnetic flow meter will also be installed on the wastewater force-main leaving Big Pine Island Pump Station #1 in the summer of 2011.

Adding the data for the total rainfall over this 10 month period (without May and June) equals +10.705MG with a total of -9.197MG for evaporation over the same time period. The correction in the square footage actually supports the common engineering claim that the sum of evaporation negates precipitation over the course of a year.

I apologize for any confusion this may have caused.

Sincerely,



John Rydbeck
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Infrastructure Alternatives - Grattan Township Sewer System Operations Manger