Executive Summary

Aggregate washing operations in Minnesota are subject to a Minnesota Department of Natural Resources (MDNR) Water Appropriations Permit. The Water Appropriations Permit establishes a permitted maximum pumping rate and maximum annual water use. The Aggregate & Ready Mix Association of Minnesota (ARM) and its members have identified inconsistency in water use reporting in Minnesota at aggregate washing operations, either based on Water Appropriations Permit requirements, or different aggregate producer-specific approaches to monitoring and reporting total water use. Currently, total groundwater consumption is not distinguished from total water use in Minnesota at aggregate washing operations.

The purpose of this study was to determine a baseline percentage of aggregate wash water that is recycled during aggregate wash plant operations. Accounting for data produced from this study, ARM producer members would like to establish a minimum percentage of recycled aggregate wash water applied to the total measured or estimated volume of wash water circulated during aggregate washing operations as the basis of: annual water appropriation for future Water Appropriations Permits, annually reported water use volumes for Water Appropriations Permits, and the associated annual water use fee.

The Researchers including Stantec Consulting Services, Inc. (Stantec), Sunde Engineering, PLLC (Sunde), and Summit Envirosolutions, Inc. (Summit) jointly conducted the Water Appropriations Study (the Study) requested by ARM. The data generated by the Study was voluntarily provided by and collected from participating producer members of ARM. The study focused on aggregate wash plant operations that represent the lowest estimated aggregate wash water effective recycle rates (i.e., least efficient aggregate wash plant operations with no assumed groundwater recharge) for sand, gravel, and crushed bedrock (i.e., limestone/dolomite) aggregate washing operations in accordance with an **Ideal Study Site Conceptual Model** developed for the Study. The Researchers selected transit time ultrasonic flow meters to collect water flow volume and flow rate data using portable meters attached to the outside of each selected conveyance pipe for the Study. Specifically, the Researchers and TAP selected the Dynasonics® TFX-5000 Meter manufactured by Badger Meter® for flow data collection for the Study. Two flow meters were installed to simultaneously monitor the total volume of water pumped from the production well and the total volume of water pumped from the wash plant feed pond to the wash plant for targeted two-week intervals at five different, anonymous, study sites between June and September of 2023.

The primary findings of the Study are as follows:

- The minimum wash water effective recycle rate measured during the Study was 79% and the maximum wash water effective recycle rate measured during the Study was 95%.
- The Researchers conclude that at least 75% of wash water circulated through most aggregate wash plants in Minnesota is recycled or returned directly to the source.
- Site-specific calculations for higher wash water effective recycle rates may be possible for future water appropriations data reporting in accordance with individual Water Appropriations Permits and MDNR site-specific guidance

8 Conclusions

Researchers were able to collect totalized water flow data in general accordance with the Study Plan at five selected Study sites in 2023. The minimum wash water effective recycle rate measured during the Study was 79% and the maximum wash water effective recycle rate measured during the Study was 95%. The three Study sites with the best wash water recycling rates measured either had clay or synthetic lined pond bottoms, mitigating the infiltration (consumption or loss as defined in this Study) of aggregate wash water back to the water table. It is also noteworthy that the Study site with the highest wash water effective recycle rate also was the only site with documented aggregate mining below the water table, likely resulting in less water being required to effectively wash the aggregate products. Based on the Study sites selected, the conservative approach assuming that all groundwater pumped from the production well is consumed and not returned to its source aquifer (i.e., worst-case recycling scenario), and omitting water volume contributions from rainfall (i.e., accounting for aggregate wash plant operations during drought conditions), the Researchers conclude that at least 75% of wash water circulated through most aggregate wash plants in Minnesota is recycled or returned directly to the source.

The Researchers acknowledge that only five Study sites were selected for data collection due to budgetary and timeline constraints. Therefore, this Study may be considered a baseline Study that could lead to additional research regarding groundwater consumption associated with aggregate washing operations. Total water use monitoring at additional study sites may provide a more statistically significant sample size to better define industry-wide aggregate wash water effective recycle rates. Also, site-specific calculations for higher wash water effective recycle rates may be possible for future water appropriations data reporting in accordance with individual Water Appropriations Permits and MDNR site-specific guidance.

To the knowledge of the Researchers and TAP, no related prior study has been completed before this Study: measuring wash water effective recycle rates at different aggregate washing facilities owned by different producers and/or washing different aggregate products. Given the precautions exercised during the Study including anonymity of Study site locations/ownership, isolation of variables, and repeatability of data collection, the Researchers believe the Study has provided a scientific basis for quantifying wash water effective recycle rates at aggregate production facilities.