

# NSWA Technical Bulletin

## Gravel Operations in the Sturgeon River Watershed

### Introduction

Two major gravel deposits occur within the Sturgeon River watershed:

Calahoo-Villeneuve in Sturgeon County, which extends along the south side of the Sturgeon River from NW of St Albert toward the Hamlet of Calahoo. Gravel mining in this area has been ongoing for over thirty years.

Kilini Creek in Lac St. Anne County, which lies between the Town of Onoway and Highway 16, from Kilini Creek west to Highway 43. Gravel mining in this area has been ongoing since the 1950's.

These deposits are currently being mined and will continue to be mined due to their economic value, which derives from their quality and proximity to the large Edmonton region market. Only small portions of the Sturgeon River watershed's 3300 square kilometer area contain economically viable gravel deposits as discussed below. However, gravel is a non-renewable resource, so these deposits will eventually be mined out, or made uneconomic or inaccessible due to development restrictions. Over time operations will migrate to more remote deposits outside this watershed.

The development, operation, and reclamation of gravel pits on private land is primarily regulated by the Province under the Environmental Protection and Enhancement Act and its regulations, including the Conservation and Reclamation Regulation and the Code of Practice

for Pits. As well, other Provincial legislation, particularly the Water Act, may apply to some aspects or circumstances of a specific gravel operation. Certain Federal legislation may also apply, again depending on the specific situation. However, it is the municipalities that have the authority to plan and regulate land use within their boundaries and issue development permits. They therefore decide whether gravel can be mined in a particular area or a specific land parcel and under what additional conditions other than those imposed Provincially or Federally. These can be surface water and groundwater concerns but also issues such as noise, dust, buffers, hours of operation, haul routes, road maintenance, traffic, and safety. This is well described in the AAMDC publication "A Municipal Guide to Sand and Gravel Operations in Alberta". Overviews of Federal, Provincial and municipal legislation are also contained in the Sturgeon County report "Calahoo-Villeneuve Sand and Gravel Extraction Area Structure Plan" and the Lac Ste. Anne County report "Understanding and Managing Cumulative Effects of Aggregate Projects on Water Resources in Lac Ste. Anne County, AB".

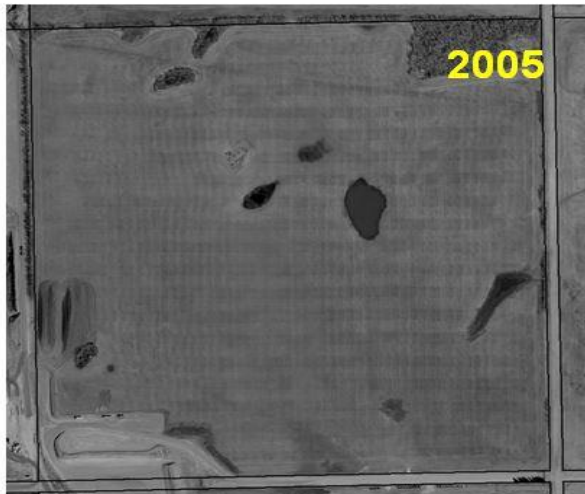
Gravel mining in the Sturgeon River watershed is a sequential, multi-year process of selectively removing and stockpiling topsoil and overburden, dewatering the gravel if necessary, excavating it, then replacing, contouring, and revegetating the overburden and topsoil in the mined-out area as shown below. In the Sturgeon River watershed,

land use prior to mining and after reclamation is almost entirely agricultural.

From a water perspective, gravel operations are concentrated on a specific portion of the watershed, changing the surface and subsurface which can affect both surface water and groundwater characteristics. Some changes are temporary but others are permanent, most notably lowering of the land surface and forming end pit waterbodies. The Code of Practice for Pits requires pit operations not divert, block or impound the natural surface or subsurface drainage during both operation and reclamation. Gravel mining operations temporarily disrupt

existing surface water drainage patterns. These are only partially restored after reclamation as the land surface is lowered by removal of the gravel layer. The last area to be mined is generally left as an end pit lake. Past practice was to make these lakes small and deep to maximize the useable surface area. More recently larger, shallower lakes are being created to increase their environmental value as wetlands.

Some gravel operations may also divert and use (in the sense of reducing the quantity) surface water or groundwater in several ways including off-site dewatering, storage, dust control, and gravel washing.



## Calahoo-Villeneuve Gravel Deposit

### Characteristics

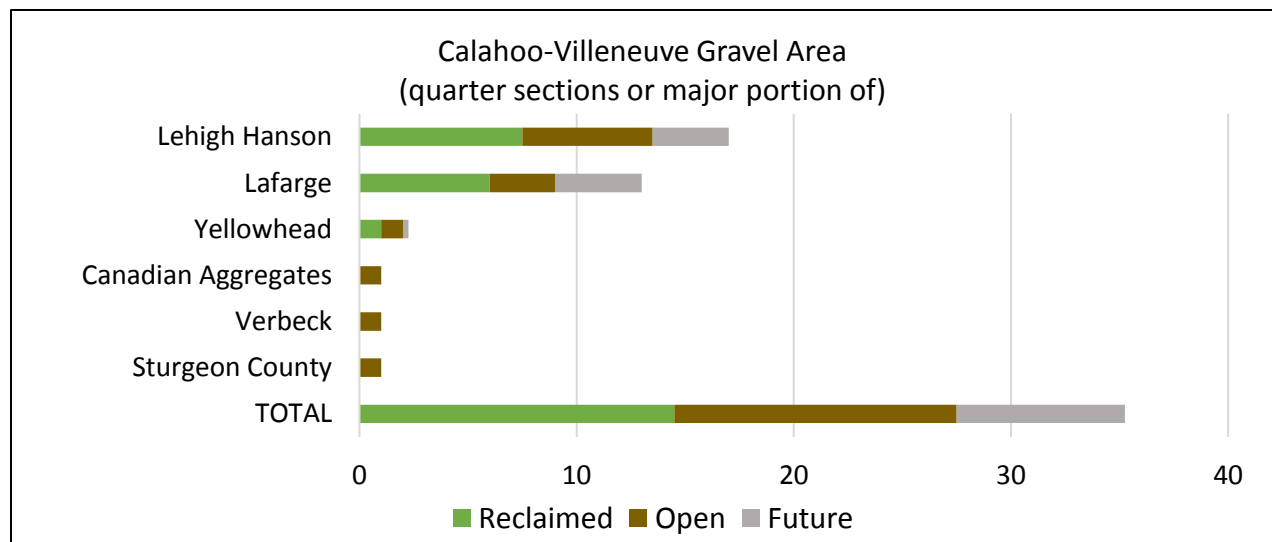
This deposit extends about 20 km mostly to the south side of the Sturgeon River from NW of St Albert to the Hamlet of Calahoo, with a small outlier SW of the Villeneuve Airport. It overlies bedrock in a buried pre-glacial river channel, varies from 0-15m thick, and is covered by 7-10 m of low permeability glacial clay till and lake sediments. The terrain is gently rolling with most of the area having soils rated as high quality agricultural.

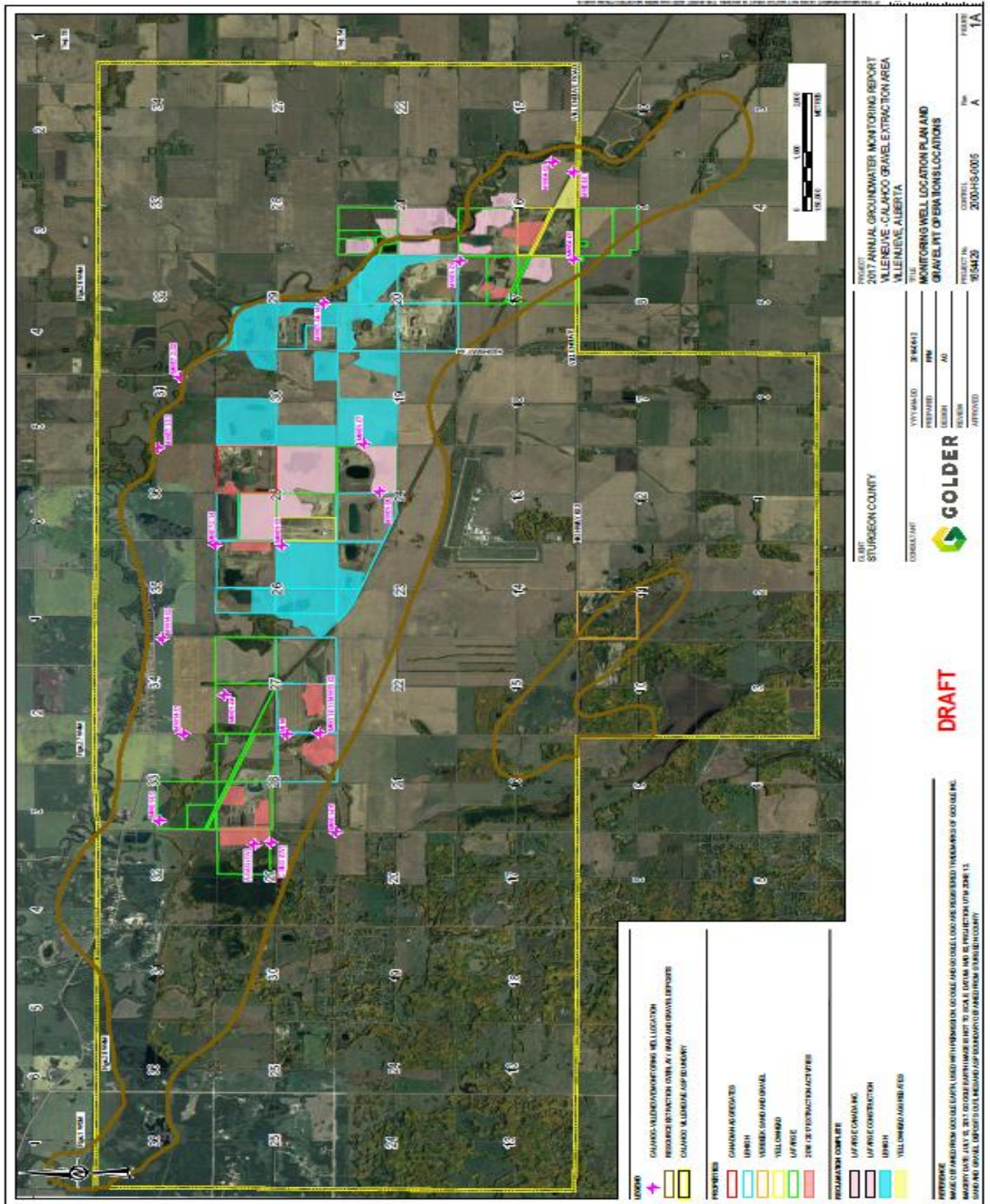
### Area and Utilization

The total area of this gravel deposit is estimated to be 50 km<sup>2</sup>, about 1.5% of the total watershed area. Most of this land was or is being used for agriculture. However, only a portion of the area is available for mining due to other land uses, setback requirements, and local variations in the depths of overburden and gravel. Production has averaged about 2.9 million tonnes per year over the past decade and is expected to continue at this rate for another 20 years, depending on

demand and other factors. Two multinational construction materials companies, Lehigh Hanson and LafargeHolcim, have the largest operations in this area. There are also several smaller, more local operators. Mining has generally progressed from east to west. A large portion has been mined out and is in the process of, or has been, reclaimed for agricultural uses. Recent pit permitting and development is occurring west of Range Road 222. This area has been designated in Sturgeon County's Calahoo-Villeneuve Area Structure Plan as higher priority for new gravel pits, which must be planned and operated to reduce impacts on adjacent land owners.

The areas mined out and reclaimed for agriculture; currently in development, in operation, or undergoing reclamation; and remaining to be developed in future are presented below. The Reclaimed category only includes parcels that have a reclamation certificate but reclamation is essentially complete for a significant portion of the Open category as well.





### Surface Water

Any change in surface water quantity during mining is minimal and there are no current Water Act surface water licences for gravel mining purposes in this area.

### Groundwater

The gravel layer in this area is saturated with groundwater. The overlying glacial lake sediments and tills are highly impermeable and confine the gravel aquifer. After removal of the overburden, groundwater in the gravel layer is drained into peripheral trenches and pumped to deep ponds elsewhere in the pit. These ponds are hydraulically connected to the groundwater table and this water infiltrates back into the aquifer with only minor losses from surface evaporation. This does not require a Water Act licence but does require an approval to move groundwater within the site. Wells close to the area being dewatered may be affected if they are completed in the gravel layer. However, water levels generally return to previous levels after reclamation. Hydraulic continuity of the aquifer is restored during reclamation by placing at least one metre of sand on the bottom of the pit.

Some groundwater is used for gravel washing and not returned to the aquifer. There are currently five active groundwater licences for this purpose totalling 1.2 million m<sup>3</sup> per year, which is about 30% of the total groundwater allocations in the Sturgeon River Watershed. In the past five years two of these licences reported total annual use of 33,000 m<sup>3</sup> and two reported 0 use, one of which is a closed gravel washing location (although it could potentially reopen in future). The largest licence, for 900,000 m<sup>3</sup> per year, was issued in 2010 but

no actual use information has been recorded in the AEP Water Use Reporting System database. According to the pit owner, since 2012 no groundwater has been moved off-site and very little on-site as the pit is nearly worked out and activity has been limited. There is a wash plant on the site which operates a maximum of three months per year using about 2200 m<sup>3</sup> per month. Also, this license expires in 2020.

There are also two groundwater drainage licences allowing 362,000 m<sup>3</sup> discharge to the Sturgeon River annually but neither have done so for at least 10 years according to AEP records. One of these is for the closed washing operation noted above.

Since late 2001, Sturgeon County's Calahoo-Villeneuve Sand and Gravel Extraction Area Structure Plan has required an independent hydrologist to install, maintain, and operate a regional groundwater monitoring system on behalf of the pit operators. An annual groundwater level and quality monitoring report, including recommended remedial action if required, is submitted to the County and Alberta Environment and Parks, and made publicly available. The most recent report states: "The water level monitoring results in 2017 indicated that groundwater levels are consistent with historical observations and predicted localized pressures from the mining operations." and "The 2017 results suggest that the mining operations is not overstressing or permanently dewatering the shallow sand and gravel aquifer.". Some groundwater monitoring is also done by the operators where required to meet specific licence conditions or operational purposes.

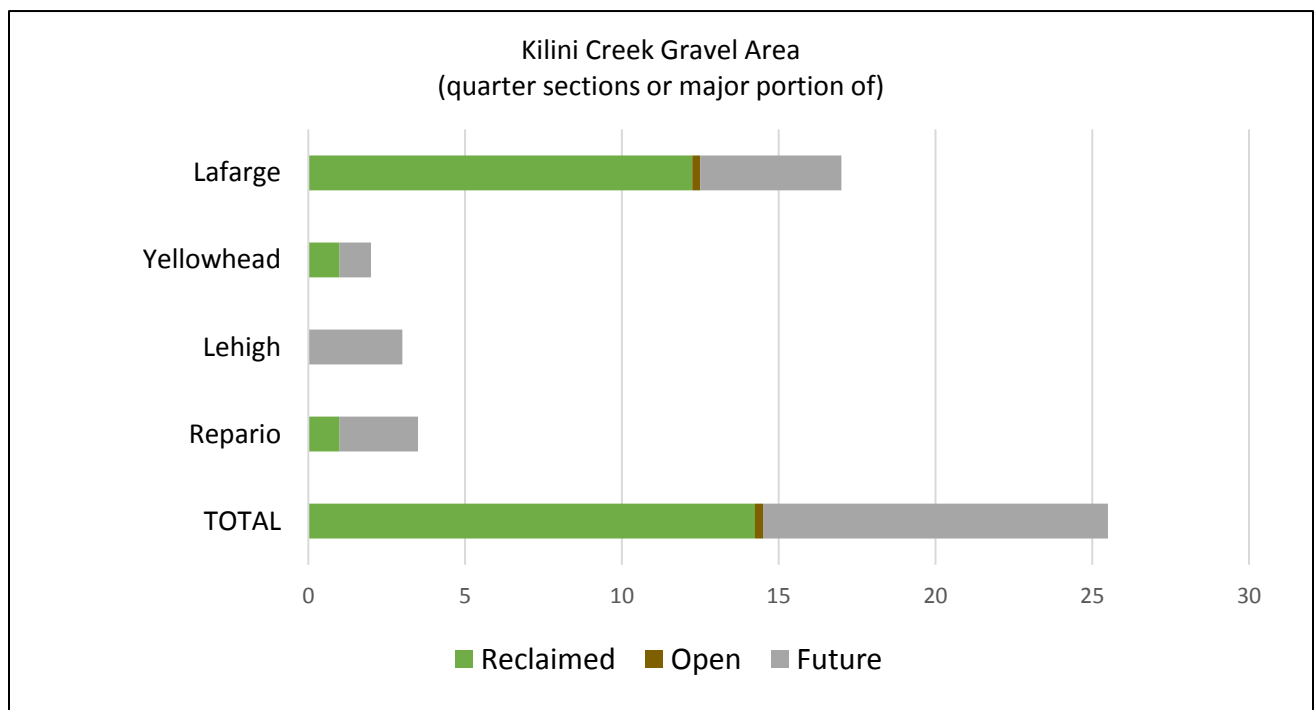
## Kilini Creek Gravel Deposit

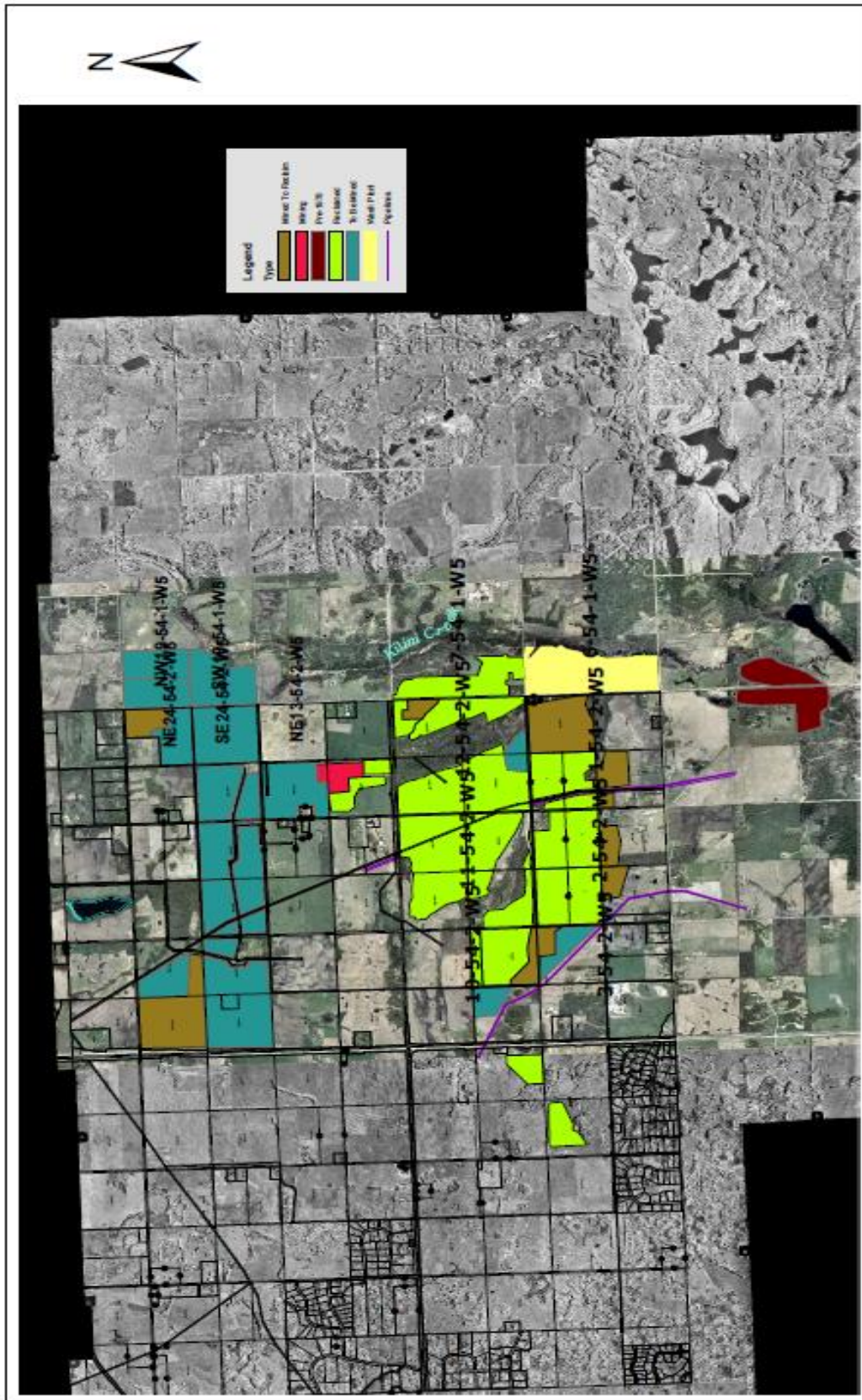
### Characteristics

This deposit extends westward from the Kilini Creek valley to Highway 43, south of the Town of Oneway and north of Highway 16, with minor outliers east of the creek. The gravel layer sits atop the bedrock and is overlain by clay tills. The surface topography is hilly and depth of overburden, bedrock elevations and gravel seam thickness all vary considerably. Initial extraction areas were relatively shallow and dry. However, as operations have moved to deeper areas more groundwater is encountered. The groundwater surface tends to be within the gravel layer and flow direction is northeast toward the deeply buried Oneway Valley, which trends west to east across the north end of the gravel deposit area.

### Area and Utilization

A large portion of this deposit has been mined out and reclaimed for agriculture. The estimated original area of minable deposit is 17 km<sup>2</sup>, about 0.5% of the total watershed area. The areas mined out and reclaimed for agriculture; currently in development, in operation, or undergoing reclamation; and remaining to be developed in future are presented below. However, it is likely only about half of the remaining 7 km<sup>2</sup> will ever be mined due to difficulty in obtaining development permits or unfavourable economics arising from setback requirements and/or excessive overburden depth to gravel depth ratios. Map 2 shows the location of reclaimed areas (with and without a certificate), current operating pits, and potential future operations.





Project:	NSWA	Figure 1
Title:	Onoway Area	
Date:	July 7, 2018	
	Land Status	

Air Photos Taken 2015 & 2002

Scale



Meters

## Surface Water

Since the 1950's Kilini Creek has been dammed and water diverted from the reservoir to the adjacent Lafarge gravel washing plant. After use this water flows through a series of four settling ponds to remove suspended solids. The last pond discharges back into the Creek above the dam. The current plant infrastructure is quite new and is expected to operate for the long term. Gravel will continue to be trucked to it from more remote sources after local deposits are mined out.

Three water licences for this operation allow total withdrawal of 4,691,000 m<sup>3</sup> per year, of which at least 4,012,000 m<sup>3</sup> must be returned to the Creek. A fourth licence, which has never been used, allows 80,175 m<sup>3</sup> to be taken from an end pit pond adjacent to Kilini Creek if there is insufficient flow in the Creek itself to refill the settling ponds during the annual start-up described below. While the licensed withdrawal is about 30% of total licensed surface water withdrawals in the Sturgeon River Watershed, it is only about 8% of the total licensed consumption plus losses, i.e. net use.

Watershed and an even smaller proportion of its 83,000,000 m<sup>3</sup> average annual flow as estimated in NSWA's Technical Bulletin "Influence of Climate, Landscape Change and Licenced Water Removal on Flows in the Sturgeon River Basin".

## Groundwater

Alberta Rock Products holds the only groundwater licence in this area, for a pit on an outlier gravel deposit east of Kilini Creek. This licence allows withdrawal of 102,000 m<sup>3</sup> per year for gravel washing purposes with no return. This amount is

When the wash plant is started in the spring, operating practice is to initially pump at a low rate to replace the water lost from the settling ponds through seepage during the winter. The licences require a minimum flow of 0.05 m<sup>3</sup>/second be maintained in the Creek between April 15 and May 31 to protect fish spawning. After the ponds are filled the pumping rate can be increased as needed with minimal impact on flow in the Creek because the return flow is nearly equal to the withdrawal. Over recent years withdrawal has averaged about 2,300,000 m<sup>3</sup> per year, of which about 68,000 m<sup>3</sup> (3%) is lost through pond evaporation and product water content. The rest returns to the reservoir via the outfall from the final settling pond and seepage through the bottom of all the ponds. To put this water loss in perspective, since flow metering began in 2013, the total flow in Kilini Creek from March to October ranged from 950,000 m<sup>3</sup> in 2016 to 4,820,000 m<sup>3</sup> in 2013. The water loss from the gravel operations has therefore been from 1.5 to 7.5 percent of Creek flow during the open water period. However, this water loss is a very small proportion of the estimated annual water use of 7,500,000 m<sup>3</sup> for the entire Sturgeon River

As future gravel pits are developed in this area Water Act approvals will be required where wetlands will be disturbed or end pit lakes created.

about 2.5% of the total groundwater allocations in the Sturgeon River Watershed. Since 2011 this licence has required monthly electronic reporting of the water volume diverted, however no information currently appears in the AEP Water Use Reporting System database. Other operations have not needed water licences because



groundwater is managed on-site and not removed or used.

There was limited groundwater monitoring done in older portions of this area. However, for more recent operations toward the north end of the deposit, monitoring wells have been established as required by their Water Act approvals. Levels in

private wells close to the operations are also monitored. Impact on wells over 400 m from active pits has generally been less than a 1 m drop and levels recover after the overburden is replaced during reclamation.

### **Cumulative Effects Report**

The report “Understanding and Managing Cumulative Effects of Aggregate Projects on Water Resources in Lac Ste. Anne County, AB” was done for the County in 2015. It concluded:

“... based on available information, existing and continued aggregate pit operation likely has minor (immeasurable) cumulative effects at a regional scale ... largely because of the extensive mandatory project design-based management measures required for each individually approved project. Also, ... there is no substantial and extensive known water-related issue of concern proven to be a consequence of aggregate projects, ...”

## SUMMARY

- Economically viable gravel deposits occur over a total of about 50 km<sup>2</sup> or 1.5% of the Sturgeon River watershed in two separate areas.
- Prior to gravel mining most of both areas is or was being used for agriculture and is being returned to agriculture after reclamation.
- About half of the gravel area has been mined and reclaimed, 20% is operational, and only about half of the remaining area is likely to be mined in future.
- There are no identified cumulative effects of gravel mining on watershed scale surface water or groundwater quantity or quality.
- Localized impacts of gravel mining on surface water and groundwater are managed through a combination of Provincial, Federal, and municipal legislation and regulation.

## References

Alberta Association of Municipal Districts and Counties. (2007). *A Municipal Guide to Sand and Gravel Operations in Alberta*.

Golder Associates Ltd. (March 2018). *Villeneuve-Calahoo Gravel Extraction Area 2017 Annual Groundwater Monitoring Report*.

NSWA Technical Bulletin (June 2017). *Influence of Climate, Landscape Change and Licenced Water Removal on Flows in the Sturgeon River Basin*.

Stantec Consulting Ltd. (March 2015). *Understanding and Managing Cumulative Effects of Aggregate Projects on Water Resources in Lac Ste. County, AB*. Prepared for Lac Ste Anne County.

UMA Engineering Ltd. (October 9, 2001 with amendments up to and including February 2, 2014). *Calahoo-Villeneuve Sand and Gravel Extraction Area Structure Plan Bylaw 922/01 Schedule A*. Prepared for Sturgeon County.