

**To:** Chris Hertz, City of Billings  
**From:** Craig Dalton, PE  
**Date:** November 30, 2015  
**Subject:** Glynn Abbey Subdivision Greywater System

On behalf of Glynn Abbey, LLC (Owner), Performance Engineering & Consulting, PLLC (PEC), is notifying the City of Billings of the greywater evacuation plan for Glynn Abbey Subdivision stormwater detention system.

The proposed Glynn Abbey Subdivision is a 22-acre residential development consisting of 33 single-family lots varying in size from 20,475 to 39,640 square-feet (0.47 to 0.91 acres); approximately one acre of ponds and streams; approximately one half mile of asphalt walking and recreational trails; and 3 acres of open/green space.

All of the ponds within the proposed development are designed to hold water year round. This includes the main retention ponds (Ponds 2 and 3). Pond 2 is designed to route water to Pond 3 and assist in controlling flow rates during major events. Pond 3 is the main stormwater retention pond in the proposed development, providing 27,068 cubic feet (cf) of runoff storage capacity. In addition to the storage provided by Ponds 2 and 3, a raised trail loop system has been placed around the ponds to provide additional storage within the open space area during major storm events. The maximum storage capacity provided by the area inside the trail loop is 31,862 cf. Using Autodesk Storm & Sanitary Analysis (SSA) design modeling, runoff volumes for the 50-year and 100-year storm were found to be 43,438 cf and 60,848 cf, respectively. The excess runoff volume beyond the retention area capacity (31,862 cf) will be released at a controlled rate through a spillway located within the trail along the southern portion of Pond 3. Water released through the low point in the trail will be conveyed to the northern right-of-way of Rimrock Road. Table 1 depicts the retained runoff volumes for the storm events of interest.

**Table 1: Retained Runoff Volumes**

	5-year Storm	10-year Storm	25-year Storm	50-year Storm	100-year Storm
Retained Runoff Volumes (cf)	10,947	17,704	32,482	43,438	43,438

The proposed development will implement a centralized greywater system for the irrigation of all landscaped areas including residential lawns. In addition to its irrigation duties, the greywater system will also be utilized for the dissipation of stormwater.

Following a large storm event, water remaining within the trail loop will be evacuated by employing the greywater system to spread the excess water to irrigable areas throughout the proposed subdivision. The irrigable area was calculated by taking the total property area less the impervious road/trail and pond surface areas. Additionally, the residential lots were assumed to have an impervious area of 30% to account for rooftops and driveways. The total irrigable area of the proposed subdivision was calculated to be 607,435 sf or 13.94 acres. Daily historic consumptive rates for lawns in the Billings area, as supplied by the U.S. Department of Interior, were averaged to estimate the Glynn Abbey Development's daily consumptive volume. Table 2 summarizes the results.

**Table 2: Average Daily Consumptive Volumes for Glynn Abbey Subdivision**

	April	May	June	July	August	September	Average
Average Daily Consumptive Rate (in)	0.08	0.15	0.19	0.24	0.20	0.14	0.17
Average Daily Use (cf)	3,980	7,413	9,613	12,109	10,269	7,154	8,423

Using the consumptive rates shown in Table 2, the average evacuation times for the storm events of interest are presented in Table 3. These values were obtained by dividing the excess water volumes given in Table 1 by the average daily consumptive volume of 8,423 cf/day. The average time it would take to evacuate the water within the retention area back to the normal operating levels of the ponds following a 100-year storm is approximately 124 hours (5.15 days).

**Table 3: Average Time to Return to Normal Operating Pond Levels**

	5-year Storm	10-year Storm	25-year Storm	50-year Storm	100-year Storm
Average Time to Consume Excess Water (hours)	31	50	92.5	124	124

Although the average evacuation time for the 25-, 50-, and 100-year storms exceed the 72-hour maximum duration outlined in the City of Billings Stormwater Regulations, the proposed system will disperse over 58% of the stored runoff volume in the first 72 hours.

Please contact PEC Project Engineer Craig Dalton with any questions or concerns at 406-384-0080 or [craig@performance-ec.com](mailto:craig@performance-ec.com). Thank you for your consideration and coordination in our project.

Cc: Glynn Abbey, file