

January 7, 2021

Project No. 18107598

Mr. Chris Marchant, Senior Manager of Solid Waste and Technical Operations

City of Barrie
Environmental Centre
272 Ferndale Drive North
Barrie, ON L4N 7M6

**CITY OF BARRIE LANDFILL PURGE WELL SYSTEM
FALL 2020 WELL PERFORMANCE TESTING**

Dear Mr. Marchant,

The City of Barrie (City) retained Golder Associates Ltd. (Golder) to provide consulting services relating to the assessment of purge well operation at the Barrie Landfill site. The City's purge well system is located along the southern limit of the Barrie Landfill and is included in Permit to Take Water (PTTW) No. 4785-AJTNQ2. The purge well system began operating in 2007 and consists of four operational wells (PW1, PW2, PW3, and PW4), which have been used to control groundwater impacted by leachate from the City landfill.

Inspection and testing of the purge wells is performed on a semi-annual basis. The testing consists of stepped rated pumping tests, during which the drawdown (s) and yield (Q) characteristics of the wells are documented. The relative performance of the wells is determined by comparing the current test results with previous testing results. Specific capacity (Q/s) is normally used to report on the performance of the well. An observed trend of declining specific capacity in a purge well typically indicates that the well has become less efficient at capturing groundwater.

The high mineral and organic content of the groundwater at the landfill causes routine clogging of the well screens and/or discharge pipes with mineral and/or bacterial deposits. Eventually, the buildup of mineral and/or bacterial deposits reduces the ability of the purge well screen to effectively pull in water, reducing its capture zone. In order to increase the performance of the purge wells, pumps, and discharge pipes are cleaned, rehabilitated and/or replaced on a regular basis.

The maintenance of the purge well/pump is typically conducted semi-annually in the spring (March to May) and fall (September to October). Testing of pump and well performance is undertaken during the spring and fall maintenance period.

This technical memorandum summarizes the results from the fall 2020 well performance testing and provides recommendations for well and pump maintenance activities. It is noted that International Water Supply Ltd. (IWS) most recently completed the pump and discharge line inspection and cleaning for PW1, PW2, PW3 and PW4 in September 2020.

Well Performance Test Results

Golder performed stepped rate pumping tests at PW1, PW2, PW3 and PW4 on October 2, 2020. The recent and historical test results for PW1, PW2, PW3, and PW4 are illustrated on Figures 1, 3, 5, and 7, respectively. Referring to the figures, the tabulated test data is included on the left side of the page, and a graph of the water level measurement at a given step versus time is also shown. The results from current and previous test are tabulated in Tables 1 and 2.

Figures 2, 4, 6, and 8 illustrate the long term pumping rates, water level trends and the long term performance of PW1, PW2, PW3, and PW4. As shown on Figure 8, there a reduction in well yield with a corresponding rise in water level following cleaning and pump maintenance activities. This reduction in well yield is caused plugging of by the pump and discharge lines with iron precipitate. IWS has completed cleaning of the pump and discharge line at this location more frequently to maintain the yield at this location.

Figure 9 illustrates the combined system yield of all four purge wells over time. The combined system yield is over 400 L/min and stable. The combined yield of Wells 3 and 4 is more than the minimum recommended rate of 150 L/min for these two wells.

Results

A summary of the fall 2020 results for each of the four purge wells is provided below:

PW1

- The test consisted of two steps at pumping rates of 43 L/min and 86 L/min; a maximum drawdown of 3.86 m was achieved. The results from the test and the drawdown versus pumping rate graph are shown in Figure 1;
- PW1 was last rehabilitated in May 2020. The current performance represents a 55% decrease in the specific capacity and a 58% decline in well yield compared to the original yield of 205 L/min. A 25% increase in performance has occurred since the last rehabilitation in May 2020 and a 51% increase in performance was observed since the performance inspection in April 2020 as a result of the rehabilitation; and
- As of October, PW1 was operating at a rate of 73 L/min.

Rehabilitation of this well is not required at this time. The pumping rate should be maintained at approximately 80 L/min to maintain the target water level 22.1 mbmp.

PW2

- The test consisted of three steps at pumping rates of 51 L/min, 104 L/min, and 160 L/min; a maximum drawdown of 3.64 m was achieved. The results from the test and the drawdown versus pumping rate graph are shown in Figure 3;
- PW2 was last rehabilitated in November 2019. The current performance represents a 41% decrease in the specific capacity and a 53% decline in well yield compared to the original yield of 341 L/min. A 10% decrease in performance has occurred since the last rehabilitation in November 2019 and a 3% increase in performance has occurred since the last performance inspection in April 2020; and
- As of October, PW2 was operating at a rate of approximately 141 L/min.

Rehabilitation of this well is not required at this time. The pumping rate should be maintained at approximately 155 L/min to maintain the target water level 24.8 mbmp.

PW3

- The test consisted of two steps at pumping rates of 30 L/min and 51 L/min; a maximum drawdown of 0.93 m was achieved. The results from the test and the drawdown versus pumping rate graph are shown in Figure 5;
- PW3 was rehabilitated in June 2019. The current performance represents a 50% decrease in the specific capacity and an 83% decline in well yield compared to the original yield of 295 L/min. A 4% decrease in performance has occurred since the last rehabilitation in June 2019 and a 2% decrease in performance since the last performance inspection in May 2020 was observed; and
- As of October, PW3 was operating at a rate of 49 L/min.

Rehabilitation of this well is not required at this time. The pumping rate should be maintained at approximately 55 L/min to maintain the target water level 26.0 mbmp.

PW4

- The test consisted of two steps at pumping rates of 88 L/min and 183 L/min; a maximum drawdown of 6.02 m was achieved. The results from the test and the drawdown versus pumping rate graph are shown in Figure 7;
- PW4 was rehabilitated in November 2018. The current performance represents a 47% decrease in the specific capacity and a 26% decline in well yield compared to the original yield of 241 L/min. A 6% decrease in performance was observed since the last rehabilitation in November 2018 and a 1% decrease since the last performance inspection in April 2020; and
- As of October, PW4 was operating at a rate of 170 L/min.

Rehabilitation of this well is not required at this time. The period of plugging has progressed such that cleaning the pump and discharge lines are required every 45 to 60 days and therefore the need for cleaning should be evaluated at least every 45 days. Pumping rates above 100 L/min should be maintained through regular cleaning.

Recommendations

The proposed maintenance schedule for the purge wells is summarized below.

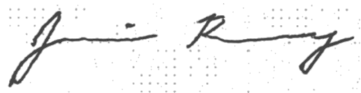
	Last Rehabilitation	Recommended Rehabilitation/Maintenance	Comments
PW1	May 2020	-	<ul style="list-style-type: none"> Rehabilitation is not recommended at this time. The pumping rate should be maintained at approximately 80 L/min to maintain the target water level of 22.1 mbmp.
PW2	November 2019	--	<ul style="list-style-type: none"> Rehabilitation is not recommended at this time. The pumping rate should be maintained at approximately 155 L/min to maintain the target water level of 24.8 mbmp.
PW3	June 2019	--	<ul style="list-style-type: none"> Rehabilitation is not recommended at this time. The pumping rate should be maintained at approximately 55 L/min to maintain the target water level of 26.0 mbmp.
PW4	November 2018	--	<ul style="list-style-type: none"> Rehabilitation is not recommended at this time. A Pumping rate of above 100 L/min should be maintained.

mbmp = metres below measuring point

January 7, 2021

We trust that this report meets your current requirements. Please contact the undersigned should you have any questions or comments.

Golder Associates Ltd.



Jamie Bonany, M.A.Sc.
Project Scientist



Paul Dewaele, M.Sc., P.Eng.
Senior Geo-Environmental Engineer, Principal

JEB/PJD/cdr

cc

Lindsay Quinn, Supervisor of Waste Disposal

Attachments:

Figure 1 - PW1 Performance Test
Figure 2 - PW1 Graph of Rate vs. Water Level
Figure 3 - PW2 Performance Test
Figure 4 - PW2 Graph of Rate vs. Water Level
Figure 5 - PW3 Performance Test
Figure 6 - PW3 Graph of Rate vs. Water Level
Figure 7 – PW4 Performance Test
Figure 8 – PW4 Graph of Rate vs. Water Level
Figure 9 – Graph of System Total
Table 1 – Fall 2020 Testing Summary
Table 2 – Fall 2020 Well Performance Change

[https://golderassociates.sharepoint.com/sites/31835g/deliverables/2020 purge well fall testing/18107598 let 2021'01'07 fall 2020 pw inspection.docx](https://golderassociates.sharepoint.com/sites/31835g/deliverables/2020%20purge%20well%20fall%20testing/18107598%20let%2021'01'07%20fall%2020%20pw%20inspection.docx)

Figures

TEST DATE: 02-Oct-2020

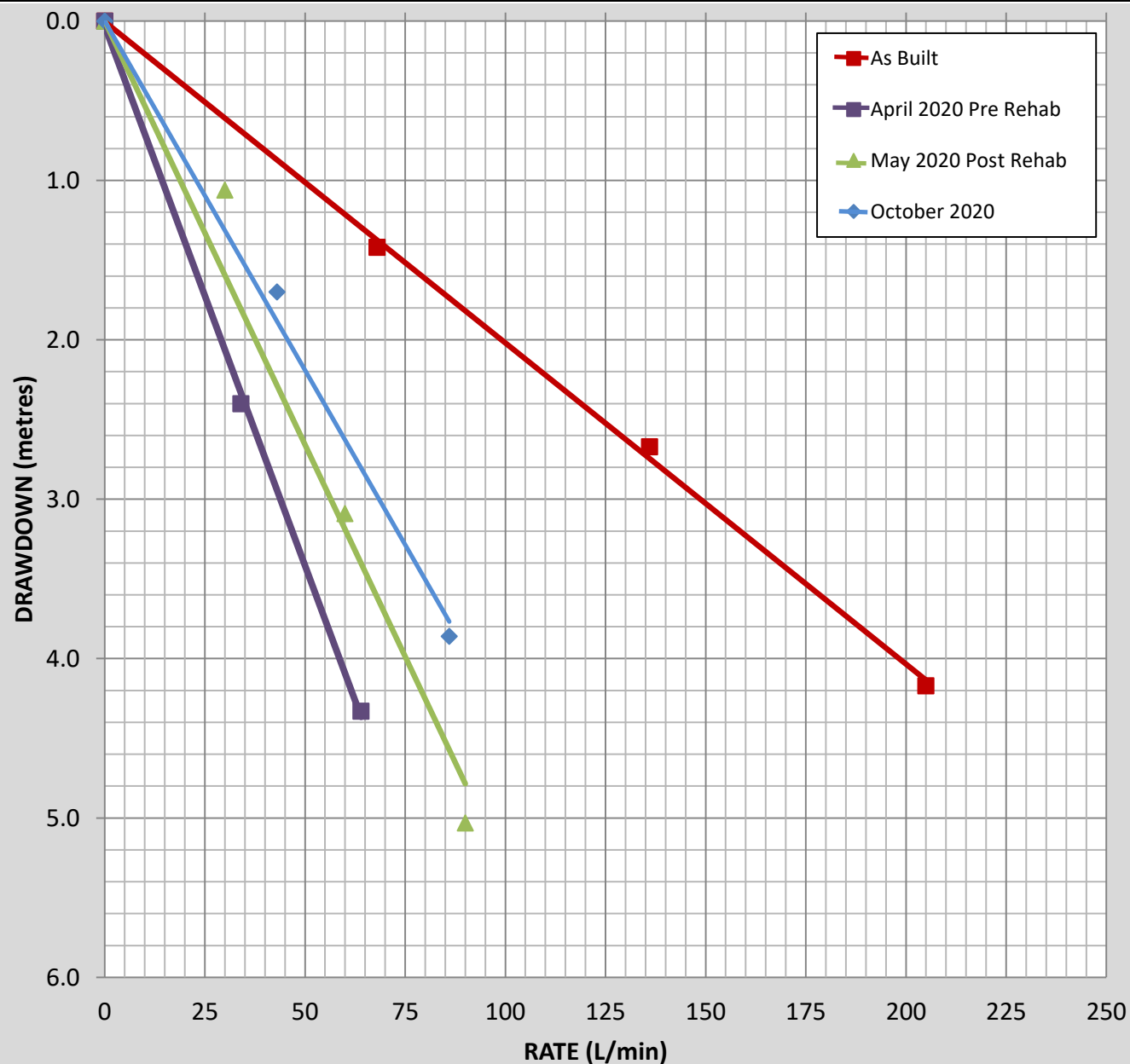
Running: 73.0 L/min
 Level: 21.67 mbmp
 Pump Off: 9:45 AM
 Static: 17.56 mbmp
 Pump On: 2:00 PM

STEP	Rate	PL	DD(m)
	0	17.56	0.00
1	43	19.26	1.70
2	86	21.42	3.86

SETTINGS

Measuring Point: 277.14 masl
 Pump Intake: 23.1 mbmp
 Top of Screen: 16.6 mbmp
 Target Level: 22.1 mbmp
 Permitted Rate: 145 L/min

Note: mbmp = metres below measuring point



PL Pumping Level end of Step
RATE Rate L/min



FILE No.
 PROJECT No. 18107598

SCALE: NTS

DATE: 6-Oct-20

CAD: JEB

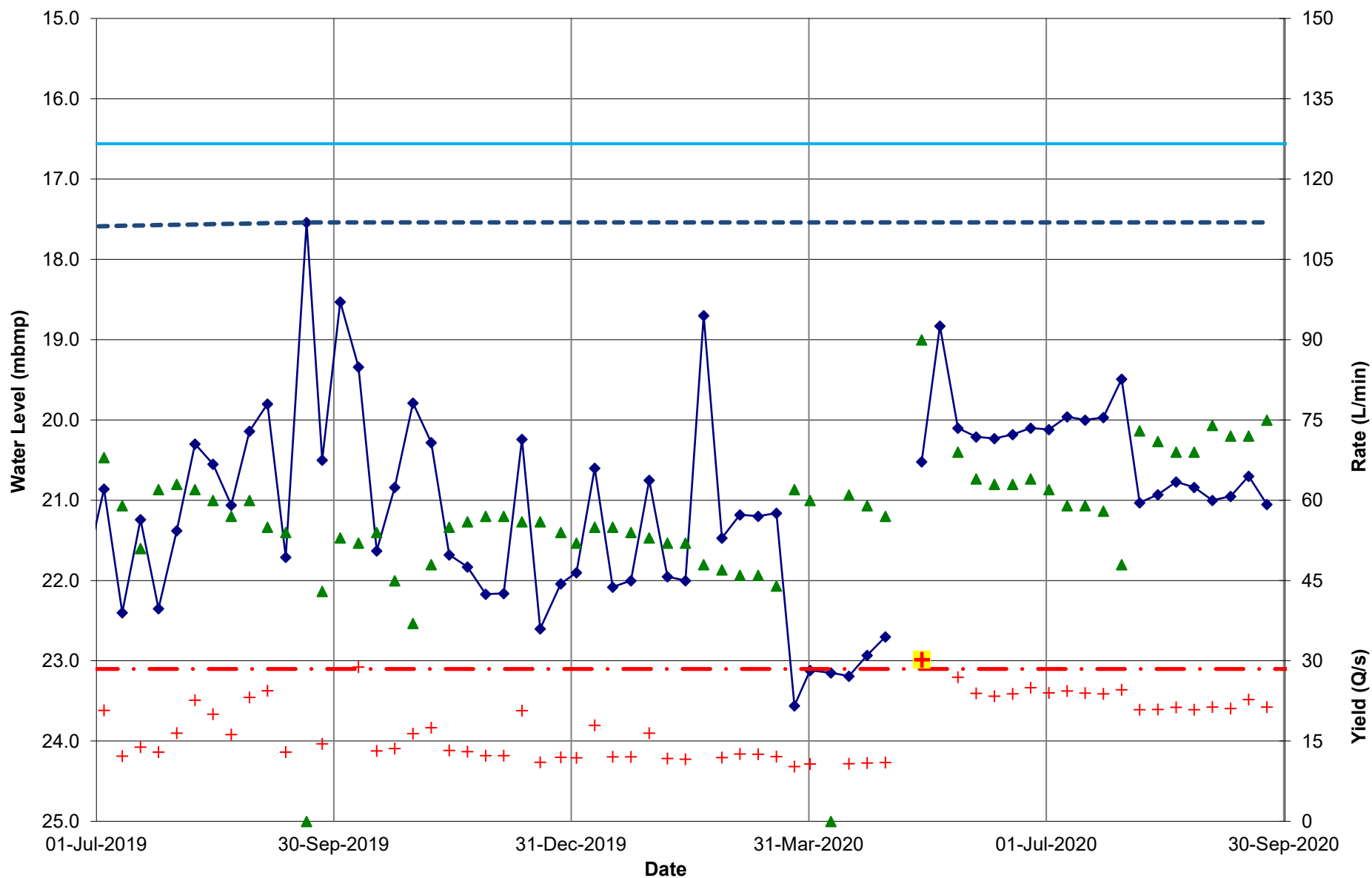
TEST: JEB

REVIEW: PJD

PURGE WELL PW1

CITY OF BARRIE LANDFILL
 PURGE WELL PERFORMANCE TEST

FIGURE No
 1



Rehabbed May 2020

- WL
- Top of Screen
- Pump Intake
- SWL
- Rate
- Qs (L/min/m)



FILE No. PWDATA
PROJECT No. 1773343

SCALE: NTS
DATE: 7-Oct-20
CAD: JPR
CHECK:
REVIEW:

PW 1 GRAPH OF RATE vs WATERLEVEL

CITY OF BARRIE LANDFILL

FIGURE No.
2

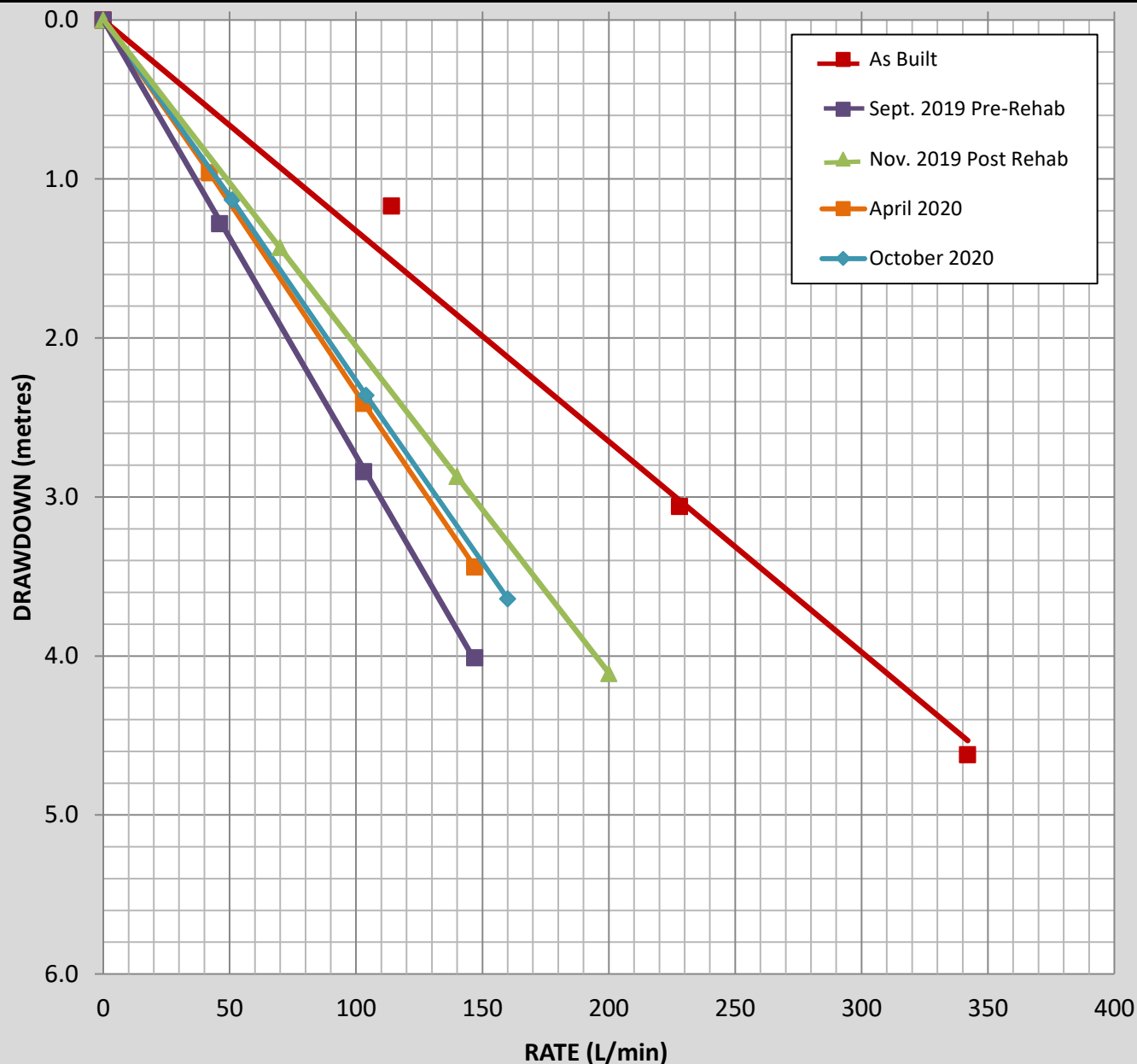
TEST DATE: 02-Oct-2020

Running: 141.0 L/min
 Level: 24.26 mbmp
 Pump Off: 9:40 AM
 Static: 20.65 mbmp
 Pump On: 10:35 AM

STEP	Rate	PL	DD(m)
	0	20.65	0.00
1	51	21.78	1.13
2	104	23.01	2.36
3	160	24.29	3.64

SETTINGS

Measuring Point: 279.39 masl
 Pump Intake: 25.8 mbmp
 Top of Screen: 23.8 mbmp
 Target Level: 24.8 mbmp
 Permitted Rate: 318 L/min



Note: mbmp = metres below measuring point

PL Pumping Level end of Step
RATE Rate L/min



FILE No.
 PROJECT No. 18107598

SCALE: NTS

DATE: 6-Oct-20

CAD: JEB

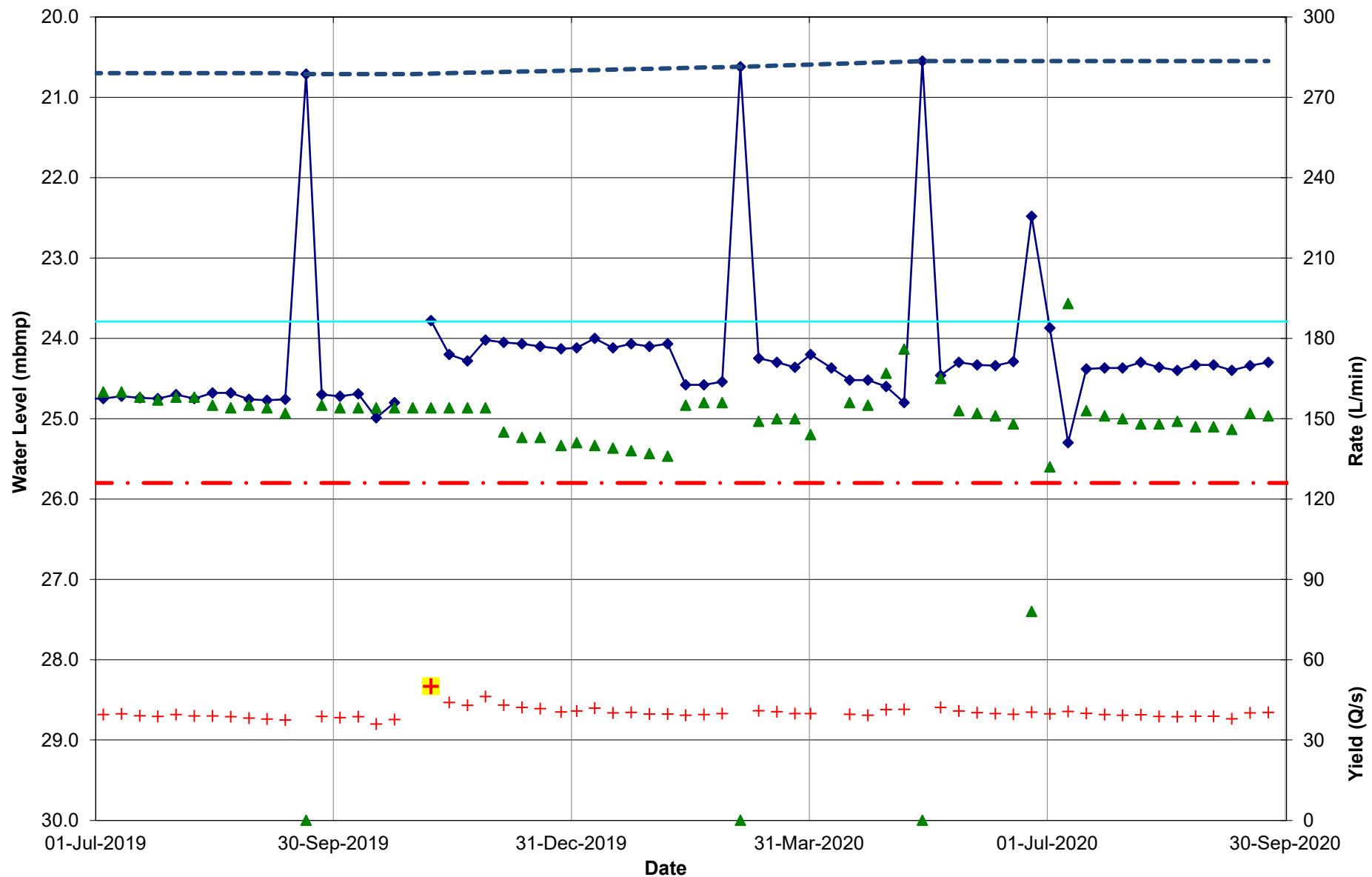
TEST: JEB

REVIEW: PJD

PURGE WELL PW2

CITY OF BARRIE LANDFILL
 PURGE WELL PERFORMANCE TEST

FIGURE No.
3



✚ Rehabbed October 2019

- ◆ WL
- ✚ Top of Screen
- ✚ Pump Intake
- SWL
- ▲ Rate
- + Qs (L/min/m)



GOLDER

SCALE: NTS

DATE: 7-Oct-20

CAD: JPR

CHECK:

REVIEW:

FILE No. PWDATA

PROJECT No. 1773343

PW 2 GRAPH OF RATE vs WATERLEVEL

CITY OF BARRIE LANDFILL

FIGURE No.

4

TEST DATE: 02-Oct-2020

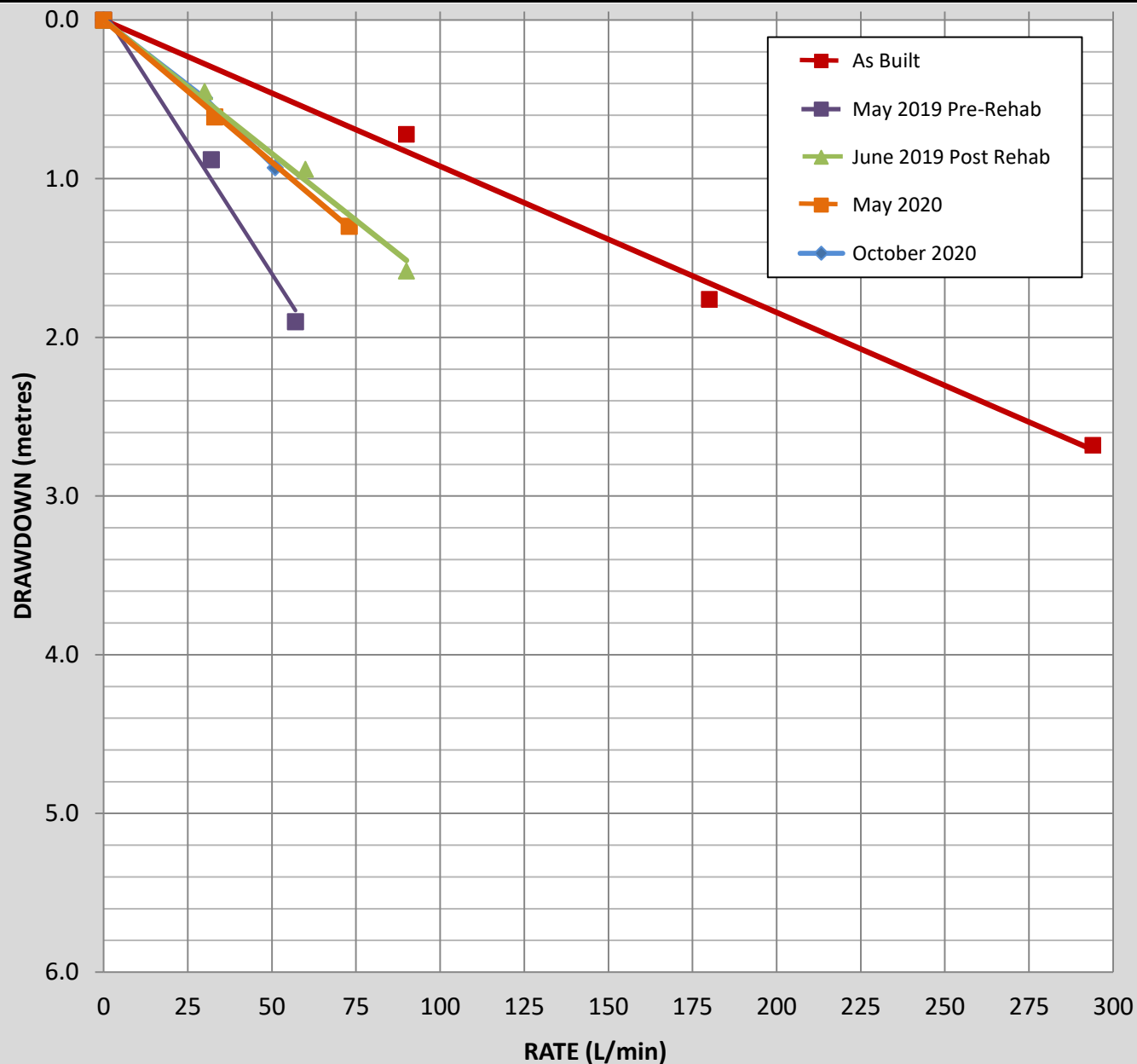
Running: 51.0 L/min
 Level: 24.71 mbmp
 Pump Off: 9:35 AM
 Static: 23.64 mbmp
 Pump On: 1:55 PM

STEP	Rate	PL	DD(m)
	0	23.64	0
1	30	24.13	0.49
2	51	24.57	0.93

SETTINGS

Measuring Point: 281.98 masl
 Pump Intake: 27.0 mbmp
 Top of Screen: 24.3 mbmp
 Target Level: 26.0 mbmp
 Permitted Rate: 250 L/min

Note: mbmp = metres below measuring point



PL Pumping Level end of Step
RATE Rate L/min



GOLDER

SCALE: NTS

DATE: 6-Oct-20

CAD: JEB

PURGE WELL PW3

FILE No.

PROJECT No. 18107598

TEST: JEB

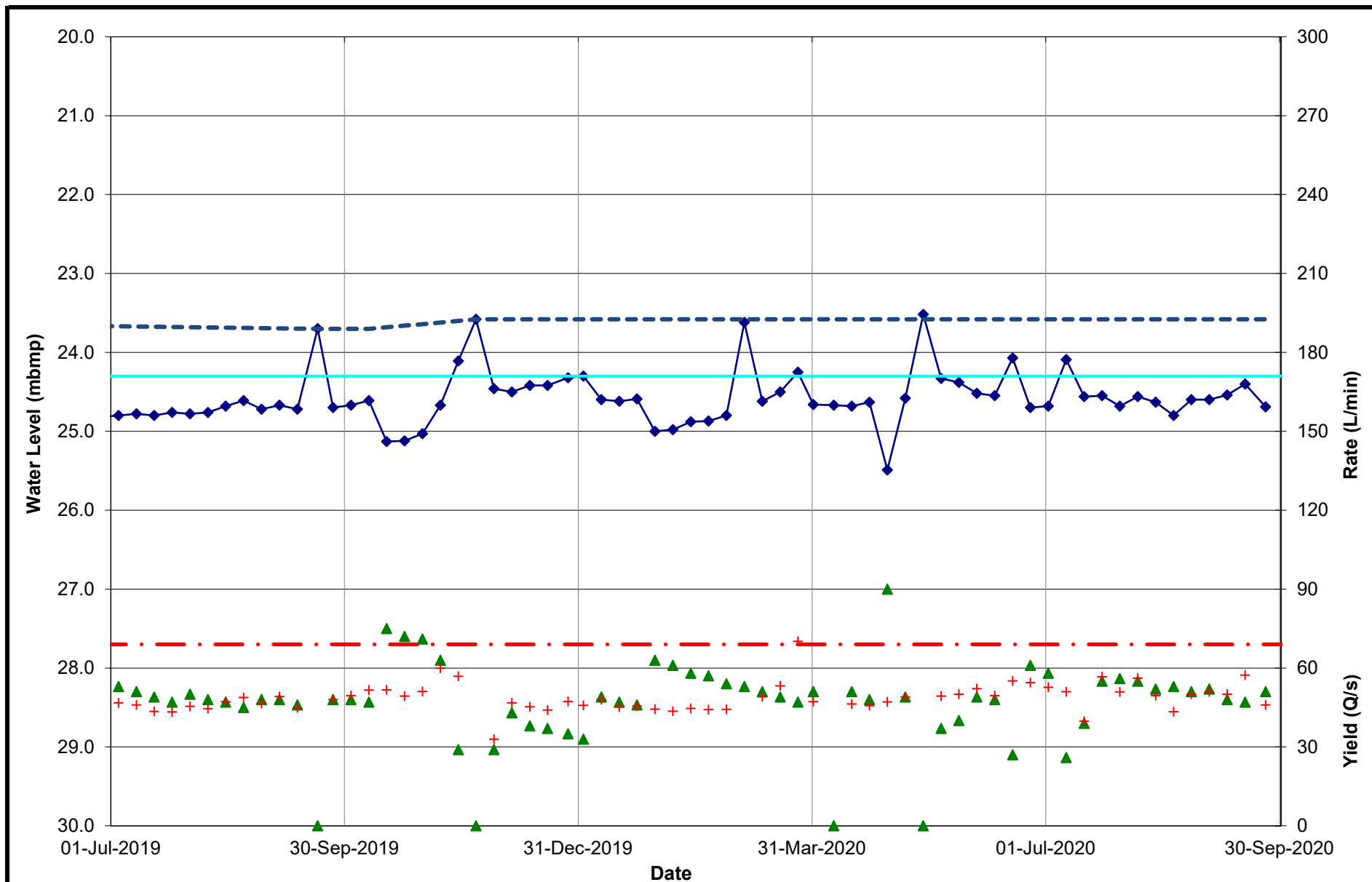
REVIEW: PJD

CITY OF BARRIE LANDFILL

PURGE WELL PERFORMANCE TEST

FIGURE No

5



Note: Pumping Rates are variably report based on Display and / or Datalogger; Rehabs June 2018 & June 2019

<ul style="list-style-type: none"> WL Top of Screen Top of Pump SWL Rate Q/s (L/min/m) 		SCALE:	NTS	PW 3 GRAPH OF RATE vs WATERLEVEL	
		DATE:	7-Oct-20		
		CAD:	JPR		
		CHECK:		CITY OF BARRIE LANDFILL	FIGURE No.
FILE No. PWDATA		REVIEW:			
PROJECT No. 1773343					6

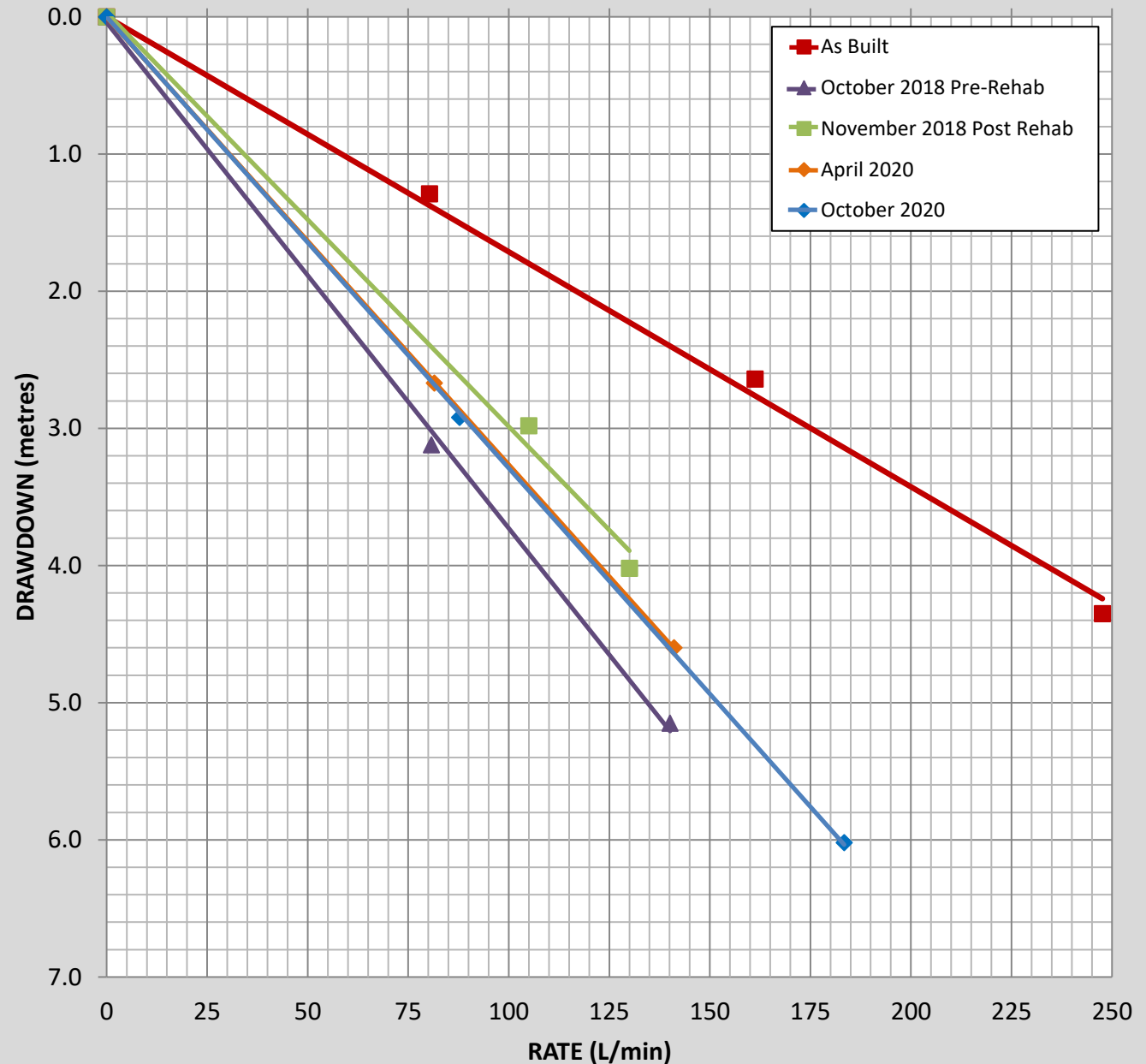
TEST DATE: 02-Oct-2020

Running: 169.9 L/min
 Level: 33.37 mbmp
 Pump Off: 9:30 AM
 Static: 28.06 mbmp
 Pump On: 10:30 AM

STEP	Rate	PL	DD(m)
	0	28.06	0.00
1	88	30.98	2.92
2	183	34.08	6.02

SETTINGS

Measuring Point: 285.88 masl
 Pump Intake: 37 mbmp
 Top of Screen: 27.5 mbmp
 Target Level: 35 mbmp
 Permitted Rate: 240 L/min



Note: mbmp = metres below measuring point

PL Pumping Level end of Step
RATE Rate L/min



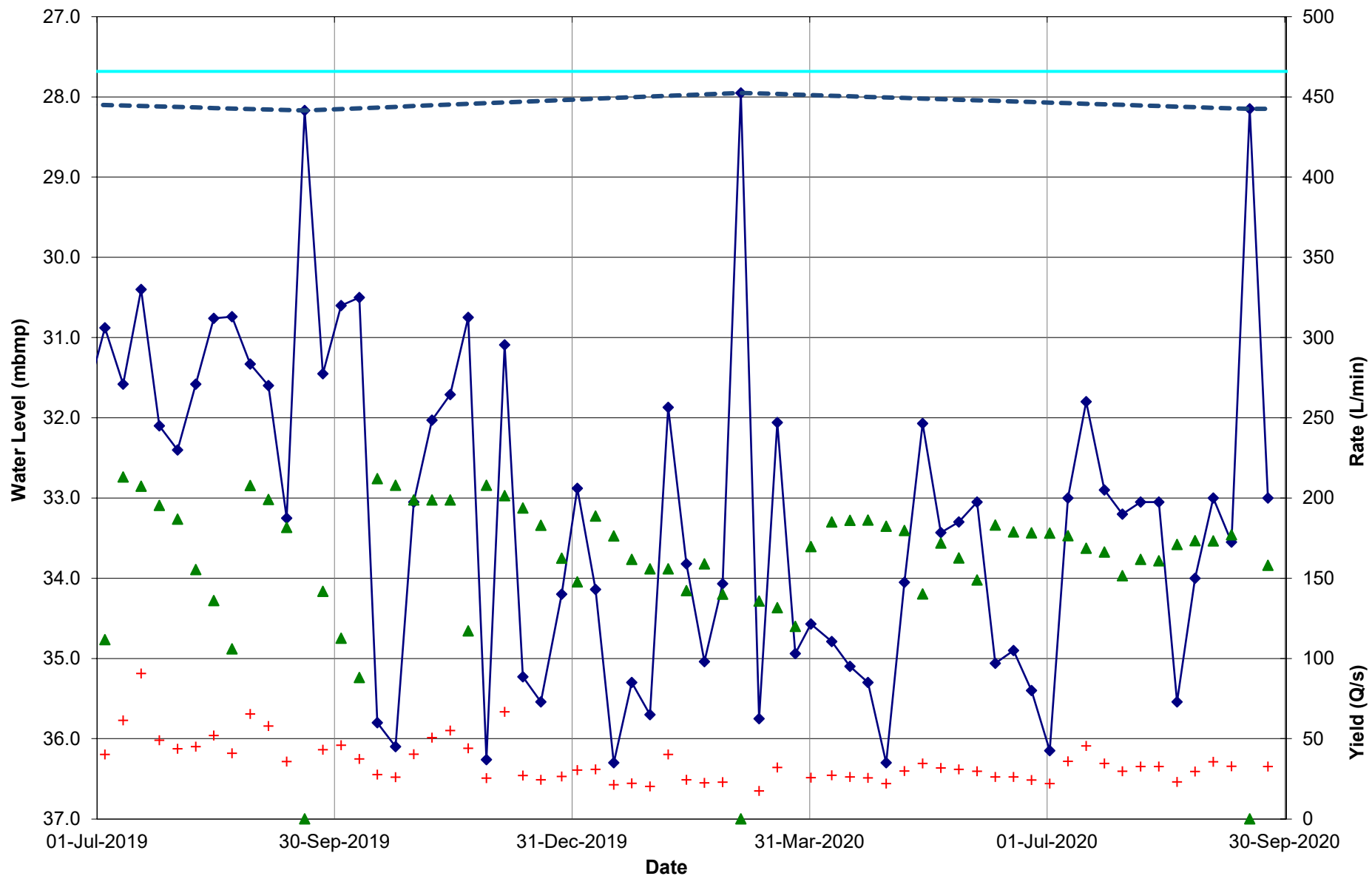
FILE No.
 PROJECT No. **18107598**

SCALE: **NTS**
 DATE: 6-Oct-20
 CAD: JEB
 TEST: JEB
 REVIEW: PJD

PURGE WELL PW4

CITY OF BARRIE LANDFILL
 PURGE WELL PERFORMANCE TEST

FIGURE No
7



- ◆ WL
- Top of Screen
- Top of Pump
- SWL
- ▲ Rate
- + Q/s (L/min/m)



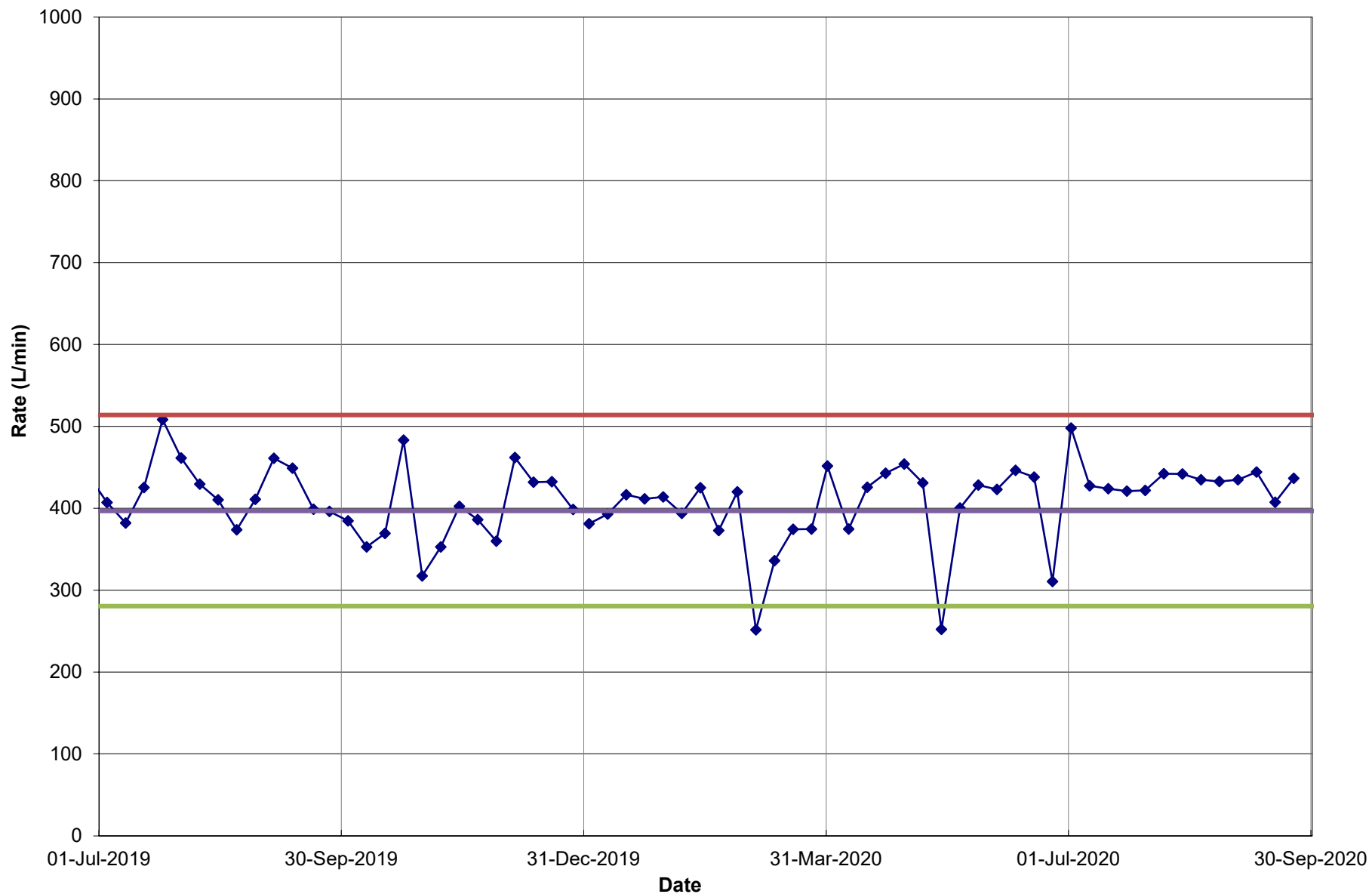
FILE No. PWDATA
PROJECT No. 1773343

SCALE: NTS
DATE: 7-Oct-20
CAD: JPR
CHECK:
REVIEW:

PW 4
GRAPH OF RATE vs WATERLEVEL

CITY OF BARRIE LANDFILL

FIGURE No.
8



- ◆— System Total Rate
- Annual Maximum
- ▲— Annual Minimum
- ×— Annual Average



FILE No. **PWDATA**
PROJECT No. **1773343**

SCALE: **NTS**
DATE: 7-Oct-20
CAD: J REGIER
CHECK:
REVIEW:

GRAPH OF SYSTEM TOTAL

CITY OF BARRIE LANDFILL

FIGURE No.
9

Tables

**TABLE 1: FALL 2020 TESTING SUMMARY
CITY OF BARRIE LANDFILL PURGE WELLS**

Well	As Constructed			Post-Rehabilitation				Last Inspection				Current Testing			
	RATE L/min	m DD	Q/s	Date	RATE L/min	m DD	Q/s	Date	RATE L/min	m DD	Q/s	Date	RATE L/min	m DD	Q/s
PW1	205	4.17	49.2	May/20	90	5.03	17.9	Apr/20	64	4.33	14.8	Oct/20	86	3.86	22.3
PW2	342	4.62	74.0	Nov/19	200	4.11	48.7	Apr/20	147	3.44	42.7	Oct/20	160	3.64	44.0
PW3	294	2.68	109.7	Jun/19	90	1.58	57.0	May/20	73	1.30	56.2	Oct/20	51	0.93	54.8
PW4	248	4.35	57.0	Nov/18	130	4.02	32.3	Apr/20	141	4.60	30.7	Oct/20	183	6.02	30.4

**TABLE 2: FALL 2020 WELL PERFORMANCE CHANGE
CITY OF BARRIE LANDFILL PURGE WELLS**

Well	Δ Q/s (%)	Δ Q/s (%)	Δ Q/s (%)
	Original ¹	Post Rehab ²	Last Inspection ³
PW1	-55	25	51
PW2	-41	-10	3
PW3	-50	-4	-2
PW4	-47	-6	-1

¹ Δ Q/s based current performance compared to as constructed original performance

² Δ Q/s based current performance compared to post rehabilitation performance

³ Δ Q/s based current performance compared to previous inspection performance