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PRODUCTION REPORT ON

Giant Mine
B1-18 Stope Complex

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(PWGSC)
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REPORT

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The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

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1.0 PASTE PRODUCTION SET-UP

Paste production at the B1 pit location started on Monday, October 21, 2013 after completion of the first paste site trial in the South Tailings Pond, and ended on December 10, 2013 due to the low ambient temperature.

The following is a summary of the system that was utilized throughout the program starting with the set-up, production information by borehole, the changes that occurred throughout the process, and ending with a description of the status of the boreholes as of December 10, 2013.

The paste production process started at the South Tailings Pond where suitable tailings for paste production were excavated into a stockpile. The tailings from the stockpile were then trucked to an area next to the B1 pit. This "daily stockpile" area was constructed to temporarily store tailings for feed material for the paste production system. From this daily stockpile, a loader brought tailings to the paste production area where an excavator lifted the tailings into either a surge hopper which discharged onto a conveyor that loaded tailings into a mixer truck (Mixer #1), or into a second mixer truck directly (Mixer #2). Inside the mixer trucks, the tailings were mixed with water, aggregate, and cement in given proportions for the target recipe of any given pour. From the mixer trucks, the paste was augured into a hopper attached to the pump truck, where the paste was then pumped underground through the appropriate borehole. In one instance, which will be described more fully below, the pump was not utilized and gravity flow into the borehole was used as the delivery method. For a paste production flow diagram please refer to Appendix A, and for a production area general arrangement layout please refer to Appendix B.

2.0 BOREHOLE PRODUCTION OVERVIEW

The following is the description of the pours into each of the boreholes.

2.1 Plug_Deliv_118_05

On Monday October 21, 2013 production started with borehole Plug_Deliv_118_05 with a target recipe of 100% tailings between a 5" and 7" slump with 5% cement. When the first pour was delivered underground, it was discovered that the paste was flowing into an unknown void rather than filling the designated area. Pouring continued for the next week at the same parameters in an attempt to try and plug the void.

On October 26, 2013 the target recipe changed to 5" slump with 3% cement as the void did not require the increased strength, only the increased viscosity of the 5" slump to plug the path to the unknown void. After two pours of the new target recipe the unknown void was plugged. Pouring continued on October 29 with subsequent staged lifts to allow for a slow buildup against the conventional muck and timber barricade (B1) at the base of the targeted void. Each lift was about 1 m in height.

After each pour the paste was allowed to set-up in order to dissipate any pressures against the barricade. This continued until the paste level was over the brow of the barricade. The last pour had a target recipe of 2% cement, starting with a 10" slump and finishing with a 5" slump – the target recipe was changed to a 5" slump in an attempt to plug small leaks at the B1 barricade. The original void was filled on October 31 and the borehole was plugged below the surface collar. The first indication that the void was filled was by remote video feed via a borehole camera through OBS_118_03. This was confirmed later by observation with a borehole camera and underground visual inspection. The total pour volume for Plug_Deliv_118_05 was 995 m^3. This volume was significantly larger than expected due to the diversion of paste into the unknown void located adjacent to the targeted void.

2.2 OBS_118_03

Even though paste was not poured through Obs_118_03, this borehole was plugged on October 31, 2013 as a by-product of backfilling the 1-18 BYPASS / 1-01E X-CUT area through P_Deliv_118_05. The borehole is plugged ~1 m above the breakthrough of the borehole.

2.3 P_Deliv_118_03

On Sunday October 27, 2013 pouring into borehole P_Deliv_118_03 started in order to fill stope 1-18 EA. The target recipe was 100% tailings, 10" slump and 2% cement. There were four additional recipes used for this borehole consisting of 5" to 7", 8" and 10" slump with 5% cement and a 7" slump with 2% cement. There was a total of 16 lifts of pouring in this hole between October 27 and December 7. These 16 lifts produced a volume of 3,199 m^3. The multiple recipes were required to control and direct the paste into the areas where it was needed. The paste flowed in both the north and south direction to start, and then steadily built up to the south near 1-18 EB stope area and travelled as far as the 1-18 LH stope. Once flow began moving north, the paste found a breakthrough into another unknown void that led from 1-18 EA into the 1-18 bypass area. Repeated pours into

P_Deliv_118_03 attempted to plug the void in order to focus flow in the 1-18 EA stope. Based on Cavity Monitoring System (CMS) observations performed after the last pour, this borehole is effectively finished for paste pouring as the clearance between the top of the paste pile and the end of the casing is only a few centimeters. The void remains open to a small degree.

2.4 Plug_Deliv_118_04

The third borehole utilized was Plug_Deliv_118_04 for the purpose of building a paste barricade (borehole barricade B3). The pour started on October 29, 2013 with a target recipe of 90% tailings, 10% aggregate, 3 to 5" slump plus 15% cement for the first two pours, and then the target recipe changed to 100% tailings, 8 to10" slump plus 8% cement. There was a total of nine lifts and a total poured volume of 67.4m³. The target recipe changed because of underground observations that showed the paste had stacked up under the borehole and was close to choking off the line without having filled the area. By dropping the aggregate and loosening up the slump, the intention was to have the paste flow down off the stack and fill in the surrounding area against the B shaft entrance doors without choking the line.

The west end of the track drift, near the B shaft entrance, was observed to be plugged by underground inspection. The borehole itself is not plugged but does not require further filling.

2.5 OBS_118_02

On November 1, 2013, there was a pour into Obs_118_02 with a target recipe of 100% tailings, 10" slump and 2% cement. The purpose of this pour was to re-direct the paste flow from the 1-18 EB area, back to the north end of the 1-18 EA area. On December 9, 2013, a target recipe of 100% tailings, 10" slump and 5% cement was poured to continue backfilling 1-18 EA via this hole since P_Deliv_118_03 was not available anymore for paste pouring. The total paste volume poured through this hole was 209 m³. This borehole remains open, and may see further filling at a future date.

2.6 P_Deliv_118_12

The next borehole utilized for pouring paste was P_Deliv_118_12. The first pour was on November 5, 2013 with a target recipe of 100% tailings and 4% cement at a 10" slump. There were four additional recipes used for this borehole consisting of 5", 7" and 10" slump with 2% and 5% cement. The multiple recipes were required to control and direct the paste into the areas where it was needed. The hole was plugged on November 28, 2013 at approximately 15 m below surface collar. There was a total of ten lifts and a total volume poured of 1,852 m³.

2.7 BKGT_12_14

Even though paste was not poured through BKGT_12_14, this borehole was plugged on November 14, 2013 as a by-product of backfilling the 1-18 #1 LH area through P_Deliv_118_12. The borehole is plugged up to the surface collar.

2.8 P_Deliv_118_01

On November 6, 2013, paste was poured into borehole P_Deliv_118_01. The target recipe was 100% tailings and 2% cement at a 10" slump. The target recipe stayed mostly at a 10" slump but was increased to 7" slump on a few occasions in order to retard the flow of paste and its bleed water from areas that were not ready to be filled. The cement was increased to 5% on November 14 for the next five lifts with a final lift on December 5 back at 2% cement. There was a total of 12 lifts with a volume of 2,014 m^3. The borehole was plugged on December 5, 2013 with the level of paste approximately 20 cm from the top of the casing.

2.9 OBS_118_07

Even though paste was not poured through Obs_118_07, this borehole was plugged as a by-product of backfilling the 1-18 Lower area through P_Deliv_118_01.

2.10 P_Deliv_118_06

Paste pouring for the next borehole barricade started on November 11, 2013 through P_Deliv_118_06 (borehole barricade B4). The target recipe was 90% tailings, 10% aggregate, 3 to 5" slump plus 15% cement. The target recipe changed for the final pour to 100% tailings, 8" slump plus 8% cement. The recipe was changed due to buildup of paste below the borehole which could have potentially choked off the borehole. The higher slump and lack of aggregate would allow the paste to flow over the restriction and fill more of the cross-section without plugging the hole. The borehole was plugged on November 12, 2013 and required a total of three lifts with an accumulated volume of 24.8 m^3.

2.11 BKGT-12-15

BKGT-12-15 was a hole drilled previously as part of the geotechnical program in 2012. Due to its proximity to the 1-18 Lower stope (an area that was not accessible via P_Deliv_118_01), BKGT-12-15 was utilized to pour paste from November 20 until November 28, 2013 when it was plugged. The target recipe utilized was 100% tailings, 2% cement at a slump of 10". There was a total of five lifts at a volume of 829 m^3 of paste. The borehole is plugged at approximately 25 m below the collar at the surface (total borehole length was 27 m).

2.12 P_Deliv_118_11

On November 22, 2013 paste was poured into borehole P_Deliv_118_11 located in the B1 pit. Due to the location of this borehole, its access and the room available around it, the pump truck, the cement silo and the excavator could not be brought close to it. For this reason the pouring had to be completed by gravity in batches to allow for the longer transport of the feed material.

The target recipe for this borehole was 100% tailings, 8% cement at a slump of 7". The pours into this borehole were an attempt to plug a void along the hanging wall which was diverting paste away from 1-18 EA and into the 1-18 bypass thus preventing the filling of 1-18 EA. There were four lifts with the fourth lift on December 3, 2013 having a target recipe of 90% tailings, 10% aggregate, 7" slump plus 8% cement. The total volume poured was 122 m^3. The hole is still open and available for further paste pouring.

2.13 P_Deliv_118_15

On November 24, 2013 paste was poured into P_Deliv_118_15. The target recipe was 100% tailings, 2% cement at a slump of 10”. This was the recipe for four out of five lifts, with the different lift having a slump of 7” in order to prevent paste from flowing further than the intended fill area. The total volume poured was 1,024 m³. The borehole remains open, but the flushing Pipeline Inspection Gauge (PIG) from the last pour is right at breakthrough, leaving little clearance between it and the end of the casing.

2.14 P_Deliv_118_02

On November 28, 2013 there was a single pour in borehole P_Deliv_118_02. The recipe was 100% tailings, and 2% cement at a slump of 10”. The total volume poured was 8.4 m³. The borehole is plugged 1.2 m below the borehole collar located at the surface.

2.15 Obs_118_06

Even though paste was not poured through Obs_118_06, this borehole was plugged as a by-product of backfilling the 1-18 #1 LH area through P_Deliv_118_12 and P_Deliv_118_02. The borehole is plugged ~8 m below the borehole collar located at the surface.

2.16 P_Deliv_118_14

Pouring in P_Deliv_118_14 occurred on November 28, 2013 but due to paste coming through the inner and outer casing of the borehole, the pouring was stopped and there was no second attempt. The borehole is plugged 8 m below surface.

2.17 P_Deliv_118_08

The first pour into P_Deliv_118_08 occurred on December 8, 2013 with a target recipe of 100% tailings, and 2% cement at a slump of 10”. Two more lifts followed before shutting production down for the season: one on December 9, 2013 with a target recipe of 100% tailings, with 5% cement at a slump of 10”, and another on December 10, 2013 with a target recipe similar to the initial one. The total volume poured was 323 m³. The borehole is still open and available for further paste pouring, but confirmation that barricade B6 is fully plugged is needed to entirely backfill the 1-18 Upper area.

2.18 P_Deliv_118_10

On October 16, 2013 P_Deliv_118_10 was drilled to a partial breakthrough. Upon underground inspection it was determined that the hole was in the hanging wall and would be unusable. It was determined that re-drilling the hole was unnecessary and it was abandoned as a paste delivery hole.

2.19 P_Deliv_118_13

This hole was not drilled and is only mentioned for completeness.

3.0 PRODUCTION PROCESS CHANGES / MODIFICATIONS

The following sections detail the modifications to the original set-up and production process that were occasioned by the changes in site conditions.

3.1 Surge Hopper Process

Two mixer trucks were brought in for this campaign of paste production. Mixer #1, which did not have a grizzly on top of its bin to screen the tailings material, and Mixer #2 which had a grizzly. During the first site paste trial, it was noticed that Mixer #1 would need a grizzly in order to screen the tailings and produce an even mix of material for paste production.

Also, the tailings production area was confined to a small lined area on the edge of the B1 pit. The location was centred amongst the boreholes that required backfilling. The space was further restricted by existing mine infrastructure (mine ventilation building) and other paste production ancillary equipment such as cement silos, water tanks, etc. In addition to this, both mixer trucks had to be located next to the pump truck to allow the augers to feed into the pump hopper. All of these factors made the equipment location on site very challenging.

A surge hopper with a grizzly on top was made available to feed Mixer #1. This surge hopper fed the truck by drawing screened material from the bottom of the hopper via a conveyor belt discharging into the Mixer #1 bin. The addition of this surge hopper/conveyor arrangement also offered some flexibility for equipment location since the excavator could feed both mixer trucks from one tailings stockpile without moving or turning excessively. Practically speaking however, the excavator had difficulty in feeding both systems to capacity so with other complicating factors it was decided to forego running the second Mixer for the latter part of the production run.

3.2 Heated Storage Dome (Superdome)

Although the superdome was part of the paste production flow diagram, the construction of it did not finish until the second week of November 2013. Tailings stockpiling within this superdome started on November 11, 2013, and heat was brought in a two days later. This severely limited the effectiveness of this part of the process since by mid-November the in situ tailings were already frozen to some extent.

The superdome was implemented to allow paste production to continue even in colder weather. The purpose was to be able to store tailings where they would not freeze and therefore could be loaded, transported and mixed with water without clogging the system with ice chunks. Once tailings had been excavated from the South Tailings Pond, they would be stored in the superdome until required at the production site. At the end of the production day, unused tailings were returned to the superdome to keep them from freezing in the daily stockpile at the production area.

3.3 Screening Process

Tailings containing silt and sand material were excavated from the South Tailings Pond to be used for paste production. The tailings that were excavated also contained off-specification materials such as clay balls, hard packed lenses of silt, rocks, and wood debris from vegetation growing around the perimeter of the tailings pond. These materials caused hang-ups on the grizzly bars on top of Mixer #2, on the screen on top of the surge hopper that fed Mixer #1 and also jammed the Mixer augers. Manually removing these materials from the various places they hung up resulted in noticeable down time. There was also a concern that this off-specification material could damage the belts of the mixers or the pump.

In order to increase productivity and decrease potential down time from damaged equipment, a two-deck vibratory screening unit was installed on site during the first two weeks of November 2013. Screened tailings from this system started to arrive to the paste production site on November 11, 2013. The screened material was loaded into two 40-tonne haul trucks to move across the road into the superdome. The sizes of the screens on the two decks were 4 inches and 2.5 inches. The entire set-up was located on the truck turnaround outlet on South Tailings Pond so that none of the equipment was sitting directly on the tailings. On November 23, 2013, three of the four 2.5" screens were replaced with 1.5" screens to improve the downstream process as issues regarding large chunks were still occurring. The screening process yielded smaller chunks that were easier to handle downstream in the process.

3.4 Water Mixing Process

At the start of production, two water tanks with combined capacity of ~30,000 L (the "white water tank" at ~19,000 L and the "black water tank" at ~11,000 L), were available for paste production usage during the day. They were filled and heated overnight to ensure warm water was available to be mixed with the tailings. As the production progressed and the mixer trucks started to run full speed, there were corresponding drops in ambient temperatures and the temperature of the delivered tailings. This created two issues: the first one was the paste at the start of day was overly hot in the +20º C range, and the second issue was that by early afternoon the hot water reserves were exhausted. At this point, production would then be forced to shut down because the resulting paste backfill product was below the temperatures required to begin the cement hydration process underground. The lack of water in general, and hot water in particular, created downtime so an additional Super B trailer acting as a third water tank (~50,000 L capacity) was brought into production. This unit utilized a ground heater system to heat the water to approximately 20 to 30º C.

Not all of the tanks heat the water to the same degree so a water blending process was established. At the beginning of each day, the water trucks arrived at the paste production area with cold water from the polishing pond (~0º C). At the same time, the white and black water tanks contained water at about 65º C as a product of the overnight heating. The pond cold water was then mixed with the heated water in the white and black water tanks to disperse the heat evenly throughout the water tanks and trucks to about 40°C. This was done by circulating the hot and cold water from the tanks and water trucks. Once the water temperature was leveled up, paste production for the day could be started.

When the water trucks ran out of water, they filled up from the Super B which was located about 250 m away from the location of the white and black water tanks. Once all of the volume had been used up (water tanks, trucks and Super B trailer), production was halted and the water tanks and the Super B trailer were filled and left to heat overnight for the next day.

3.5 Calibration of Paste Mixer Trucks

The following section outline the methods used to generate the calibration data for the Reimer mixer trucks used on site to blend tailings, cement, admixture, water, and aggregate into paste for production. Two trucks were used for the backfilling of the B1-18 stope. The first, Mixer #1, was built onto a Volvo frame. The second was built onto a Peterbilt frame and will be referred to as Mixer #2. The trucks had to be calibrated for both mass and volumetric throughput. A copy of the calibration data for each truck can be found in Appendix A of this document.

On November 29 and December 3, 2013, a round of confirmatory calibrations was done on the two mixer Trucks:

- Mixer #1 and #2 tailings kg/count calibration;
- Mixer #1 dry yield box; and
- Mixer #2 cement and aggregate kg/count calibration.

The result of the calibration information is that Mixer truck #2 (Peterbilt) is consistent with the calibrations done during the trial period; Mixer truck #1 (Volvo) was quite a bit different from the trial information – this is mainly due to the removal of the centre divider in the truck, as well as the changes in the moisture content of the tailings and the 'flowability' of the tailings over the production timeframe. The end result is that the m^3 reported as being deposited underground were underestimated. The original reports were under by approximately 1,700 m^3.

3.5.1 Mass Calibrations – Tailings, Cement, and Aggregate

The two mixer trucks had slightly different configurations. Mixer #1 contained a large centre bin where tailings could be loaded prior to mixing, while Mixer #2 contained a large centre bin that was divided in two. This feature allowed the truck to run alternative materials such as aggregate on one side and tailings on the other. Aggregate in the mix was used to produce high-strength paste for the construction of paste barricades.

Both trucks have a hydraulically driven belt feeder under the main centre bin. The discharge from the bin falls onto the belt feeder and is controlled by two independent gates. Each gate has a scale with 12 divisions on it. In the case of Mixer #2, one gate was used for tailings while the other was used to regulate the flow of aggregate. If there was no aggregate, both gates were used to regulate the flow of tailings.

The head pulley of the belt feeder has a toothed sprocket attached to the drive shaft. A proximity sensor mounted beside the toothed wheel produces a pulse signal each time a tooth passes by. A totalizer display on each truck counts the pulses as they are generated. The pulse signal can be correlated to the amount of material flowing on the belt feeder. This is done by running the belt feeder at a gate setting for a fixed time period and collecting the material discharged. The weight of the material is divided by the pulses or "counts" generated during the time period to produce a kg/count value.

Each mixer truck was calibrated at various gate settings with tailings to produce a kg/count for each gate setting. Mixer #2 was also calibrated with aggregate on a single side of the divided center bin, at various gate settings in order to produce a kg/count value specific to aggregate. This is necessary due to the fact that tailings and aggregate have different specific gravities. Due to the size and shape of the aggregate, the operation was constrained to a minimum gate setting of 30 to ensure that the aggregate was continuously and consistently fed into the hopper. This minimum setting was used to back-calculate the required tailings gate setting in order to achieve the desired paste recipe.

The cement intake also required calibration. Each mixer is equipped with a cement screw feeder also powered by a hydraulic motor. Both the belt feeder and screw feeder's hydraulic motors are driven by the same hydraulic pump. A proportioning valve precisely splits the flow between the belt feeder and screw feeder motors in a constant ratio. The proportioning valve can be adjusted in order to change the ratio of cement to tailings. The cement feeder is calibrated (in the same way as the belt feeder) by dividing the weight of cement discharged by the counts generated by the belt feeder to produce the kg/count of cement discharged. This is possible because the proportioning valve always keeps the ratio of tailings to cement equal.

The calibration data was used to determine the precise amounts of tailings, cement and aggregate used for a specific paste pour by multiplying the counts for the run by the respective kg/count at a specific gate setting for that material. It should be noted that these values are dry amounts used to make the paste and do not correlate to volume measurement. Separate calibrations were required to determine the volume throughputs of each truck. The resulting calibration numbers are shown in Tables 1 to 3. Appendix B contains full calibration data.

Table 1: Mixer #1 100% Tailings Calibration

Gate Opening	Average kg/count	Cement Average kg/count (valve max open)
200	1.506	0.194
240	1.822	
260	2.055	

Equation for tailings kg/count based on the Gate opening = 0.009*gate opening - 0.297.

Table 2: Mixer #2 100% Tailings Calibration

Gate Opening	Average kg/count	Cement Average kg/count (valve max open)
240	1.410	0.204
200	1.151	

Equation for tailings kg/count based on the Gate opening = 0.0065*gate opening - 0.1425.

Equation for cement kg/count based on the percent cement = 1.41-3*% cement - 4E-17.

Table 3: Mixer #2 Aggregate Calibration

Gate Opening	Average kg/count	Cement Average kg/count (valve max open)
31	0.215	0.204
40	0.303	
50	0.381	

Equation for tailings and cement remains the same for the aggregate mixes

Equation for aggregate kg/count based on the Gate opening = 0.0088*gate opening - 0.0535

3.5.2 Volumetric Calibrations

Volumetric calibrations were determined using a 1 m x 1 m x 1 m ($1m^3$) wooden yield box. Paste of a known slump was blended in the mixer truck and poured into the yield box. The quantity of counts to fill the 1 m^3 box was measured for each truck at each slump.

Using this data, the cubic metres of paste produced for a specific batch could be determined by dividing the counts generated for that batch by the counts/m^3. The resulting calibration numbers are shown in Tables 4 and 5. Appendix C contains the results of the calibrations plotted for both Mixer Trucks.

Table 4: Mixer #1 Volume Calibrations

Paste Slump (in.)	Tailings (counts/m^3)
5	878
6	867
7	856
8	845
9	834
10	823

Table 5: Mixer #2 Volume Calibrations

Paste Slump (in.)	Tailings (counts/m^3)
5	1111
6	1100
7	1089
8	1078
9	1067
10	1056

Equation for counts/m^3 based on the slump = -10.971*slump + 1165.8.

4.0 B1-18 STOPE PASTE PRODUCTION STATUS

By the time that paste production was shut down for the season on December 10, 2013, a total of about 10,667 m^3 of paste was pumped underground. Ultimately, 13 boreholes were used to backfill the 1-18 stope. Table 6 shows the status of the boreholes at the time the paste production was halted for the season.

Table 6: Borehole Status

Borehole	Status
P_Deliv_118_01	Plugged
P_Deliv_118_02	Plugged
P_Deliv_118_03	Plugged
Plug_Deliv_118_04	Open, no need to fill
Plug_Deliv_118_05	Plugged
P_Deliv_118_06	Plugged
Plug_Deliv_118_07	Open, no need to fill
P_Deliv_118_08	Open
Plug_Deliv_118_09	Open, no need to fill
P_Deliv_118_10	Partial breakthrough (abandoned)
P_Deliv_118_11	Open
P_Deliv_118_12	Plugged
P_Deliv_118_13	Unavailable (never drilled)
P_Deliv_118_14	Plugged
P_Deliv_118_15	Open
Obs_118_01	Unavailable
Obs_118_02	Open
Obs_118_03	Plugged
Obs_118_04	Open, no need to fill
Obs_118_05	Open, no need to fill
Obs_118_06	Plugged
Obs_118_07	Plugged
BKGT-12-14	Plugged
BKGT-12-15	Plugged
BKGT_12_16	Unavailable – no access to collar

5.0 PRODUCTION ANALYSIS

5.1 Fill Profile

A fill profile was completed for each borehole that was injected with paste during production. This analysis indicates the relative volumes of paste poured into each borehole in terms of the date of the pour and the recipe used. The fill profiles also display the laboratory strength data for the paste poured into each borehole. The fill profiles are contained in Appendix D.

Generally the fill profiles were as expected, i.e. the recipes with higher binders had higher strengths though there were anomalies – some driven by material behaviour and others by the laboratory environment. All recipes reached the 100 kPa target easily by 28 days – most recipes in fact reached 100 kPa at the 1- or 3-day mark.

5.2 Slump Profile and Solids Content

Analysis was completed to examine the different paste recipes used during production and to relate the volumes of paste poured to the slump and binder content used. This analysis can be found in Appendix E. In summary, the most common recipe was a 10" slump @ 2% binder. This was utilized approximately 80% of the time.

In terms of solids content, as the moisture contents changed so did the ultimate solids content of the paste material. For the days when moisture content data was available, the % solids for paste was calculated as a function of the tailings feed moisture content for both 7 and 10" slumps.

The conclusion is that while moisture content varied more than 10% in the feed material, the resulting paste was reasonably consistent in terms of final moisture content. To get a tighter range, more process control would be required.

5.3 Water Consumption

In order to understand the correlation between the volume of water used during production and the volume of paste poured, underground paste volumes, tailings moistures, and water data was analyzed and is graphically presented in Appendix F.

One of the conclusions is that the moisture content of the tailings changed drastically over the production program. This had an impact on the amount of water consumed per m^3 of paste. As can be seen on Figure 1 and in Appendix F, the average water to paste ratio is 0.19.

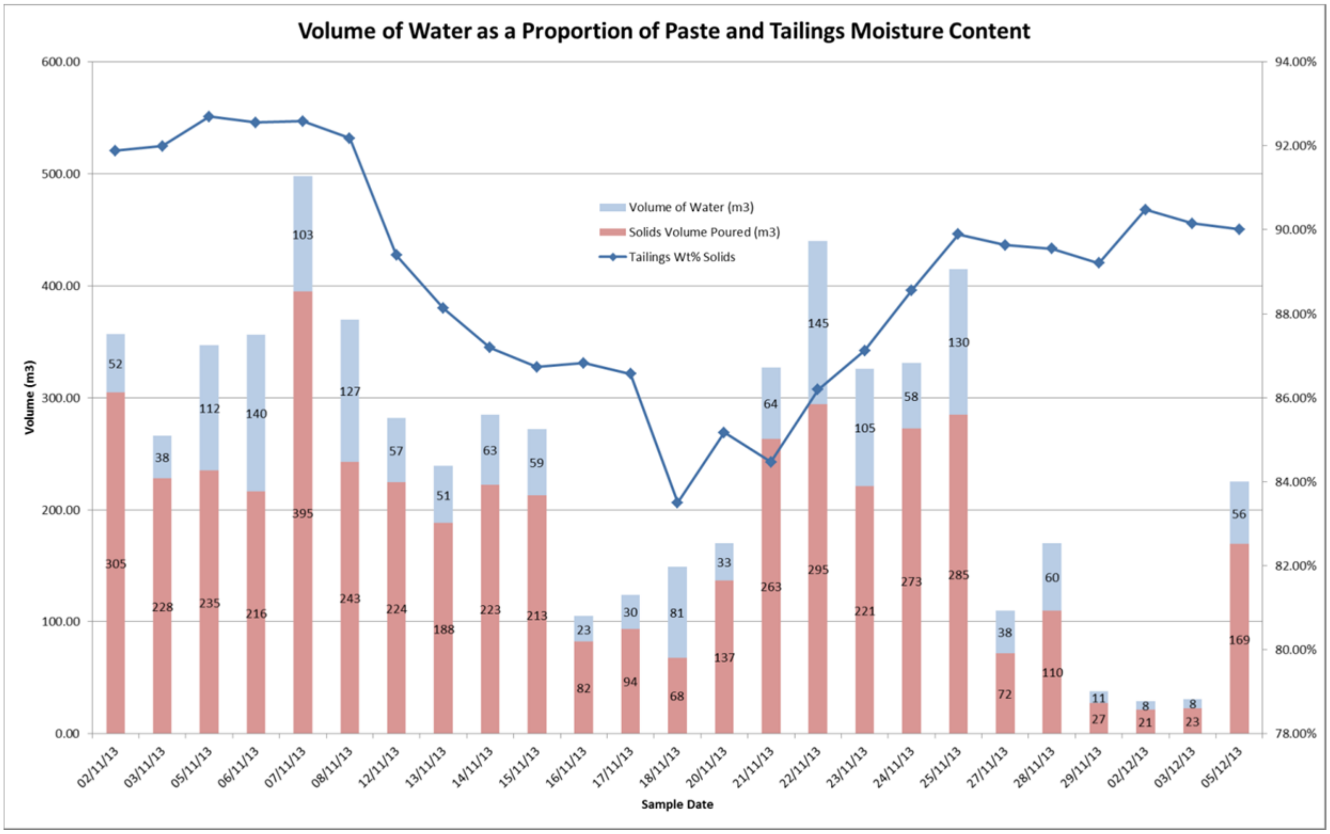


Figure 1: Volume of Water as a Proportion of Paste and Tailings Moisture Content per Day

5.4 Production Hours per Day and Flow Rate Profile

Analysis was completed to determine the average hours per day that paste was being pumped. This affected overall production numbers especially when the weather started playing a big role in operations. The average for the program was 3.44 hrs per day. The full graph is presented in Appendix G.

As production hours fluctuated so did the flow rates produced by the Mixer trucks. There are two plots showing average daily production flow rates and then each Mixer truck flow rate per day per mix. The end result is an average of 67 m^3/hr. The full graph is presented in Appendix G.

6.0 CLOSURE

Should there be any questions or comments relating to the enclosed report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

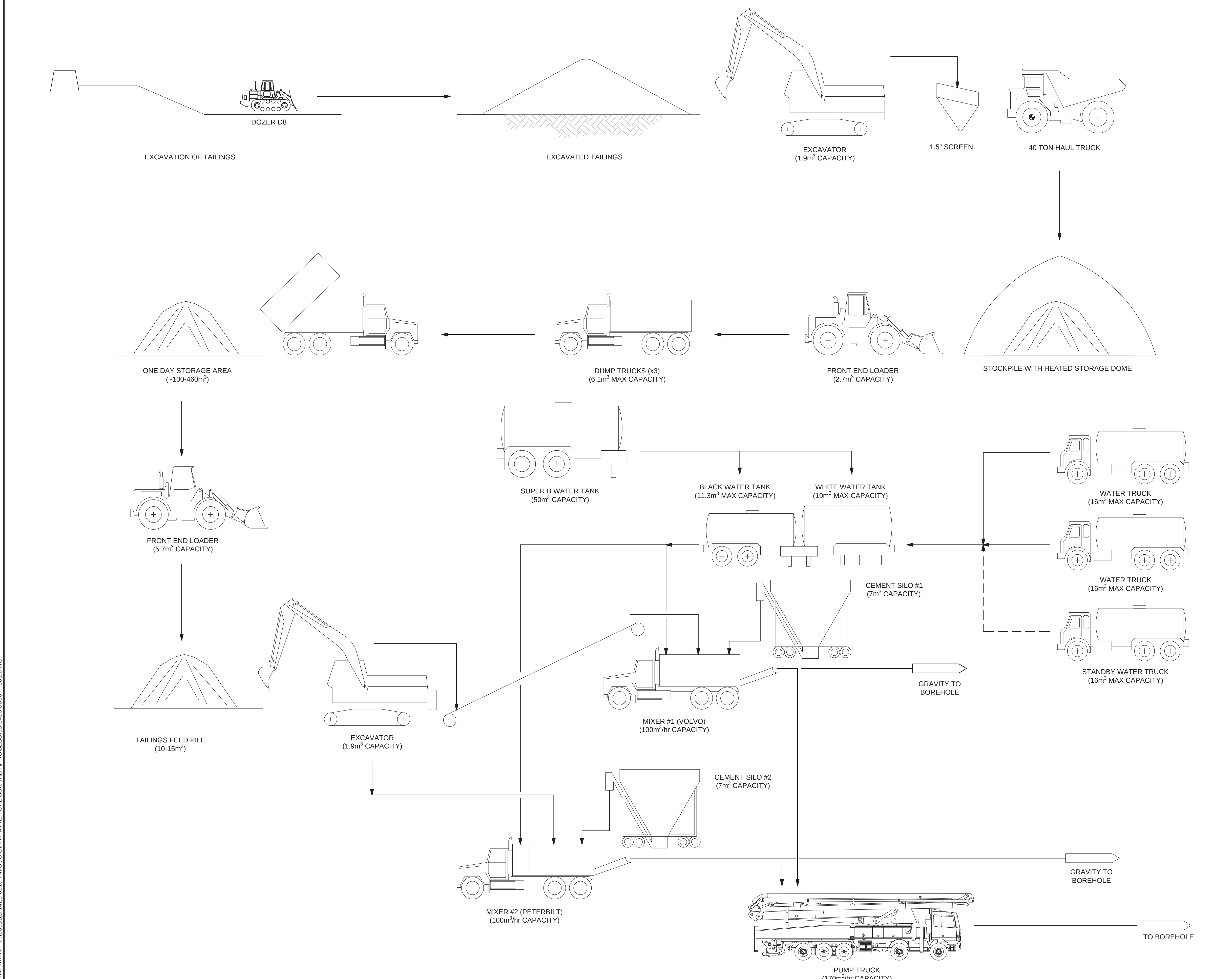
Andrés Quintero, P.Eng.
Mechanical Engineer

Sue Longo, P.Eng.
Associate / Paste Task Lead

AV/SL/AQ/JT/ds/md

APPENDIX A

Paste Production Flow Diagram



CADD FILE LOCN: P:\2013\13-1426-0010 PWGSC GIANT MINE - GAL BURNABY\PROCESS\13-1426-0010-P-001.DWG

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Revision/ Revision	Description/Description	Date/Date
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###	###	###
###	###	###
A	FOR REVIEW	13/12/02

Client/client
PUBLIC WORKS
GOVERNMENT SERVICES
CANADA

Project title/Titre du projet
GIANT MINE
REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

Approved by/Approuve par
S.L

Designed by/Concept par
A.V.

Drawn by/Dessine par
A.V.

PWGSC Project Manager/Administrateur de Projets TPSGC
DAVE COLBOURNE

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

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PASTE PRODUCTION AREA
PROCESS FLOW DIAGRAM

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	A

PWGSC – A1 – 841X594

13-1426-0010-P-001

APPENDIX B

Production Area General Arrangement Layout

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PASTE PRODUCTION AREA
B1 PIT
GENERAL ARRANGEMENT
AS CONSTRUCTED

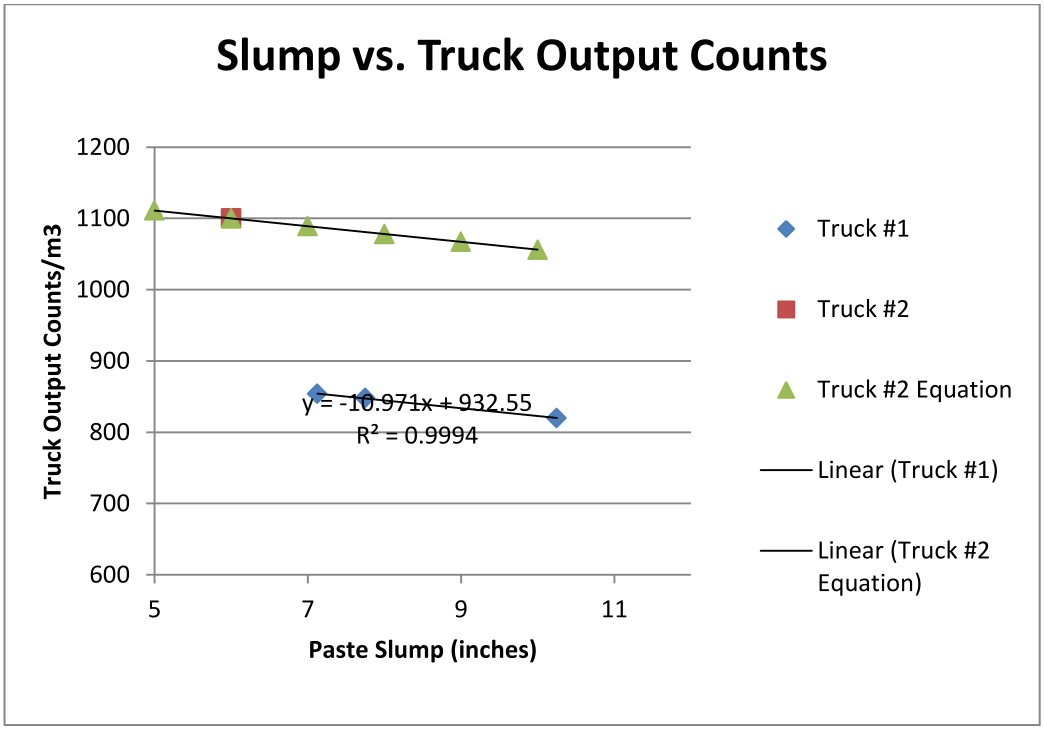
Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	0

APPENDIX C

Calibration Results

Appendix C – Calibration Results

The following graph outlines the slumps versus truck output counts for both mixer trucks. Several test calibration points were taken for Mixer Truck #1 which allowed for the plot line to be developed. For Mixer Truck #2 there was only one point taken so some of the data from the previous calibrations were used to overlay the line of best fit.



APPENDIX D

Fill Profiles

Appendix D – Fill Profiles

The following outlines the fill profiles for each borehole backfilled with paste during production.

There are two parts to the diagram showing the profile of the deposit per each borehole. The first is a representation of the relative volume (totaling 100%) of paste poured in each borehole broken down by the date and recipe of the pour (shown on the chart legend as "date binder percent/aggregate %). The laboratory strength profile for 1-day, 3-day, 7-day, and 28-day is overlaid on top of the fill profile which indicates the strength information for each pour. The results are presented in Tables 1 to 11, as well as on Figures 1 to 12.

Table 1: P_Deliv_118_01 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 6-13	2	84	66	139	179	217
Nov 7-13	2	447	79	188	234	290
Nov 9-13	2	101	86	155	180	173
Nov 10-13	2	241	94	192	246	308
Nov 12-13	2	181	77	141	186	219
Nov 13-13	2	63	101	196	309	385
Nov 14-13	5	103	63	261	339	589
Nov 15-13	5	272	96	467	310	468
Nov 16-13	5	105	147	279	296	338
Nov 17-13	5	124	69	203	313	416
Nov 18-13	5	149	94	174	195	308
Dec 5-13	2	145	90	184	234	269

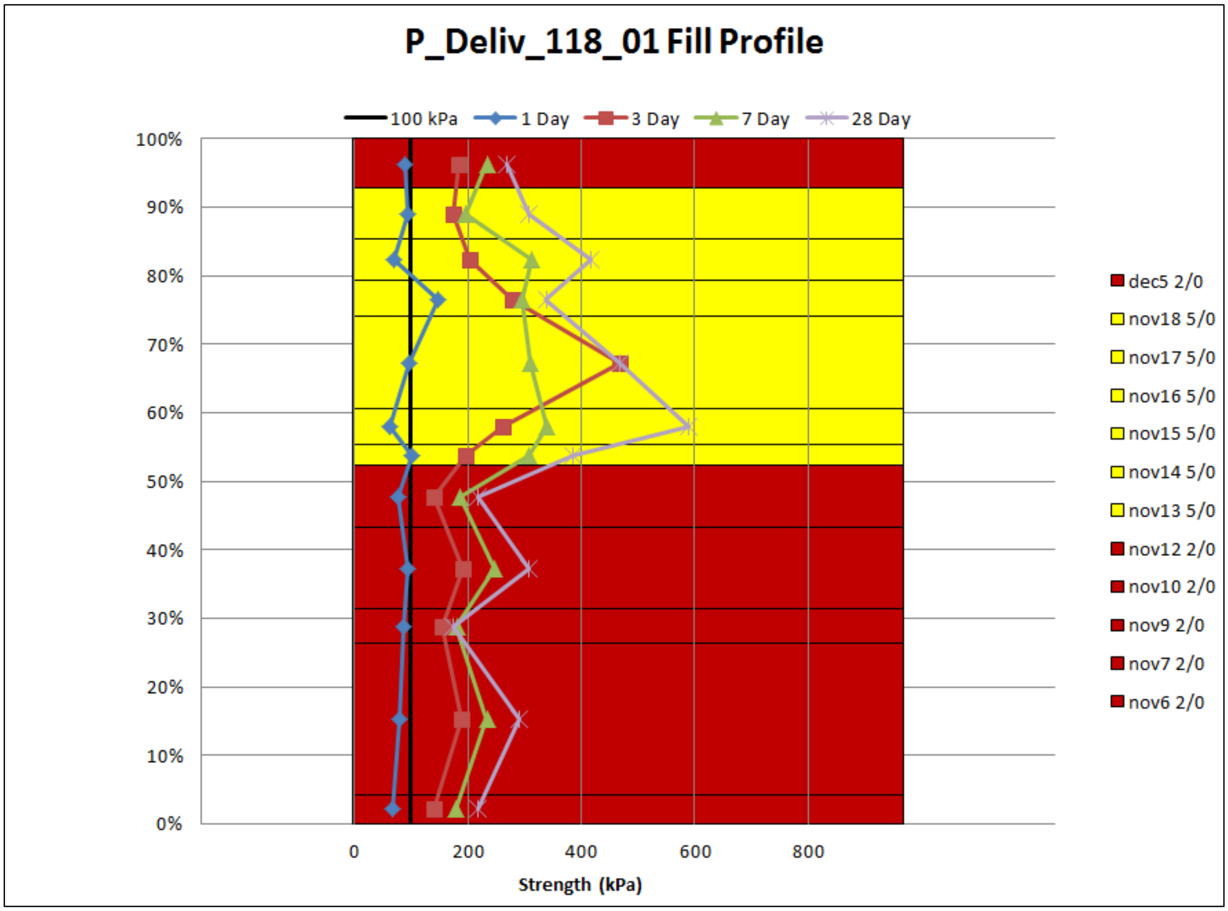


Figure 1: P_Deliv_118_01 Fill Profile

Table 2: P_Deliv_118_03 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Oct 27-13	2	367	116	249	290	406
Oct 28-13	2	392	67	179	143	245
Oct 30-13	2	131	124	292	336	378
Oct 31-13	5	38	192	430	458	679
Nov 1-13	2	117	98	234	277	346
Nov 2-13	2	353	162	456	453	709
Nov 3-13	2	201	77	174	212	283
Nov 3-13	5	61	1130*	3872*	3893*	9552*
Nov 4-13	5	142	142	323	442	572
Nov 4-13	2	109	92	191	224	276
Nov 9-13	2	61	86	155	180	173
Nov 19-13	5	171	73	217	256	240
Nov 20-13	2	104	40	99	124	110
Nov 23-13	2	326	74	133	144	169
Nov 24-13	2	138	69	121	125	176
Nov 26-13	2	315	80	151	139	204
Dec 7-13	2	99	85	108	184	217

*These strength results are not included in Figure 2 as there was calibration error.

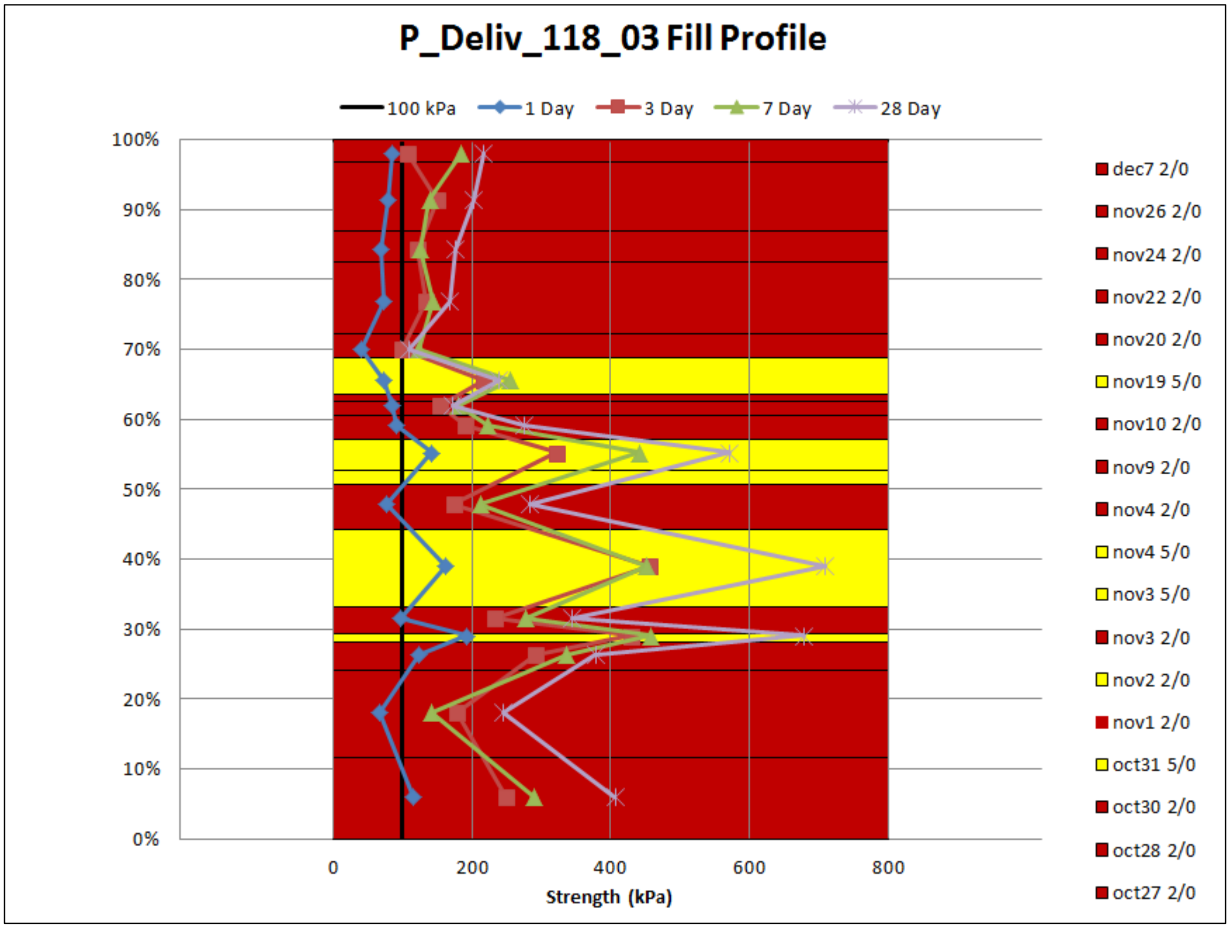


Figure 2: P_Deliv_118_03 Fill Profile

Table 3: Plug_Deliv_118_04 Fill Profile

Date	Binder Percent (wt%)	Target Aggregate Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Oct 29-13	15	10	36	2517*	7017*	9440*	9426*
Oct 30-13	15	10	8	1848*	7284*	8693*	9431*
Oct 31-13	8	0	2	206	685	906	1205
Nov 1-13	8	0	2	185	519	690	1230
Nov 2-13	8	0	4	236	550	673	1061
Nov 3-13	8	0	4	232	561	712	909
Nov 4-13	8	0	3	226	488	673	1102
Nov 5-13	8	0	3	186	485	724	1132
Nov 6-13	8	0	6	204	555	713	1245

*These strength results are presented in Figure 3 separately as they exhibited extremely high strength with high binder content. The 28 day cylinders reached the load cell limit and did not break fully.

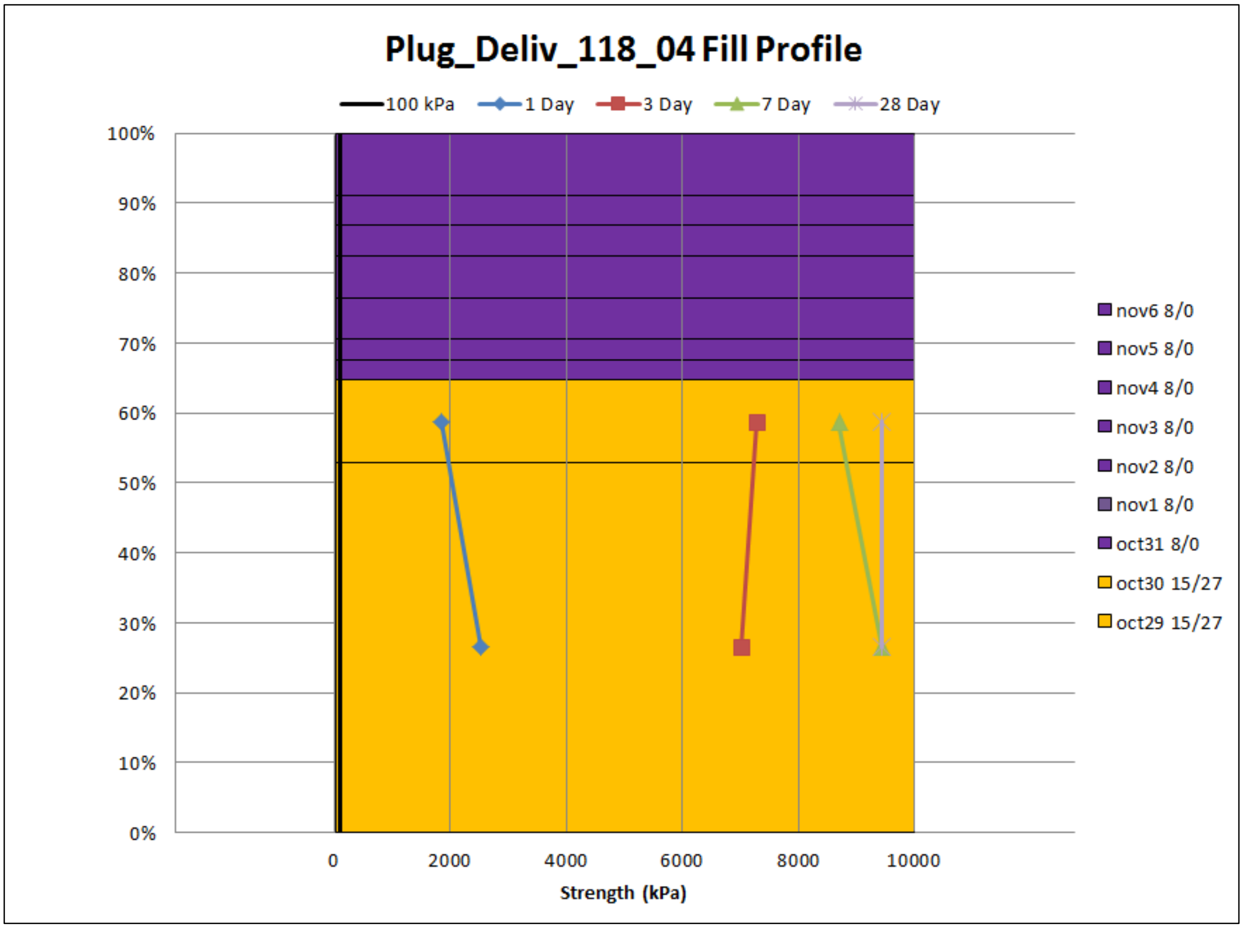


Figure 3: Plug_Deliv_118_04 Fill Profile - 1

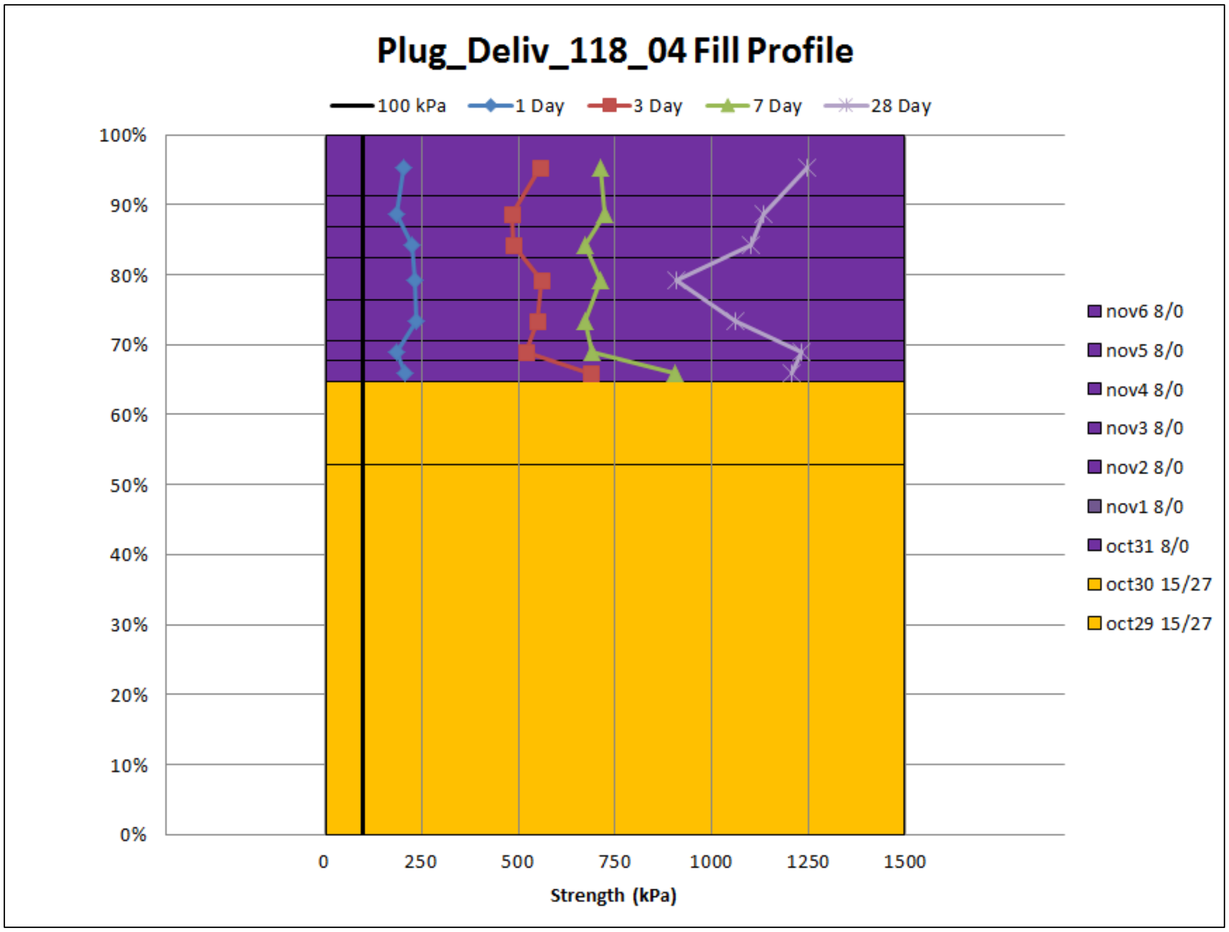


Figure 4: Plug_Deliv_118_04 Fill Profile - 2

Table 4: Plug_Deliv_118_05 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Oct 21-13	5	5	166	368	425	632
Oct 22-13	5	212	315	617	684	945
Oct 25-13	5	302	118	253	328	430
Oct 26-13	3	318	124	243	281	439
Oct 29-13	5	9	66.5	166	214	280
Oct 30-13	5	17	145	306	354	531
Oct 31-13	2	119	121	272	323	393
Oct 31-13	2	132	103	186	207	287

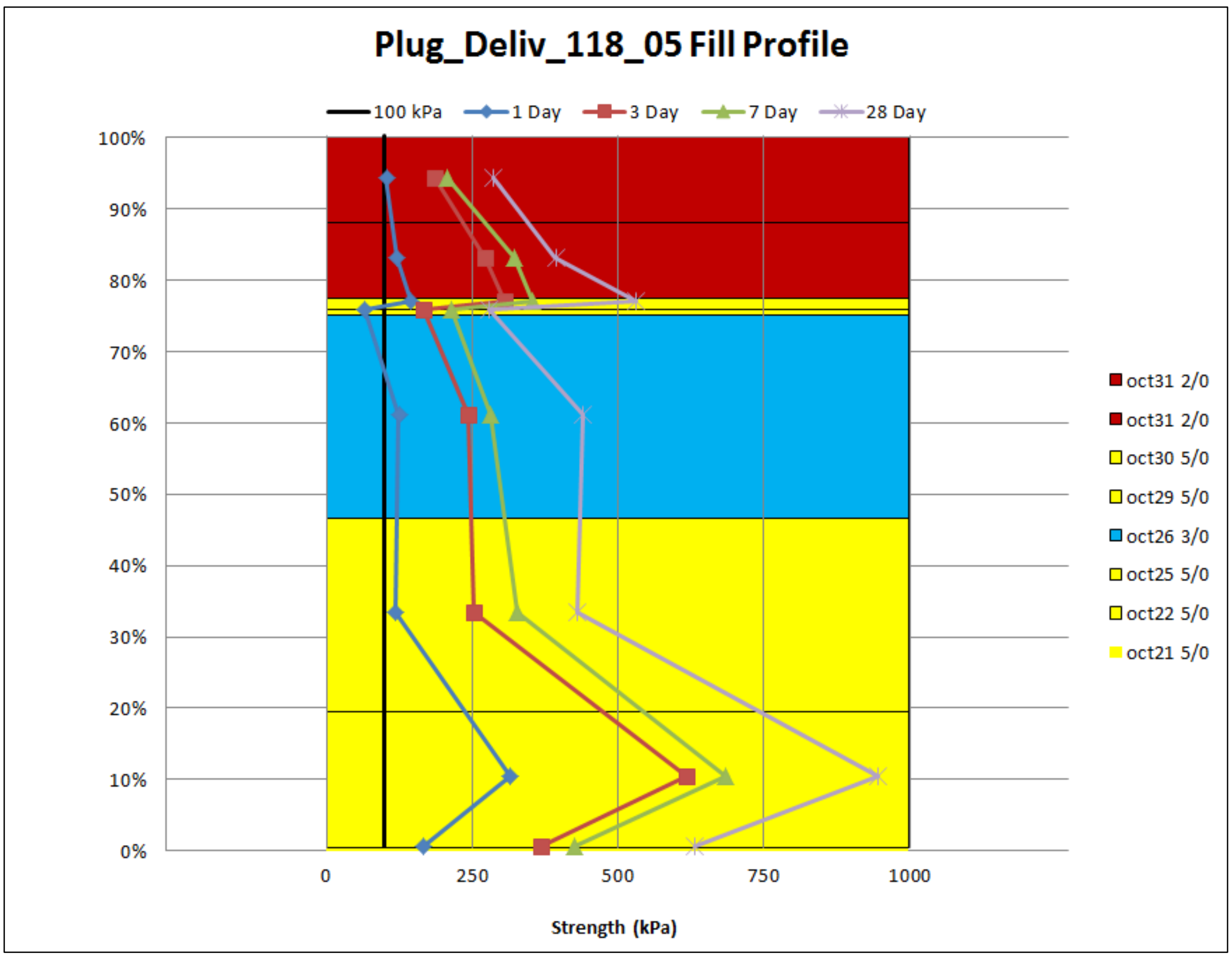


Figure 5: Plug_Deliv_118_05 Fill Profile

Table 5: P_Deliv_118_06 Fill Profile

Date	Binder Percent (wt%)	Aggregate Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 11-13	15	27	11	1752	7139	9337	10000
Nov 11-13	15	27	11	1034	4422	5005	8195
Nov 12-13	8	0	3	102	376	625	822

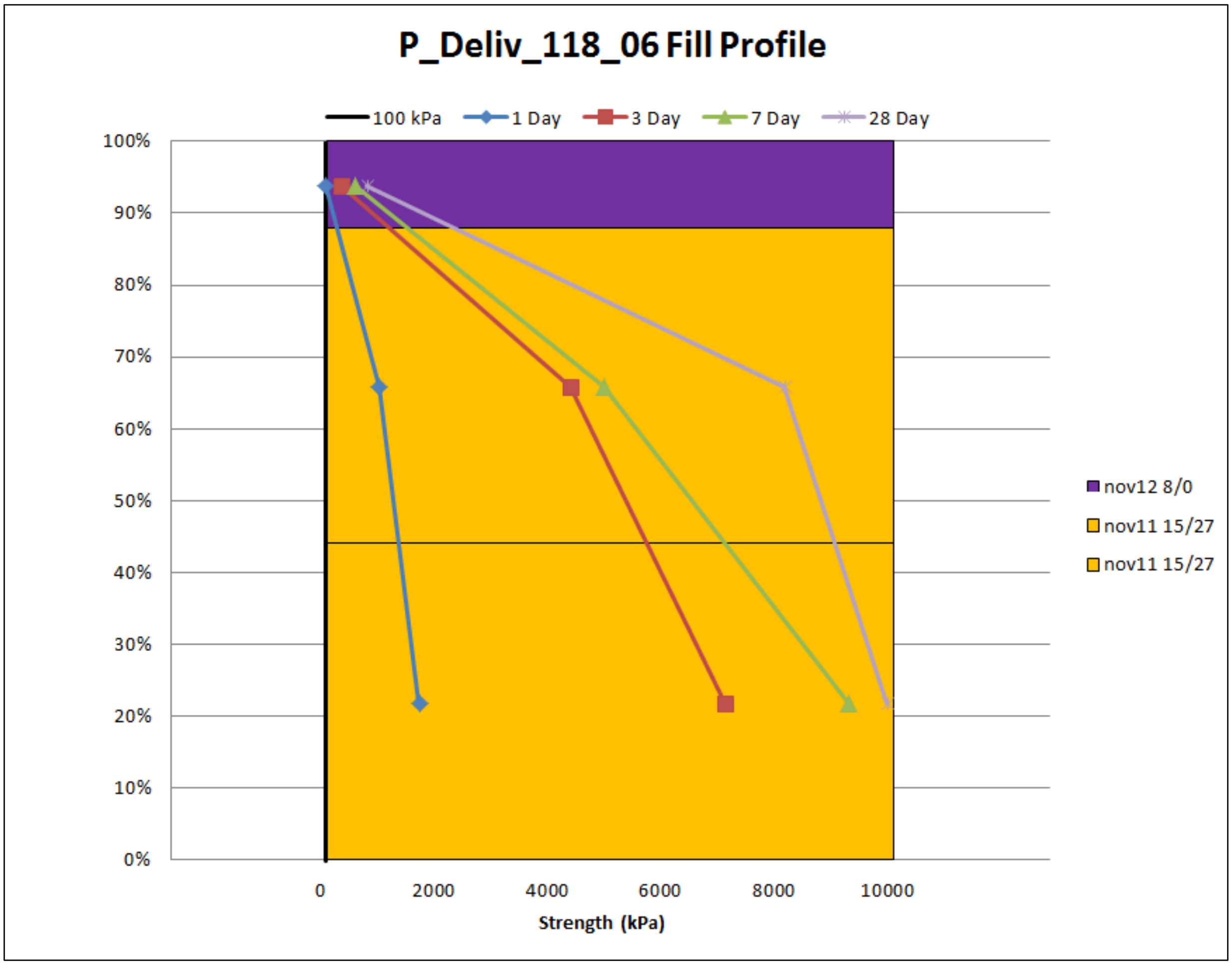


Figure 6: P_Deliv_118_06 Fill Profile

Table 6: P_Deliv_118_08 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Dec 8-13	2	184	84	144	198	251
Dec 9-13	5	104	201	389	571	588
Dec 10-13	2	35	94	199	271	330

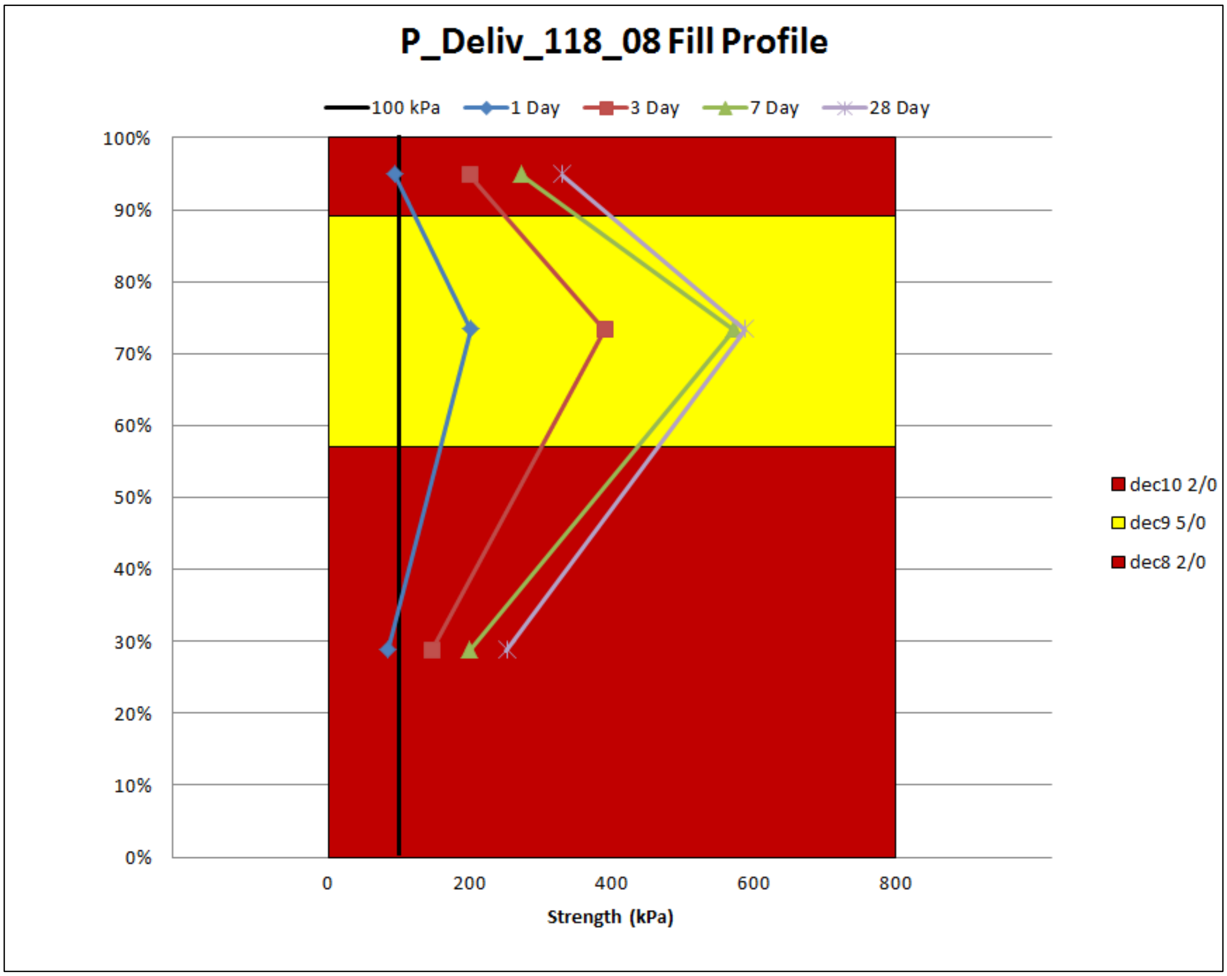


Figure 7: P_Deliv_118_08 Fill Profile

Table 7: P_Deliv_118_11 Fill Profile

Date	Binder Percent (wt%)	Aggregate Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 22-13	8	0	24	228	441	662	1134
Nov 29-13	8	0	38	287	552	501	738
Dec 2-13	8	0	29	315	700	883	884
Dec 3-13	8	22	31	302	733	1214	1967

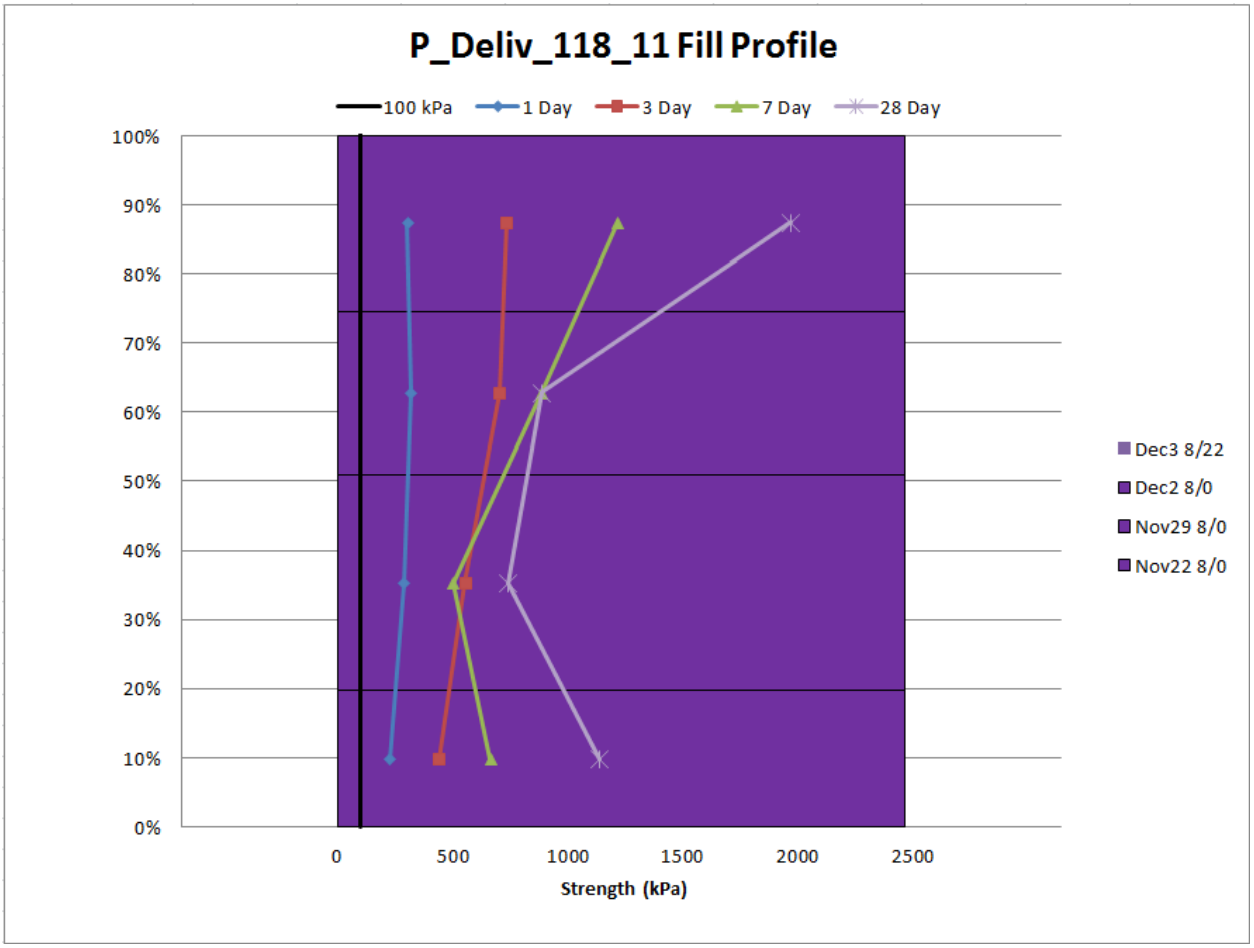


Figure 8: P_Deliv_118_11 Fill Profile

Table 8: P_Deliv_118_12 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 5-13	4	344	129	336	395	638
Nov 6-13	4	269	114	281	315	425
Nov 7-13	2	51	63	149	150	209
Nov 8-13	2	370	55.5	105	131	176
Nov 10-13	2	181	51	83	109	146
Nov 11-13	2	147	123	176	256	151
Nov 12-13	2	98	37	63	74	90
Nov 13-13	2	176	40	102	152	249
Nov 14-13	5	184	36	105	163	265
Nov 28-13	2	31	68	125	178	178

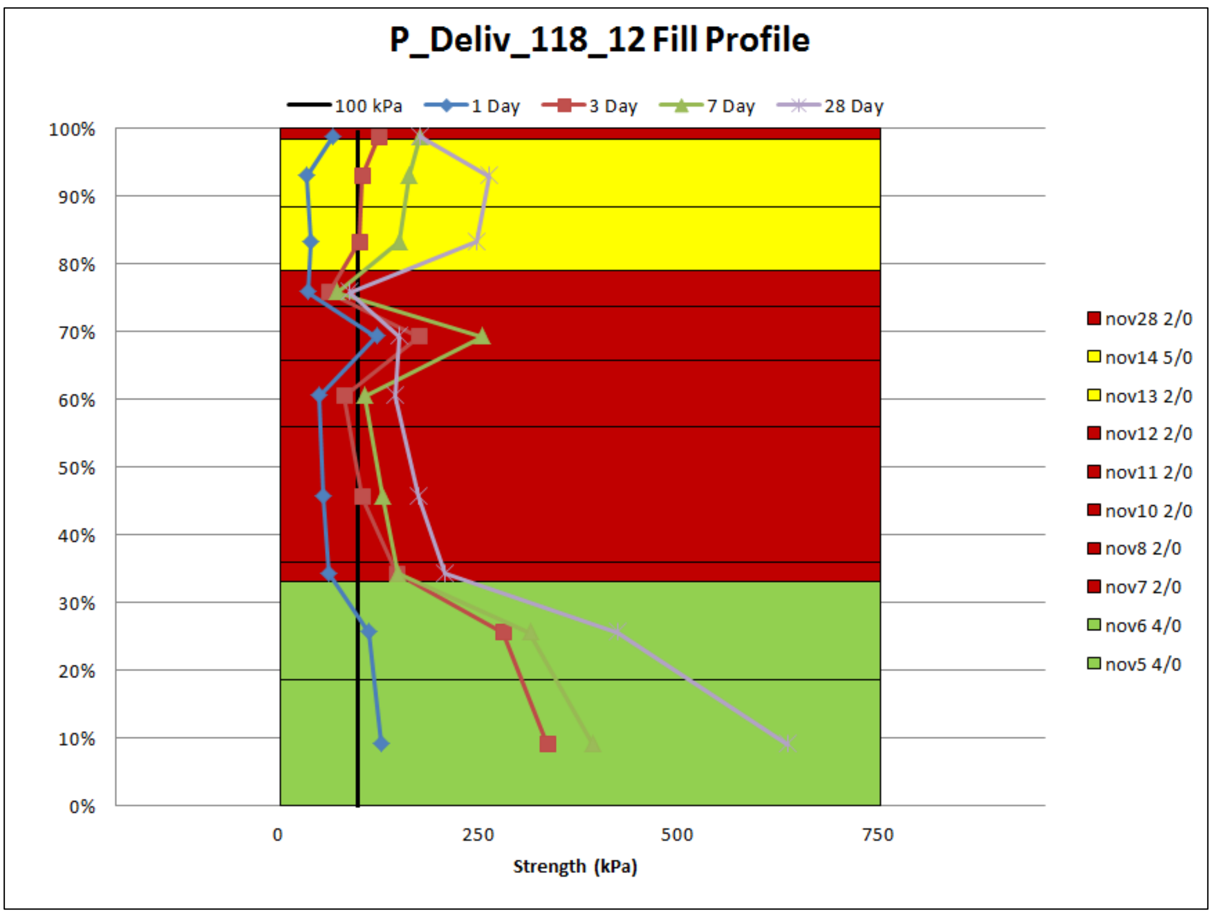


Figure 9: P_Deliv_118_12 Fill Profile

Table 9: P_Deliv_118_15 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 24-13	2	193	67	126	150	179
Nov 25-13	2	415	81	118	140	165
Dec 6-13	2	154	65	145	166	204
Dec 7-13	2	192	70	135	193	199

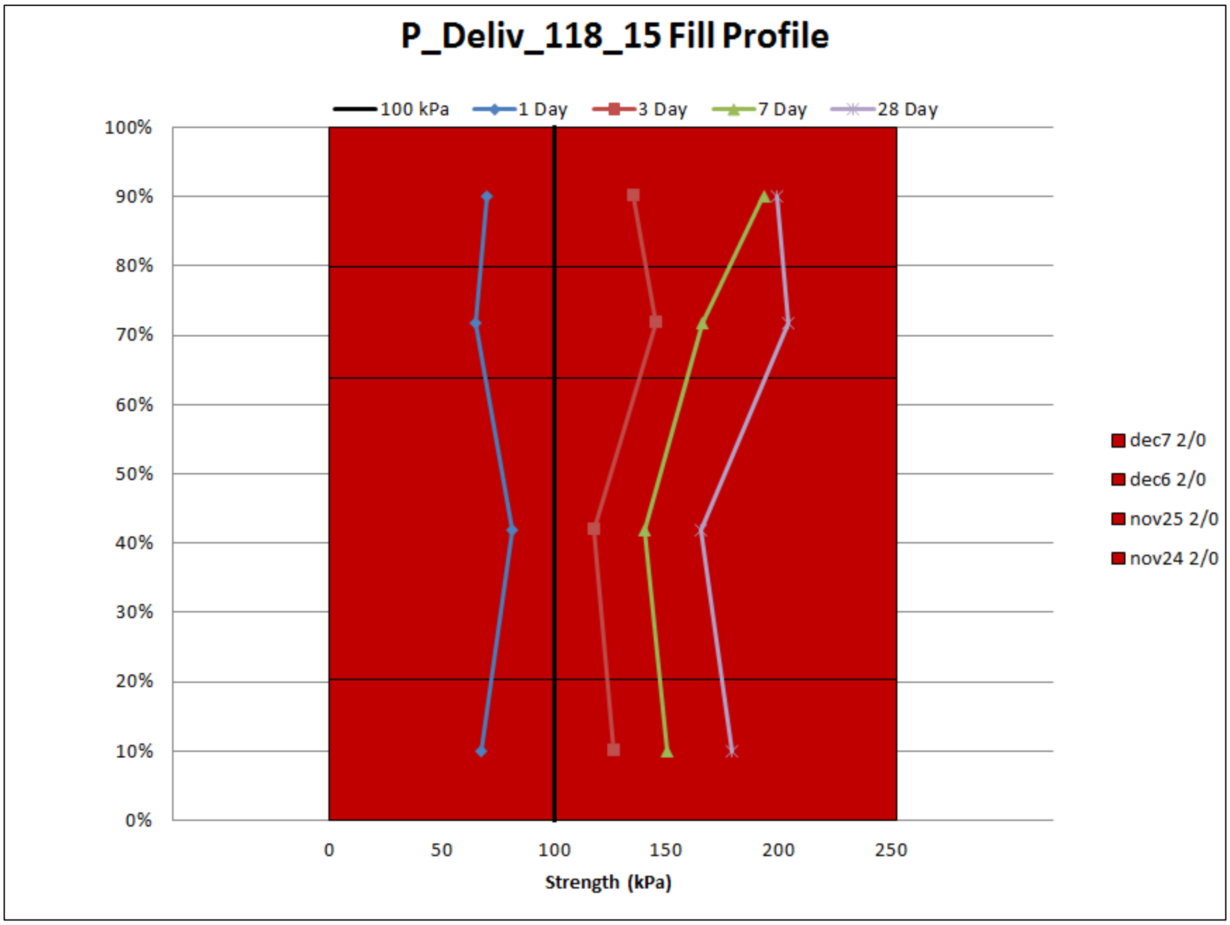


Figure 10: P_Deliv_118_15 Fill Profile

Table 10: Obs_118_02 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 1-13	2	147	94	191	237	350
Dec 9-13	5	62	176	344	463	538

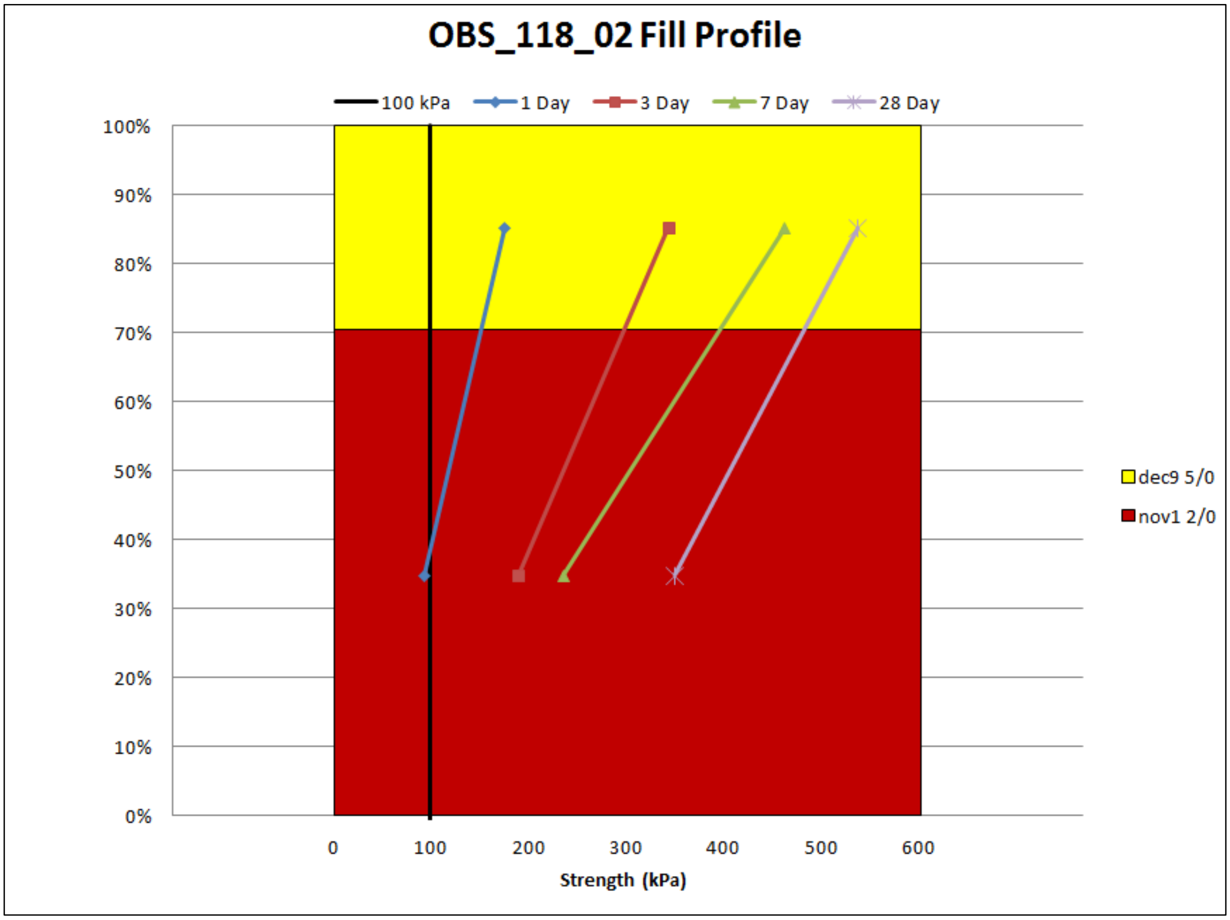


Figure 11: Obs_118_02 Fill Profile

Table 11: BKGT-12-15 Fill Profile

Date	Binder Percent (wt%)	Pour Volume (m^3)	Strength (kPa)			
			Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days
Nov 20-13	2	65	53	103	124	129
Nov 21-13	2	327	42	100	100	110
Nov 22-13	2	196	86	133	147	140
Nov 27-13	2	110	87	182	185	213
Nov 28-13	2	130	97	162	186	198

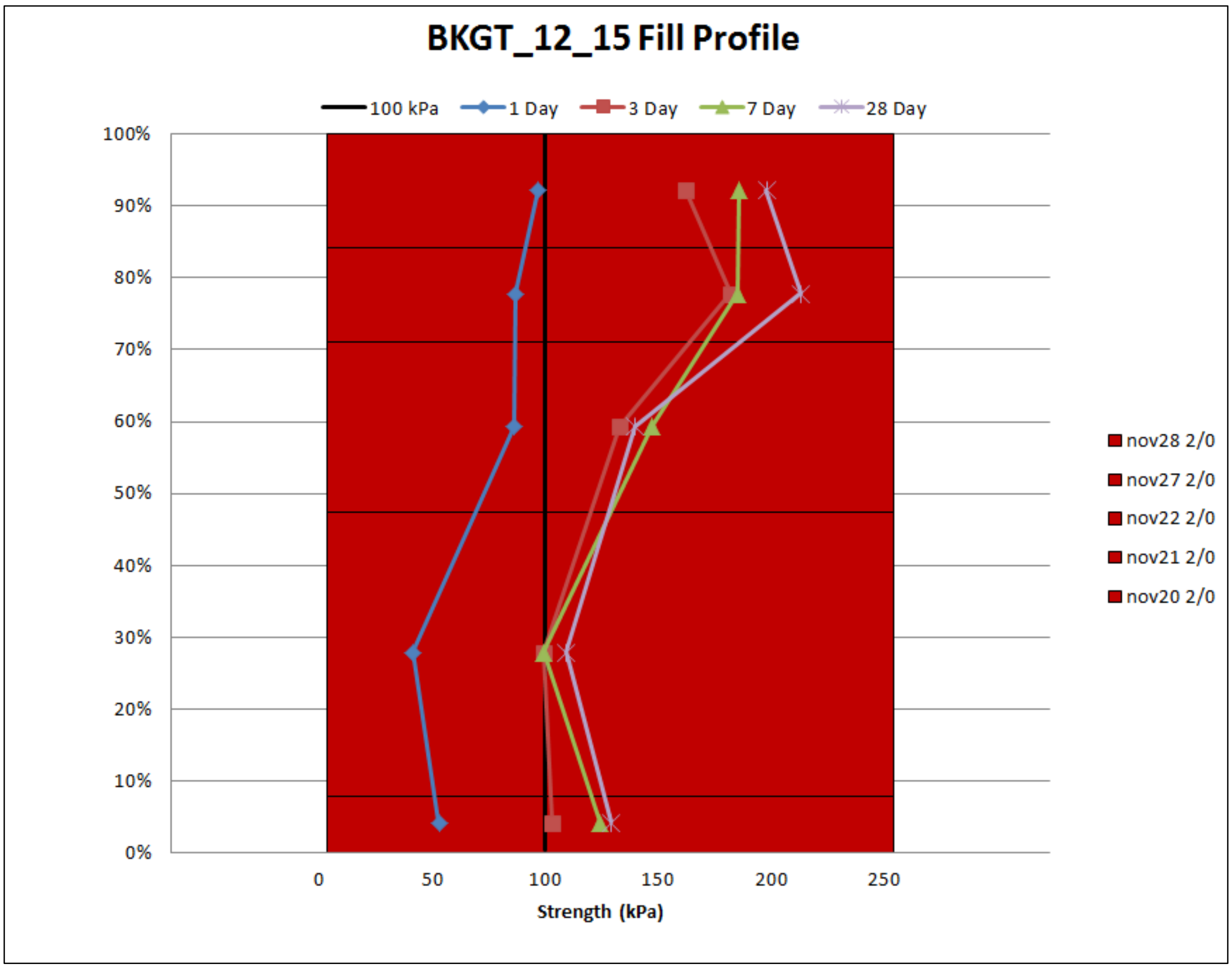


Figure 12: BKGT_12_15 Fill Profile

APPENDIX E

Slump Profiles and Solids Content

Appendix E – Slump Profile and Solids Content

A range of different recipes were used during paste production which included different target slumps. The percentage of paste poured by volume for each slump was calculated and compared. The percentage of paste poured by volume was further broken down by cement content. The results can be seen in the following Tables 1 and 2, as well as on Figures 1 to 3.

Table 1: Percentage of Paste Poured by Volume

Slump (in.)	Pour Volume (m^3)	Percentage of Paste Poured by Volume (%)	Cement Content Comment
5	806	84	Majority 2% (61%)
6	584	447	5% (100%)
7	587	101	Majority 2% (79%)
8	151	241	Majority 5% (94%)
10	8,538	181	Majority 5% (94%)
Total Volume (m^3)	10,667		

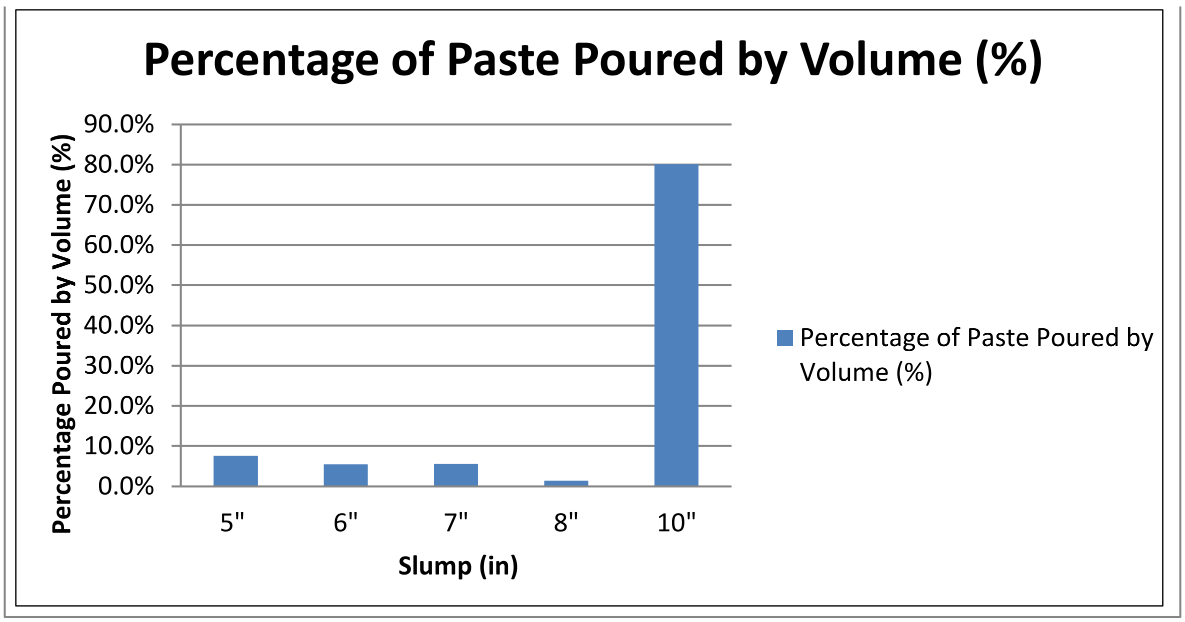


Figure 1: Percentage of Paste Poured by Volume

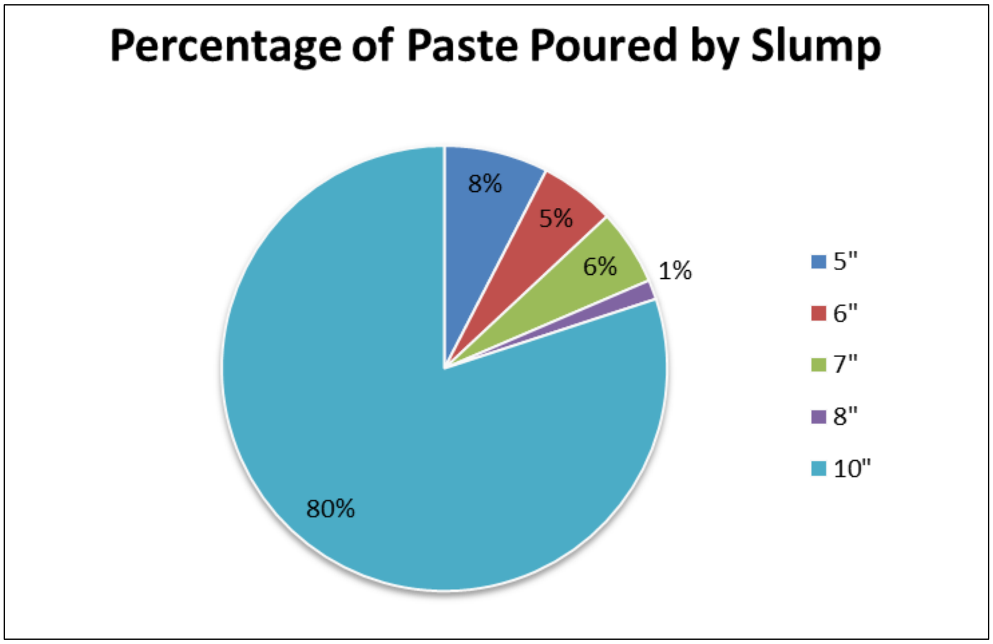


Figure 2: Percentage of Paste Poured by Slump

Table 2: 5" Slump – Percentage of Paste Poured by Cement Content

Slump (in.)	Cement Content (%)	Pour Volume (m^3)	Percentage of Paste Poured by Volume (%)
5	2	489	61
	3	318	39
6	5	584	100
7	2	465	79
	8	90	16
	10	31	5
8	5	142	94
	8	9	6
10	2	6,507	76
	4	613	7
	5	1,335	16
	8	17	0.2
	15	16	0.8
Total Volume (m^3)		10,667	

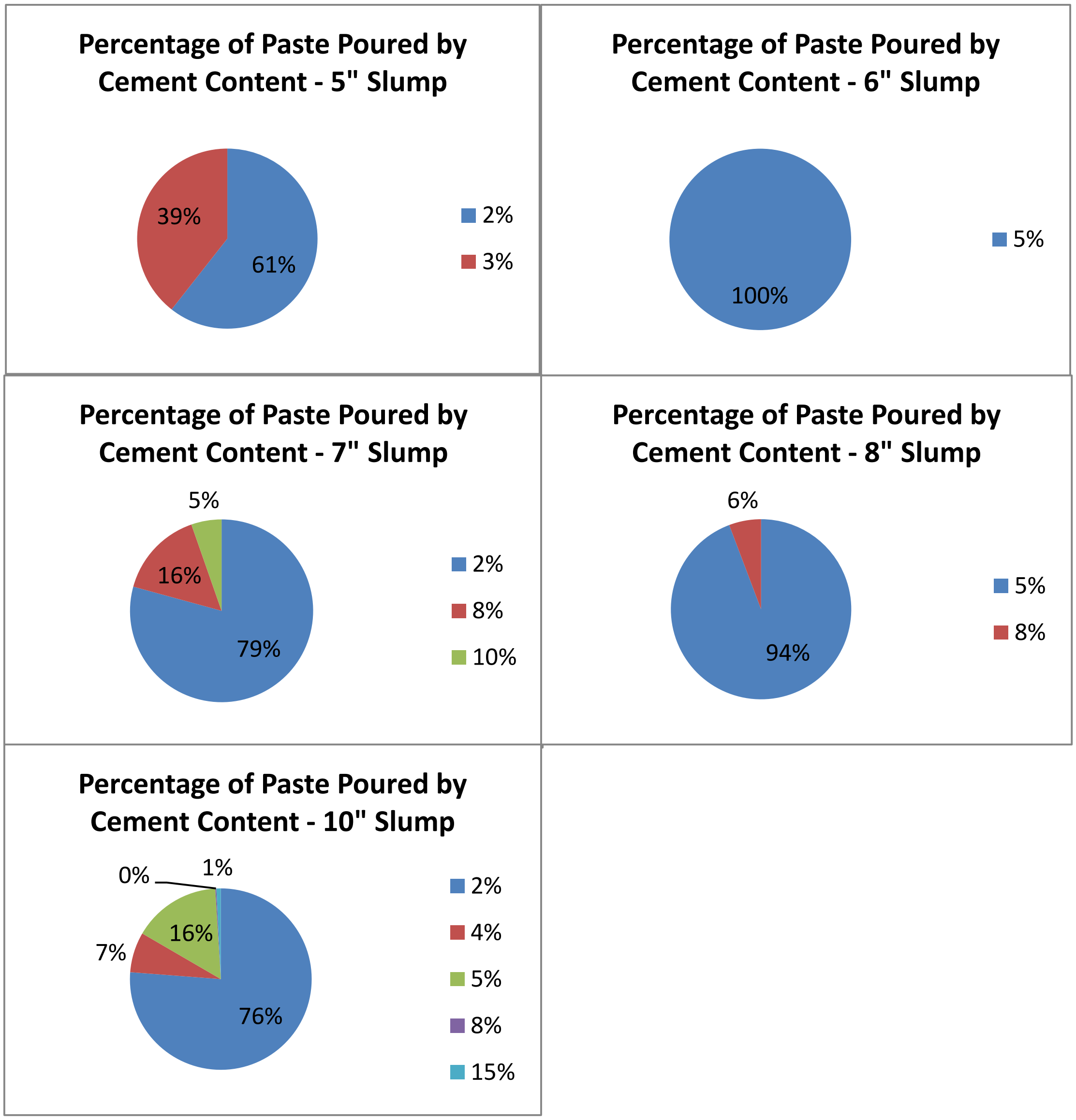


Figure 3: Percentage of Paste Poured by Cement Content

As can be seen in the above results, the majority of paste poured at each slump was at one particular cement content. In other words, per slump there was effectively one recipe and only when particular circumstances warranted was the recipe changed. Overall the majority of paste poured underground during production was a 10” slump material with a cement content of 2% while the least used recipe was an 8” slump material with a cement content of 8%.

APPENDIX F

Water Consumption vs. Paste Production

Appendix F – Water Consumption versus Paste Production

The following graphs outline the water consumption per day versus daily paste production. Figure 1 shows the total volume of paste and water poured vs the wt% solids measured in the lab on that particular day. This figure is intended to highlight the trend showing increased water consumption as the moisture content of the tailings decreased.

The second graph, Figure 2, summarizes all of the volumetric data for both paste volumes and water volumes per day and provides the average over the entire production run including days where no data was collected.

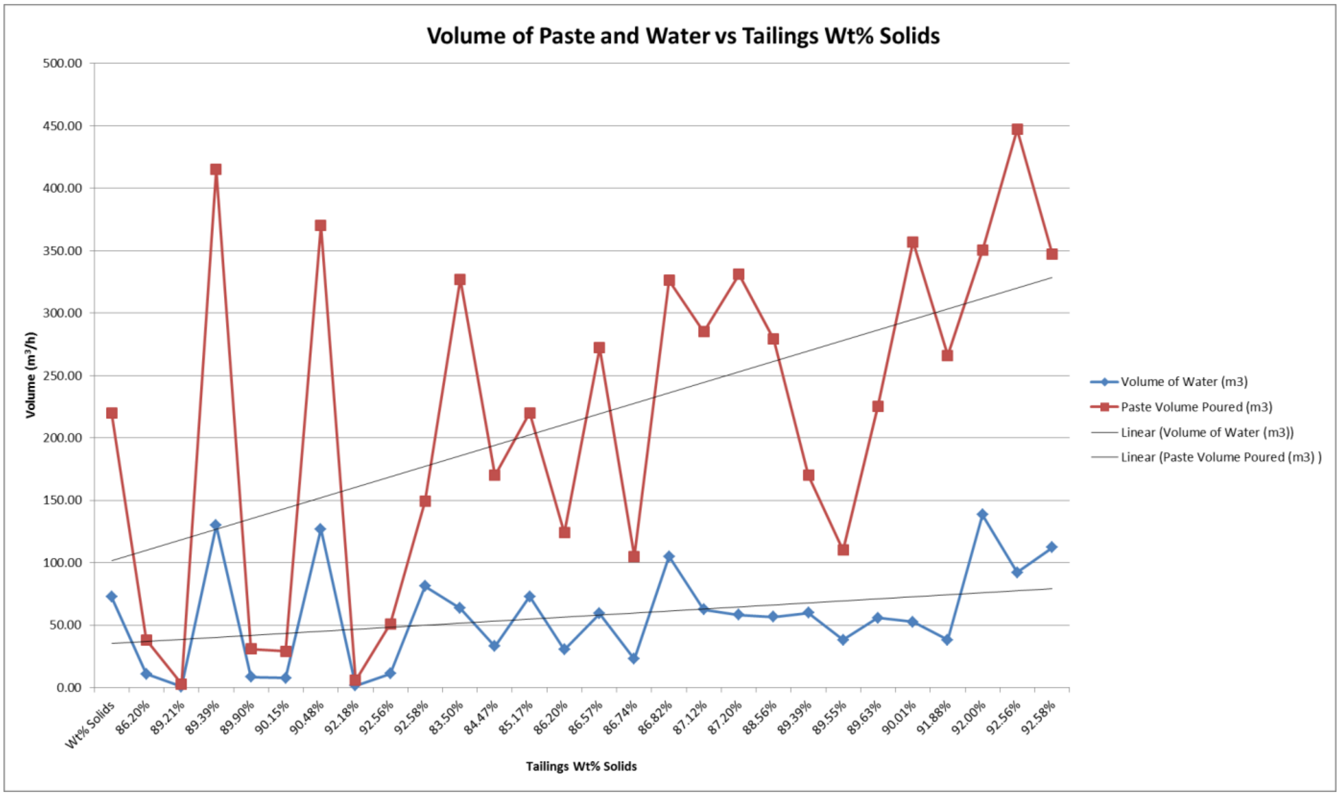


Figure 1: Volume of Paste and Water vs Tailings wt % Solids

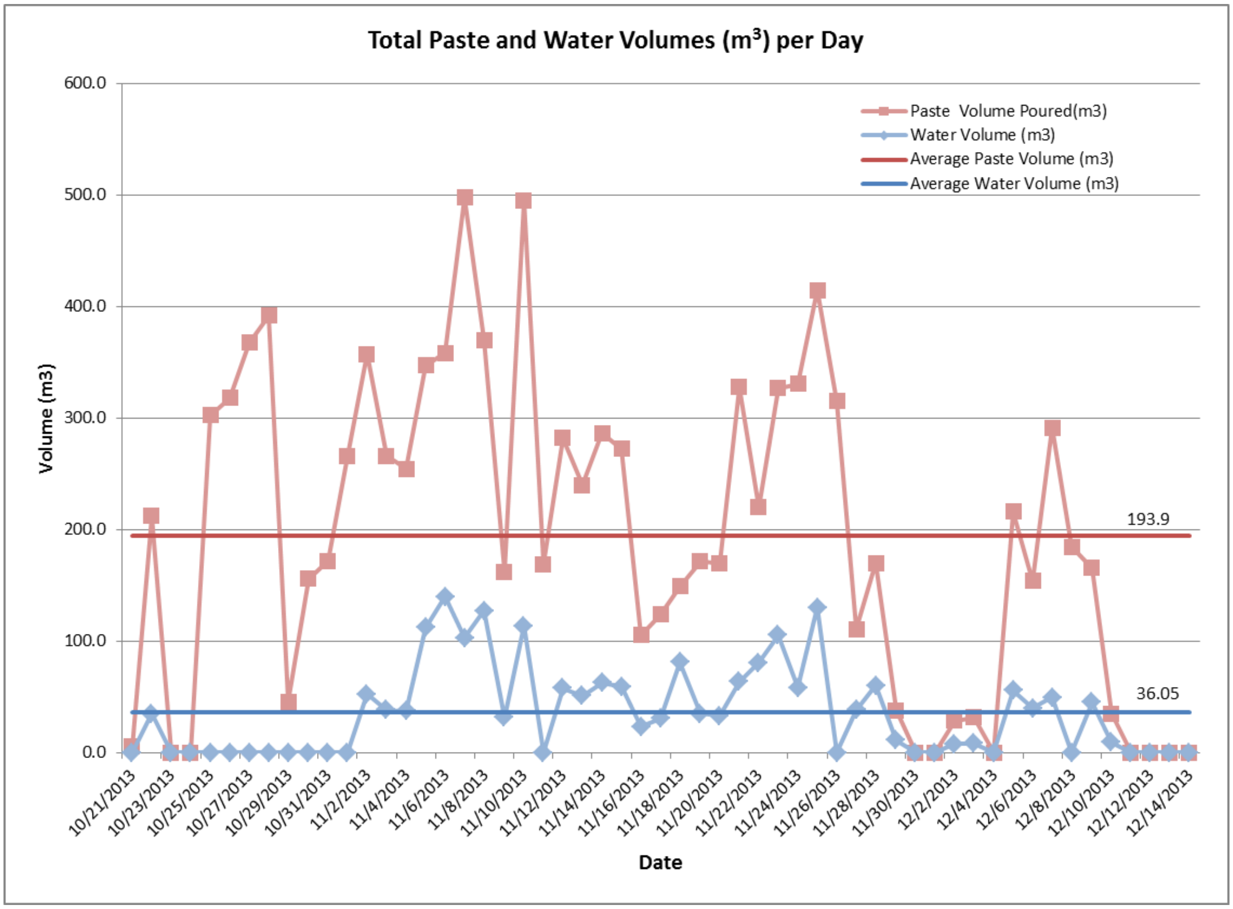


Figure 2: Total Paste and Water Volumes (m^3) per Day

APPENDIX G

Production Hours per Day and Flow Rate Profile

Appendix G – Production Hours per Day

The figures in this section summarize the production flow rates and equipment operating times.

Figure 1 details the pump hours per day as recorded off of the trucks along with the average daily pump hours. Figure 2 shows all daily pours, and includes multiple volumes per day where more than one borehole was utilized. Figure 3 shows the average flow rate per day averaging out days where multiple flow rates into multiple boreholes were recorded.

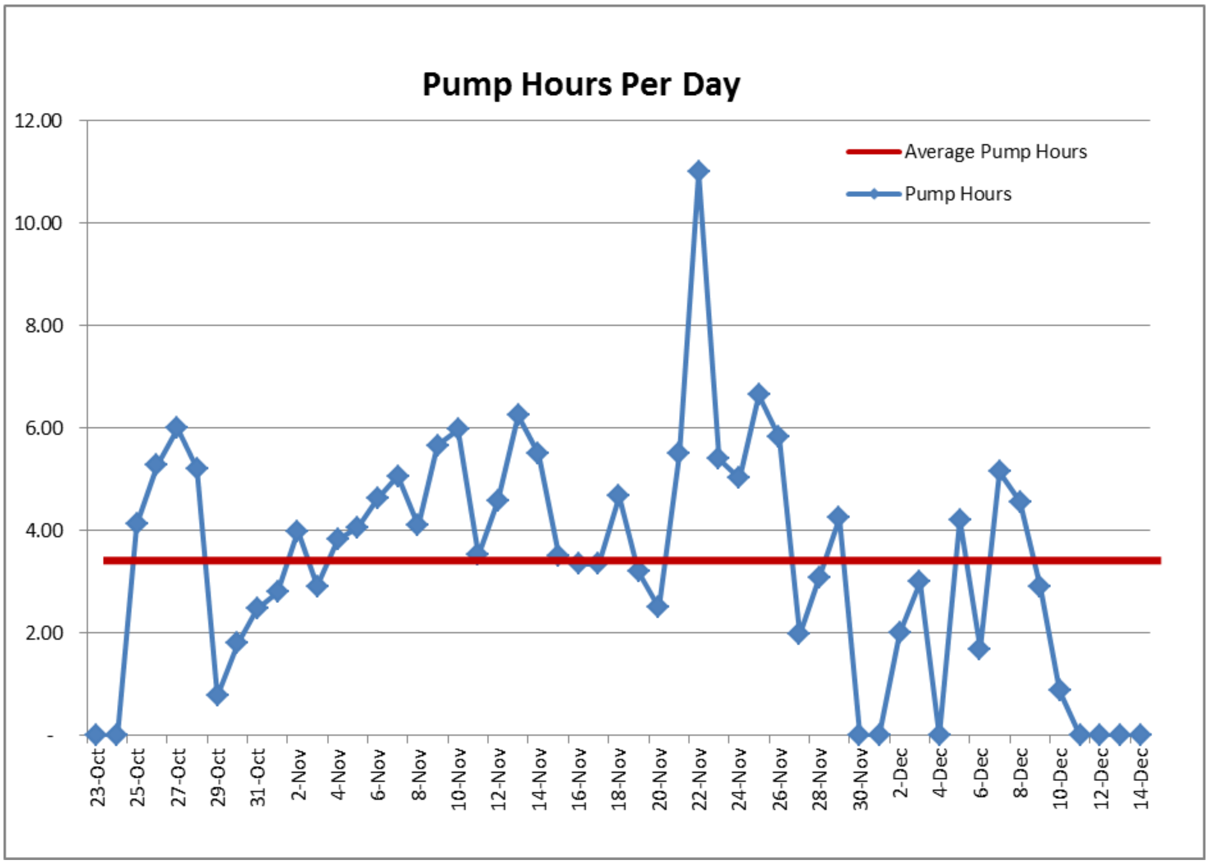


Figure 1: Pump Operating Hours per Day

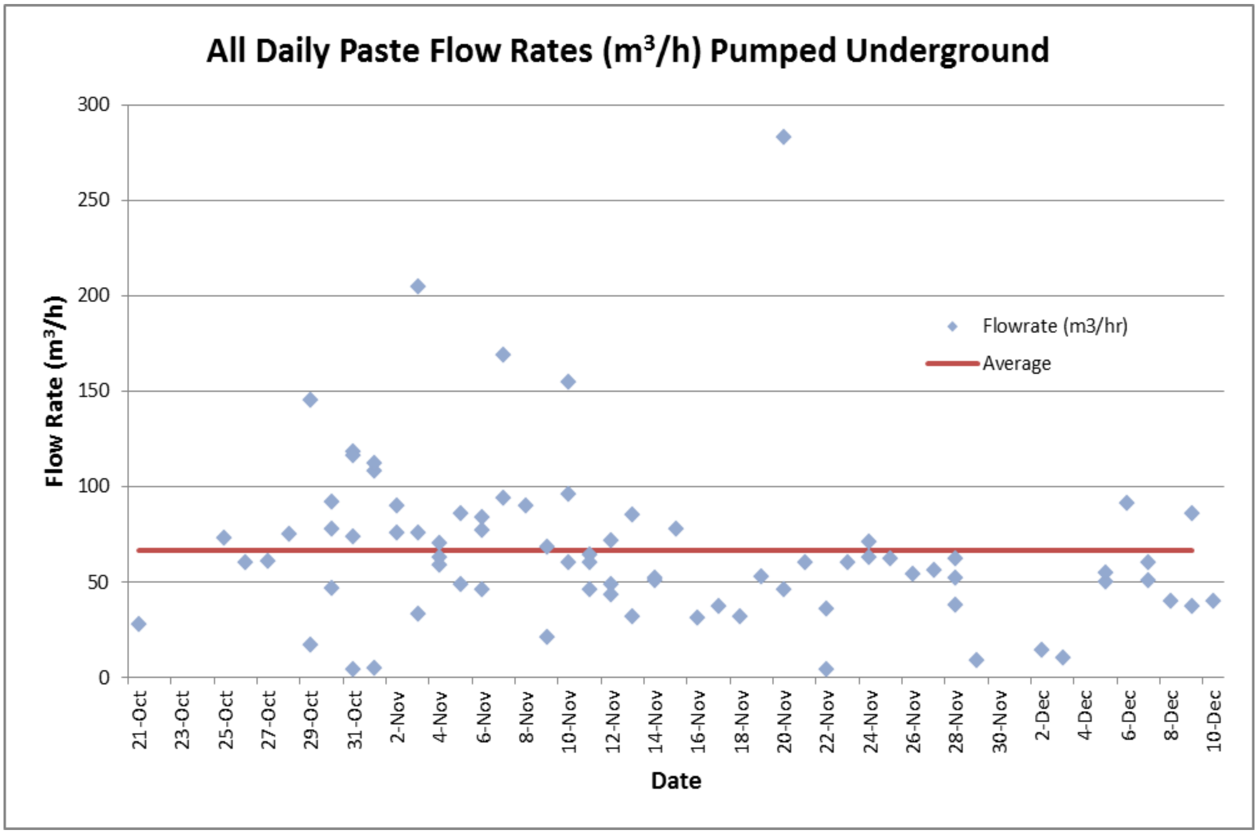


Figure 2:All Daily Paste Flow Rates (m^3/h) Pumped Underground

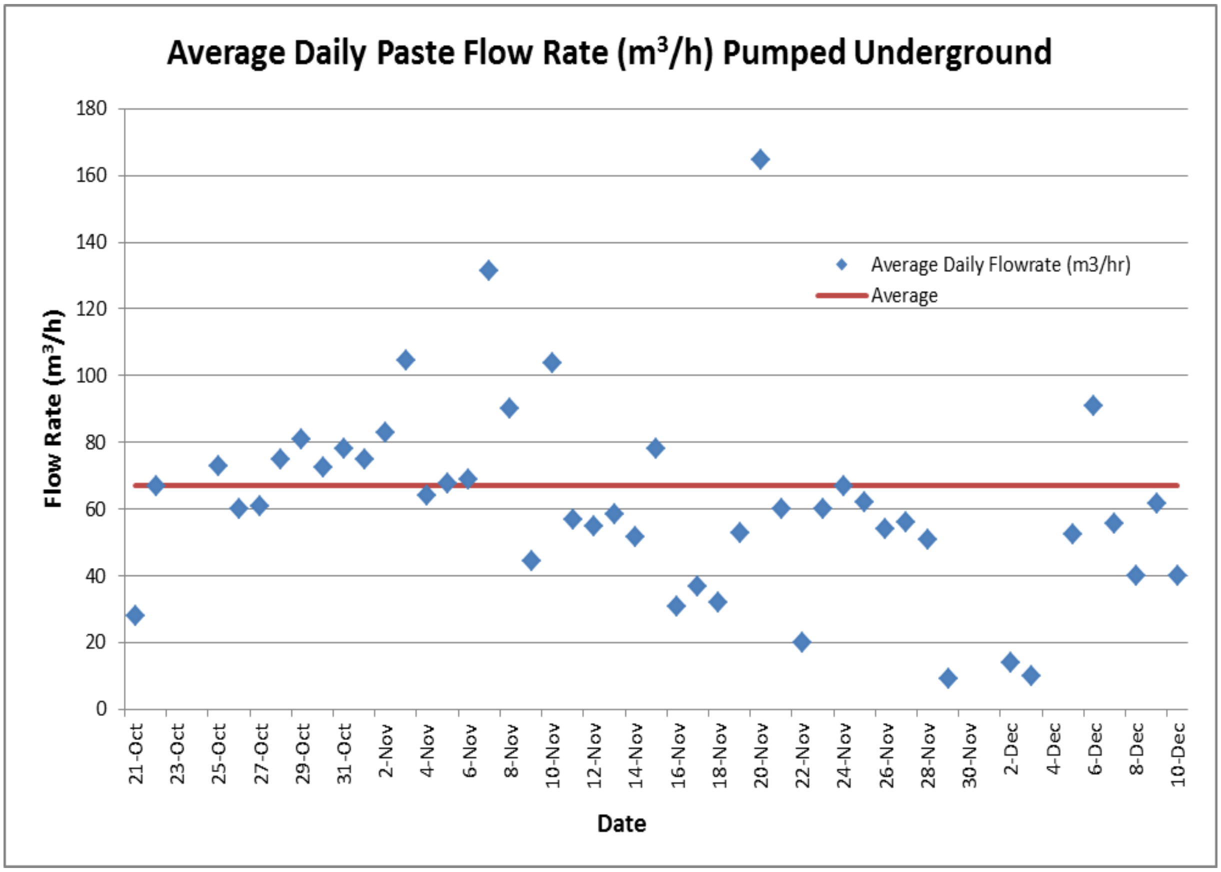


Figure 3: Average Daily Paste Flow Rate (m^3/h) Pumped Underground

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