*#101, 10630 – 172 Street*
*Edmonton, AB T5S 1H8*
*Phone: 780-486-2000*

a division of Englobe

# Hamlet of Blackfoot Wastewater System Upgrades

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| **To:** | **Roger Garret, C.E.T** | **From:** | **Saadia Sultana, Ivan Kagoro** |
| | **County of Vermilion River** | **cc:** | **Ryan Sharpe, P.Eng.** |
| **Re:** | **January 30 Open House** | **Date:** | **2024/02/28** |
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| **Email:** | **rgarnett@county24.com** | | |

## 1.0 INTRODUCTION

On January 30, 2024, the County of Vermilion River (County) held an open house for the residents of the Hamlet of Blackfoot (Blackfoot) to obtain feedback regarding the Blackfoot Wastewater (WW) System Upgrades project. The first portion of the project consisted of upgrades to the existing Blackfoot WW System to meet regulatory standards and future growth demands. The second portion consisted of extending the existing 6" effluent pipe south and west to an outfall into Blackfoot Creek for effluent disposal.

To address concerns from residents regarding the discharge of treated effluent into Blackfoot Creek, the County retained MPE a division of Englobe (MPE) to complete a high-level review of the following options:

- Option 1: Treated Effluent Irrigation
  - 1A: Status Quo: Maintain Treated Effluent Disposal to Quarter Section SE 6-50-1 W4.
  - 1B: Treated Effluent Disposal to Quarter Section SE 12-50-2 W4 immediately east of the wastewater stabilization ponds.
- Option 2: Treated Effluent Re-Use
  - 2A: Treated Effluent Re-use for Industry.
  - 2B: Treated Effluent Re-use for Agriculture.
- Option 3: Treated Effluent Disposal by Evaporation
- Option 4: Treated Effluent Disposal through Mound
- Option 5: Treated Effluent Discharge to Lloydminster's Sewer System

Residents of Blackfoot also voiced concerns of significantly low flow observed in Blackfoot Creek, potential odour control issues, and impacts to surrounding water wells. MPE has reviewed both concerns in the following sections.

# 2.0 CURRENT DESIGN - TREATED EFFLUENT DISPOSAL TO BLACKFOOT CREEK

Upgrades to Blackfoot's wastewater treatment system included a proposed 10" HDPE effluent pipeline that would discharge the treated effluent to Blackfoot Creek. The pipeline would connect to the existing 6" line at the intersection of the CN Railroad and Range Road 20, run south along the range road, and west along Township Road 494 to an outfall in Blackfoot Creek.

The following sections review the three main concerns brought up by the residents:

- No Natural Flows in Blackfoot Creek.
- Nuisance Odours from the Treated Effluent.
- Ground Water Well Impact

## 2.1 No Natural Flows in Blackfoot Creek

During the open house, residents near Blackfoot Creek noted there is usually no flow in the Creek.

MPE completed a monthly flow and discharge analysis along the section of Blackfoot Creek, at the proposed sanitary outfall location, using historical streamflow data from two stations. As there are no stations with consistent stream flow data along Blackfoot Creek, MPE selected stations in the area with considerable historical data and with similar catchment area and characteristics. These are 1) Stretton Creek and 2) Buffalo Creek.

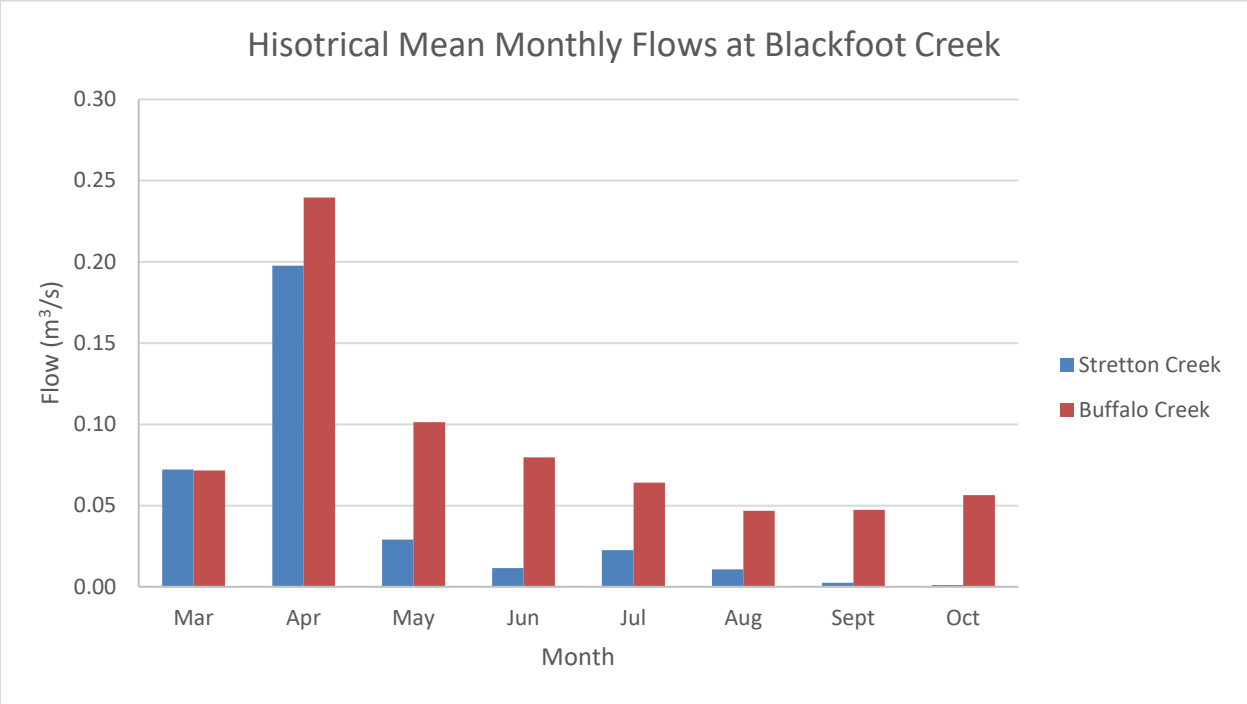
The main characteristics of these stations are listed below in **Table 2.1**.

**Table 2.1: Stream Flow Stations Characteristics**

| Name | Stretton Creek near Marwayne | Buffalo Creek at Highway 41 |
|---|---|---|
| ID | 05EE005 | 05FE002 |
| Effective Drainage Area | 56.3 $km^2$ | 147 $km^2$ |
| Period of Record | 1978-2024 | 1971-2024 |
| Operation Period | MAR-OCT | MAR-OCT |
| Regulation Type | Natural | Natural |
| Type of Water Body | River | River |

Data from both stations between March 1979 and October 2019 was used in the following analysis. **Figure 2.1** shows the mean monthly flows at Blackfoot Creek considering the stream flow data from both stations at Stretton Creek and Buffalo Creek.

**Figure 2.1. Historical Mean Monthly Flows at Blackfoot Creek**




Considering both sets of data presented in **Figure 2.1**, peak mean monthly flows occur in April, likely due to spring snowmelt. The two mean monthly flows in April average to approximately 0.22 $m^3/s$ or 19,000 $m^3/d$ between the stations. For the remaining summer months, the historical average monthly flows from the Stretton Creek station are significantly lower than the historical average seen at the Buffalo Creek station. This deviation between the historical average monthly flow may be related to smaller baseflow contribution from the Stretton Creek watershed.

Based on **Figure 2.1**, the County will be limited to discharging to the Blackfoot Creek outfall during the month of April, when the natural flows are at their highest. At the proposed treated effluent 20-year design discharge rate of 22 L/s (1,900 $m^3/d$), the Blackfoot creek would provide about a 10:1 dilution.

The monthly flows presented in **Figure 2.1** and the annual discharges shown in **Figure 2.2** were estimated considering the area draining into the Blackfoot Creek at the outfall location. The calculations are based on the flows/discharges recorded at each station and the catchment area upstream of these gauges and scaled down considering the catchment area upstream the outfall location.

### 2.2 Nuisance Odours from the Treated Effluent

During the open house, residents of Blackfoot voiced concerns of potential nuisance odours at the proposed outfall at Blackfoot Creek during and after discharge of the treated effluent. To

address the odour concerns, the following first describes a typical conventional WW system and its expectations, and then outlines the required improvements proposed for Blackfoot's WW system.

Overview of a Typical Conventional Wastewater Stabilization System

A conventional wastewater stabilization pond system typically has anaerobic ponds followed by a facultative (aerobic) pond then a storage pond. The anaerobic pond is the first point of treatment for settling solids and removal of organic matter. It has a short retention time and a relatively deep depth. A well-operating anaerobic pond would be covered entirely with a dense scum blanket which would help to keep the pond anaerobic (no oxygen) and minimize foul odors.

The second stage, the facultative pond, is shallow and is meant to provide aerobic biodegradation predominantly and some anaerobic biodegradation on the bottom of the pond. Effluent is drawn from the top and discharged into the storage pond.

The storage pond provides additional wastewater treatment (including nutrient removal) under facultative conditions and reduces the environmental impact on the receiving drainage course by facilitating the annual discharge (as required by AEP) of high-quality effluent wastewater.

Proposed Upgrades to Blackfoot Wastewater Stabilization Pond System

Blackfoot's wastewater system consists of 2 anaerobic and one facultative/storage pond. The anaerobic cells meet Alberta Environment (AEP) requirements for retention time, and depth. As part of the upgrades, these ponds are recommended to be de-sludged to remove the sludge that has accumulated over the life of the ponds.

The single facultative/storage cell does not meet AEP standards for treatment requirements and capacity. The proposed upgrades include the following:

- Partition the existing storage pond to provide a dedicated facultative cell to provide a 60-day retention time for the 20-year design horizon. The other partition would be refurbished as storage Cell (1).
- Construct a second storage Cell (2) to provide a total storage retention of 1 year to meet the 20-year design horizon.
- Remove of the built-up sludge in the existing cell.

The proposed upgrades to the Blackfoot wastewater treatment system meet industry best practices and provincial standards for providing high quality treated effluent suitable for discharge to a receiving stream. Conventional WW systems that are designed and operated to current industry and regulatory standards have typically had odourless effluent discharges.

### 2.3 Ground Water Well Impact

Treated effluent from the proposed upgrades to Blackfoot's WW system would have no more impact on surrounding ground water wells more than the impact from the natural creek run off.

Hence the reason WW systems are designed to "Best Practicable Technology" and Best Practicable Technology Standards" as outlined by Alberta Environment.

Due diligence was completed prior to design of the current effluent discharge to show that the effluent quality of the existing WW system shows concentrations of parameters to be lower than the those found the Creek. With the upgrades, it is expected that the quality of the treated effluent will improve.

Surface water replenishes underground aquafers by slowly percolating and being filtered by ground stratigraphy. Well water drawn from aquafers for human consumption would typically be filtered and treated before use.

Section 3.0 of this memo reviews potential re-use of the treated effluent for irrigation and agricultural use.

# 3.0 REVIEW OF TREATED EFFLUENT DISPOSAL OPTIONS

### 3.1 Option 1A: Do Nothing – Maintain Existing Treated Effluent Disposal Method

Blackfoot's wastewater treatment system currently discharges its treated effluent to the privately owned SE-6-50-1-4 quarter section.

The viability of maintaining this option as part of the WW system upgrade would require input from Alberta Environment and the Landowner. If viable, a further environmental review including an irrigation study would likely be needed to confirm its feasibility and any improvements.

### 3.2 Option 1B: Treated Effluent Irrigation at SE 12-50-2 W4

This section explores the option of utilizing the treated effluent for irrigation to the quarter section east of the Blackfoot wastewater treatment system. This parcel of land is owned by the County and would allow the County to control the irrigation disposal.

This option is viable and further consideration would include a study to confirm the suitability and capacity of the land to receive wastewater irrigation for the 20-year design horizon.

### 3.3 Option 2A: Treated Effluent Re-use for Industry.

This section explores the option of utilizing the treated effluent from the Blackfoot WW system for industrial use. The option to provide saleable water for industrial use will allow the County to generate revenue from the effluent.

Industrial use of the treated effluent is possible as a secondary effluent disposal approach, however, is not considered viable as a long-term permanent disposal option. Industrial use would be unstable due to the volatility economy and therefore no guarantees of a consistent long-term use of the effluent.

### 3.4 Option 2B: Treated Effluent Re-use for Agriculture.

This section explores the option of utilizing the treated effluent from the Blackfoot Lagoon for agricultural use. The option to provide saleable water for agricultural use will allow the County to generate revenue from the effluent.

Agricultural use of the treated effluent is possible as a secondary effluent disposal approach, however, is not considered viable as a long-term permanent disposal option. Agricultural use of treated effluent would be heavily affected by the weather, and source farmers with crops that meeting the requirements for treated effluent irrigation.

### 3.5 Option 3: Treated Effluent Disposal by Evaporation

This section explores the option of discharging the treated effluent via evaporation.

An evaporation pond requires a very large surface area designed to efficiently evaporate water by sunlight and allow for exposure to ambient temperatures. The design of the evaporation pond shall follow *Alberta Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems – Part* 3. Evaporation ponds are required to have a depth no greater than 1.5 m and in no case provide less than three years of storage capacity based on average daily design flows. With an expected average daily effluent discharge rate of 100 $m^3$/day, the total required area for this option is approximately 80,000 sq. meters. As a result, the footprint of the evaporation pond at the Blackfoot Lagoon is expected to be relatively large, and a significant portion of the quarter section would likely be utilized.

### 3.6 Option 4: Treated Effluent Disposal through Mound

This section explores the use of sewage mounds in place of discharging into Blackfoot Creek. During the open house, the quarter section of land to the east of the lagoon was presented as a possible location for the mounds.

Sewage mounds are regularly used in private sewage treatment/collection systems, in which primary treated effluent is dispersed into selected fill of permeable, well-drained sands containing a high volume of air voids. The effluent must be distributed over a large area of sand, so it is allowed to move slowly through the fill material and remain in contact with air as it percolates downwards.

MPE completed a high-level analysis to size a sewage mound appropriate to treat the daily effluent volume expected from the lagoon, i.e. 100 $m^3$/day. To comply with *Alberta Private Sewage Systems Standard of Practice,* the sand layer of the mound receiving the effluent shall have a surface area designed based on an effluent hydraulic loading rate of no more than 40 L per square meter. It was assumed that the $cBOD_5$ quality of the treated effluent would be < 30 mg/L.

After considering the assumptions laid out above and the total required soil infiltration area, along with the toe-to-toe width of the mound based on the required 3:1 slope, approximately

12,500 sq. meters of required land was estimated for this option. This area is based on assumptions made with limited available geotechnical data.

It is important to note that the design of a sewage mound relies heavily on the profile and composition of the soil present on site. A more detailed geotechnical study of the subsurface soil composition will be required, along with an analysis of the capital and operation and maintenance costs.

Alberta Environment Standards and Guidelines does not provide sewage mounds as a viable option for lagoon effluent discharge. As a result, this option may not necessarily be applicable to this project and is therefore considered non-viable.

### 3.7 Option 5: Treated Effluent Discharge to Lloydminster's Sewer System

This section explores the option to connect the Blackfoot Lagoon effluent line to the Lloydminster Wastewater Transmission System. Based on early conversations with the City of Lloydminster ('City'), this option would require the County to connect the Hamlet of Blackfoot into the City's wastewater system and pay a load-based charge to treat their wastewater. At this time, the County does not consider the rate to be economically viable.

The County has the option to re-negotiate with the City, to instead transport only the treated effluent through Lloydminster's WW system. Because the treated effluent is of lower strength, a lesser disposal rate may be negotiated.

## CONCLUSION

The following conclusions have been drawn from the preliminary review of the treated effluent disposal options and concerns brought up during the open house.

- For the currently designed treated effluent disposal method
    - The proposed upgrades to Blackfoot's WW system will produce high-quality treated effluent that meets industry and regulatory standards for disposal to receiving streams.
    - Blackfoot Creek's mean monthly flows peak in April which is within regulatory discharge periods and would provide up to a 10:1 dilution of the 20-year discharge rate.
    - Foul odours from treated effluent following the upgrades are not expected but there might still be some odours.
- Re-use of treated effluent for industrial and agricultural use is possible as a supplementary measure, however, is not considered viable as a long-term stable solution for effluent disposal.
- Treated effluent disposal via mounds is an on-lot private system measure and not recognized by regulations as a solution to municipal wastewater treatment. Hence this option is considered non-viable.
- Doing nothing and maintaining the current effluent disposal method would require input from regulations and the landowner to confirm its viability.

- The following remaining additional options are considered viable but would require further review studies to confirm their feasibility.
    - Treated effluent irrigation on County land east of the WW System. An irrigation study would be required and could be completed within a month or 2. However commencement of study would need to be in late spring or summer when all snow is melted.
    - Treated effluent evaporation utilizing additional land to the east of the WW System. A month or 2 of detailed design would likely be sufficient. The logistics of acquiring additional clay for the large pond could add more time.
    - Treated effluent discharge to Lloydminster's wastewater collection system.