Terran Corporation

Environmental Services

TECHNICAL MEMORANDUM

SUBJECT: Well MJ-PW2 Evaluation, Middletown-Junction Property, Warren County, Ohio

PREPARED BY: Brent E. Huntsman, CPG & Kelly C. Smith, CPG
Terran Corporation, Beavercreek, Ohio.

DATE: **May 19, 2025**

SUMMARY

Terran Corporation, on behalf of Warren County Water & Sewer Dept. (WCW&SD), submits the following technical memorandum to document the installation and testing of production well MJ-PW2 for final approval by the Ohio Environmental Protection Agency, Southwest District Office (Ohio EPA, SWDO) for use as a Public Water System, Community Water Supply (PWS CWS) well.

WCW&SD submits for consideration the following details concerning MJ-PW2:

1) MJ-PW2 is a 16-inch diameter, 71-feet deep production well located on the northeast side of the Middletown-Junction property, situated next to the Little Miami River (Figure 1).
2) The ODNR well log (#785540) is provided in Attachment #1.
3) The well's coordinates are: latitude: 39.3647528; longitude: -84.2403063.
4) The stainless steel, wire-wrapped screen consists of 20-feet of 110 slot openings set from 51 to 71 feet below ground surface (ft. bgs) at the bottom of the aquifer (an unconsolidated sand and gravel deposit approximately 90 feet thick). A quartz sand filter pack was constructed around the screen from 45 feet to 71 feet. A cement grout seal was placed from 30 ft. bgs to 5 ft. bgs (Figure 3).
5) MJ-PW2 was able to sustain a pumping rate of 1,660 gallons per minute (gpm) during the 24-hour constant rate test (CRT). WCW&SD is requesting an Ohio EPA-approved permanent pump design rating of 1,000 gpm for MJ-PW2.
6) The 2025 CRT results indicated the near-well aquifer transmissivity at MJ-PW2 ranges 23,380 to 63,360 feet squared per day ($ft.^2/day$) and averages about 35,100 $ft.^2/day$. The hydraulic conductivity ranges 410 to 892 feet/day (ft./day) and averages about 590 ft./day. Aquifer storativity ranges $3.04x10^{-7}$ to $5.5x10^{-2}$ and averaged $1.14x10^{-3}$. These values are consistent with expected values for a semi-confined aquifer and corroborate results from historical aquifer tests at the Middletown-Junction property.

The well's groundwater quality parameters meet Federal Maximum Contaminant Levels (MCLs) and Secondary MCLs (SMCLs) with the exception for the per- and polyfluoroalkyl substances (PFAS) constituent perfluorooctane sulfonate (PFOS) at 0.0164 µg/L (16.4 ng/L) (associated with the surface water quality of the Little Miami River) (Tables 4 and 5).

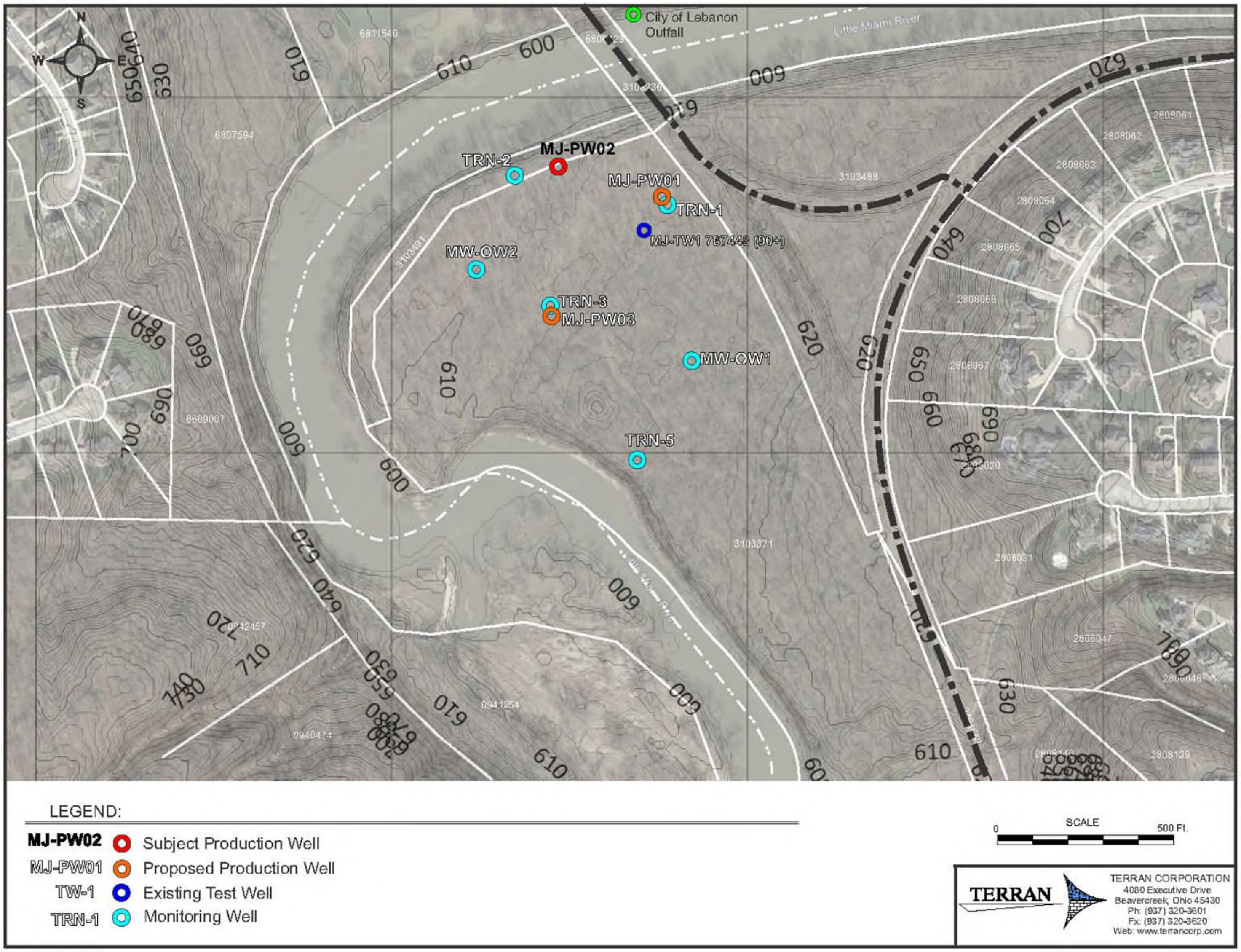


Figure 1. Location of production well MJ-PW2 and monitoring wells at the Middletown-Junction property.

Well Drilling and Construction Description

Drilling of MJ-PW2 was completed during 1994 by Reynolds, Inc. on behalf of Warren County for purposes of serving as a test production well named TW-2. TW-2 was drilled to expand the site investigation underway at that time using test well TW-1. TW-1 is an 8-inch diameter steel-cased well drilled by Moody's of Dayton during January 1994 (ODNR log #767448). TW-2 was constructed with a 24-inch outer casing using a bucket augur rig. The 24-inch casing was driven down and bailed to the bottom of the aquifer, a course sand and gravel outwash deposit encountering a gray clay deposit at 71 ft. bgs (Figure 3).

Figure 2. Test Well TW-2 as found at the Middletown-Junction property during an October 2022 reconnaissance survey and inventory of wells.

According to the ODNR well log (#785540), test well TW-2 (renamed MJ-PW2) was constructed with a 0.110-inch slot, 20-foot length of screen set from 51 to 71 ft. bgs. An unspecified quarry sand filter pack was placed around the screen and well casing from 35 to 70 ft. bgs. The remainder of the casing annular space was grouted shut using concrete grout to seal the annular space from 30 ft. bgs to 5 ft. bgs (Figure 3).

All of the well's final construction features, such as the pitless adaptor, submersible pump and supporting appurtenances will be installed according to WCW&SD plans at a later date when the well field is constructed under a separate contract and contractor. The proposed pump for MJ-

PW2 is an American-Marsh submersible pump capable of pumping 600 to 1,400 gpm under a total dynamic head pressure of 284 feet. A copy of the proposed pump performance data sheets are provided in Attachment #2 of this memorandum.

Well Development

MJ-PW2 was re-developed in accordance with OAC 3745-9-09 to clean the well in preparation for use as a PWS production well. Re-development was conducted by repeated surging of the well screen while air-lift pumping the water at a rate of approximately 100 gpm to remove the formation fines. Development was conducted during March-April 2025 and effectively removed the silt and sand from around the screen. This was confirmed using a using a Rossum Sand Tester throughout the development process. After completion of development, subsequent measurements of sand accumulation in the tester from well discharge during the SDT and CRT were hardly visible.

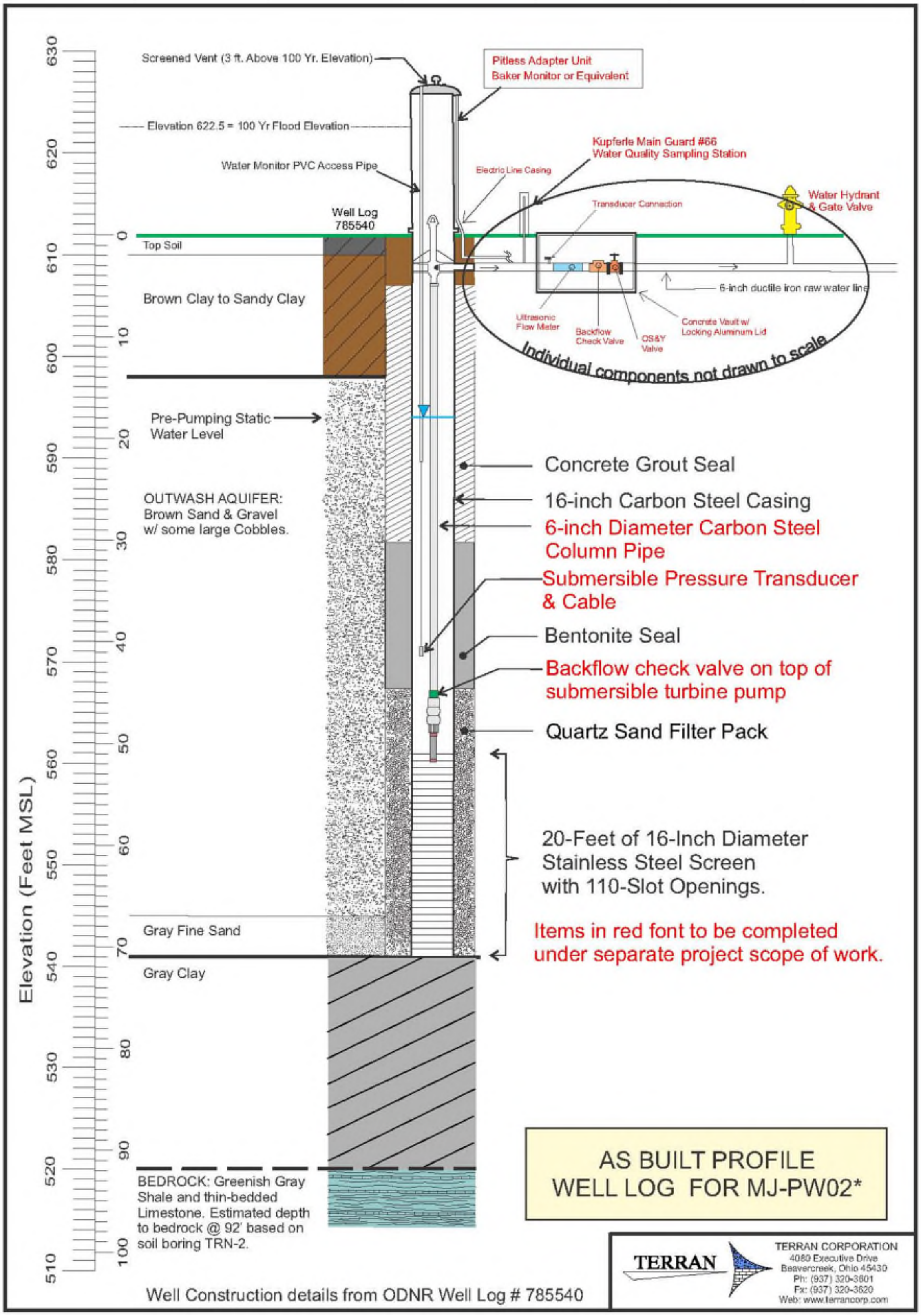


Figure 3. As built diagram for production well MJ-PW2.

Hydrogeologic Setting

The hydrogeologic setting of the subject area was characterized through the drilling of soil borings TRN-1 to TRN-7 with the installation of monitoring wells TRN-1, TRN-2, TRN-3 and TRN-5 (Terran Corp., 2022b). The site hydrogeology consists of stratified glacial outwash comprising a single buried valley aquifer (BVA) contained within a deeply incised bedrock valley (Figure 4). The BVA is primarily an unconfined aquifer and TW-2 (renamed MJ-PW2) is screened at the bottom of this aquifer at its location.

Depth to groundwater is shallow, ranging from approximately 16 to 24 ft. bgs as measured in the monitoring and test wells (Table 1). Water levels for monitoring wells TRN-1, TRN-2 and TRN-3 located throughout the site (Figure 1) reflect the hydrodynamic activity at the Middletown-Junction property. Water levels in the three wells during March and April 2023 fluctuated on the order of 3 to 4 feet in response to high water events along the Little Miami River as measured at the U.S. Geological Survey (USGS) station 03242050 at South Lebanon (Figure 5).

Groundwater modeling of the Middletown-Junction property was conducted to evaluate the production potential of the proposed well field (Terran Corp., 2022a and 2023). The modeling results indicated a well field capable of producing 2.5 million gallons per day (MGD) is possible through three production wells, pumping between 550 to 600 gpm each. Based on the aquifer testing of the test and proposed production wells at the property, the model was revised and determined that the aquifer has potential for 3.0 MGD production using two production wells. MJ-PW2 will be considered a backup well to the two primary production wells MJ-PW1 and MJ-PW3.

During the process for site approval of the Middletown-Junction property, the Ohio EPA expressed concern regarding the City of Lebanon’s WWTP outfall occurring in proximity to the proposed well field. To address the concern, Terran conducted fate and transport (F&T) modeling of the outfall using chloride as the constituent of concern to evaluate potential long-term impact to the well field under 3.0 MGD operation using wells MJ-PW1 and MJ-PW3 (Terran Corp., 2024a) and the existing test well TW-2 (Terran Corp., 2024b). Results of the F&T modeling indicated the location of the outfall with respect to the well field and the surface flow of the Little Miami River and the silty nature of the Little Miami River’s bed will sufficiently protect the water quality of the Middletown-Junction well field.

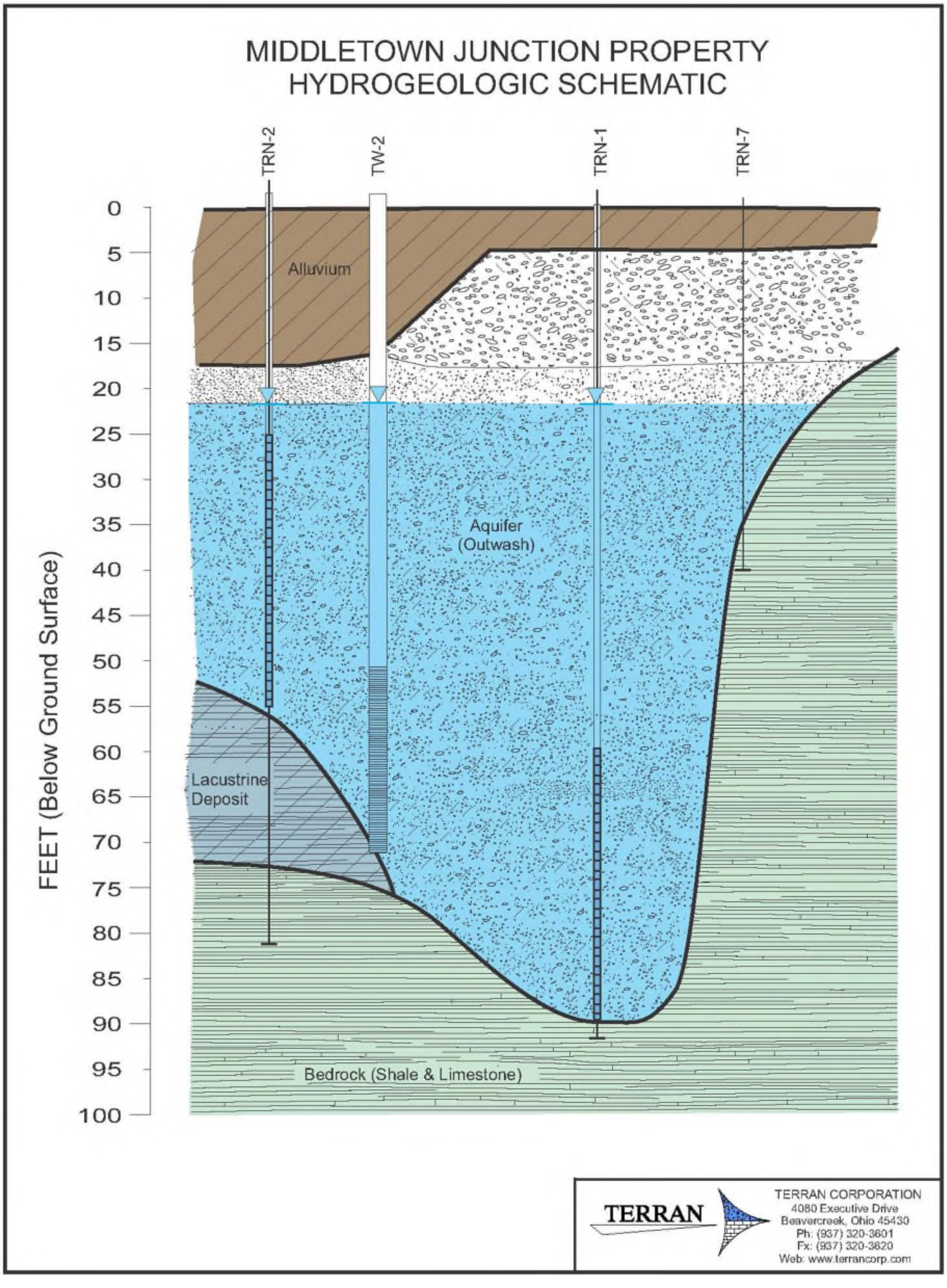


Figure 4. Conceptual hydrogeologic profile of buried valley aquifer at TW-2 (renamed MJ-PW2) across the Middletown-Junction property.

Table 1. Summary of Groundwater Level Measurements at the Middletown-Junction Property.

Date	TRN-1	TRN-2	TRN-3	TRN-5	OW-1	OW-2	TW-1	TW-2*
	Depth to Groundwater (Feet below top-of-casing)							
11/14/2022	22.70	22.40	20.02	24.85	---	---	---	---
12/29/2022	22.91	22.65	20.22	---	25.45	---	22.36	19.25
1/4/2023	21.55	21.27	18.83	23.53	24.09	18.82	20.98	17.88
1/10/2023	21.63	21.39	18.99	23.81	24.20	18.97	21.13	18.09
1/11/2023	21.75	21.49	19.09	23.91	24.30	19.10	21.21	18.16
1/18/2023	21.28	21.01	18.59	23.42	23.79	18.60	20.76	17.64
1/27/2023	20.47	20.18	17.73	22.49	22.96	17.75	19.95	16.83
2/2/2023	20.59	20.33	17.93	22.78	23.15	17.94	20.09	16.98
3/1/2023	21.46	21.17	18.74	23.54	23.97	18.79	20.57	17.76
4/11/2023	19.04	18.82	16.48	21.60	21.67	16.44	18.23	15.41
4/12/2023	20.07	19.78	17.41	22.33	22.60	17.36	19.68	16.39
5/2/2023	21.30	21.04	18.61	23.31	23.84	18.61	20.48	17.67
5/18/2023	21.30	21.03	18.66	---	23.84	18.75	20.48	17.65
5/24/2023	21.87	21.62	19.19	24.06	24.44	19.25	21.34	17.94
6/1/2023	22.52	22.28	19.87	24.68	25.09	19.87	22.00	22.28
12/11/2024	22.40	22.43	20.00	24.80	25.22	-----	21.84	20.01
12/17/2024	22.58	22.03	19.59	24.22	24.81	19.58	21.44	18.61
2/25/2025	19.71	19.63	16.95	-----	-----	17.21	18.70	16.12
3/7/2025	20.99	20.75	18.34	23.20	23.55	18.32	20.15	17.40
3/14/2025	22.41	22.12	19.70	24.40	24.91	19.72	21.57	18.76
3/18/2025	19.43	19.20	17.12	21.47	21.67	16.77	19.43	15.84

* TW-2 is renamed MJ-PW2.

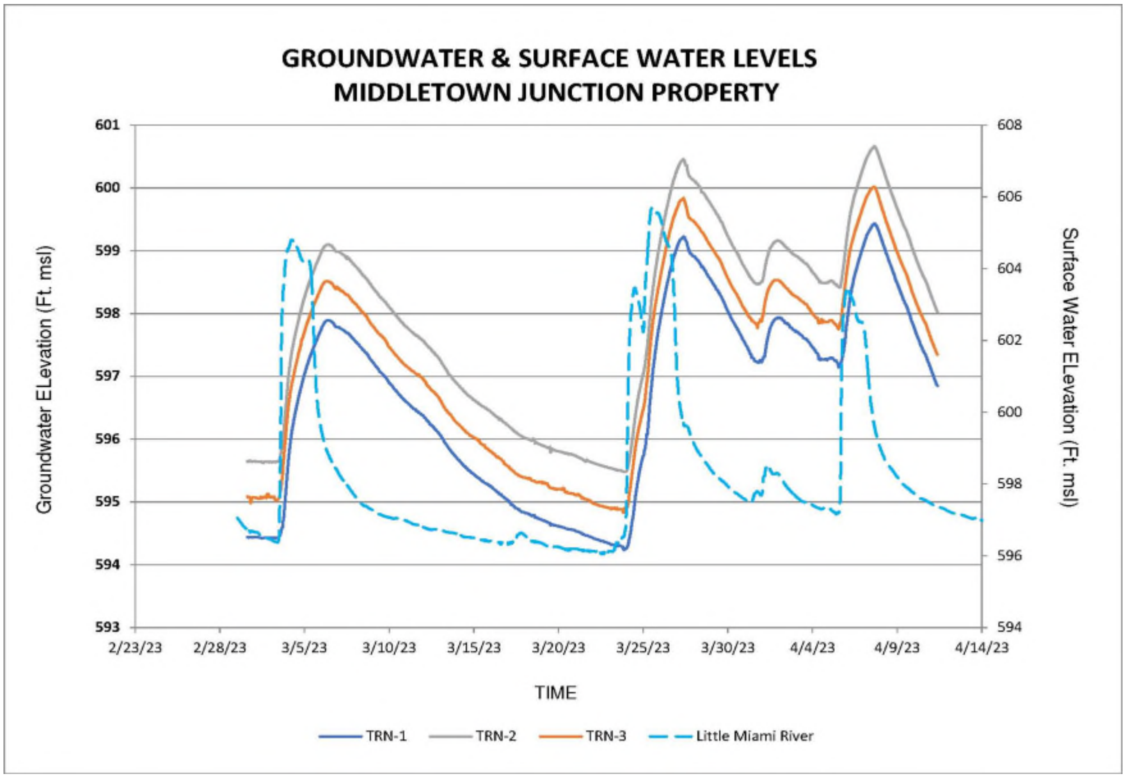


Figure 5. Groundwater level trends in monitoring wells TRN-1 to TRN-3 and Little Miami River stage elevations, March 1-April 11, 2023.

Well Testing

As required by OAC 3745-9-09(B), the aquifer and well performance at the MJ-PW3 wellsite were characterized through the conduct of a Step-Drawdown Test (SDT), a 24-hour Constant Rate Test (CRT) and a nominal 12-hour Recovery Test (RT). These tests were successfully completed from April 1-3, 2025. Test data was used for aquifer characterization to determine the sustainable yield and potential drawdown of the well at its rated design capacity. In addition to estimates of sustainable yield and drawdown, the tests were also evaluated to determine representative values of key aquifer coefficients; transmissivity, hydraulic conductivity, storativity and diffusivity. These newly acquired well and aquifer parameters are used to update the Middletown-Junction property conceptual, analytical and numerical groundwater models. The Ohio EPA required SDT and CRT field forms are provided in Attachment #3.

Step Drawdown Test (SDT) Description

The SDT of MJ-PW2 started at 09:00 hours on April 1, 2025. Four 120-minute-long steps were completed at pumping rates of 740, 1,133, 1,435 and 1,660 gpm. MJ-PW2 was tested using a submersible test pump and portable generator. At the wellhead, a 90-degree elbow, pressure gauge and controlling gate valve were installed to regulate discharge. Also installed at the pumping well were a transducer/datalogger and fixed electronic tape to monitor water levels manually and electronically (Figure 6).

Approximately 85 feet of 8-inch flexible discharge line extended the test pump discharge away from MJ-PW2 to the north, connecting to a 10x7-inch orifice meter and manometer (Figure 7). Water levels in MJ-PW2 at the wellhead were monitored using both pressure transducer/datalogger and manual measurements. The transducer/data logger combination was programmed to record water level changes to a hundredth (0.01) of a foot every minute. A pressure transducer/datalogger was also installed on the discharge pipe manometer to record changes in discharge every minute (Figure 7).

Figure 8 graphically summarizes the drawdown measured in the pumping well as a function of SDT elapse time. These data are used to calculate the well performance parameters and aquifer hydraulic characteristics at and near the production well.

Figure 6. MJ-PW2 wellhead monitoring and flow control for SDT, CRT and RT.

Figure 7. SDT & CRT discharge pipe, orifice and manometer to measure discharge.

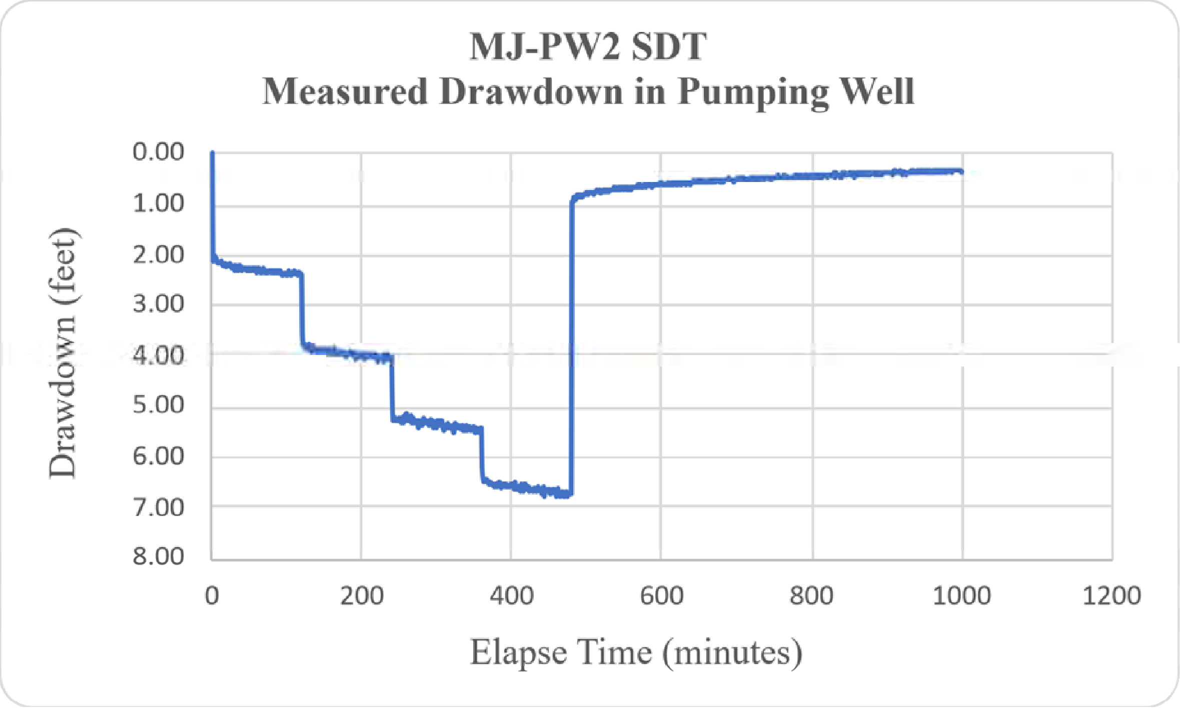


Figure 8. Graphical summary of drawdown vs. SDT elapse time at MJ-PW2.

Step Drawdown Test Results

The step test data was analyzed using various analytical techniques including those developed by Rorabaugh (1953), Kasenow (2001) and Bierschenk (1964). Analysis results are summarized in Figure 9. MJ-PW2 total in-well water level drawdown predictably decreases as pumping rates increase. This is graphically shown by the increase in the pumping well water level drawdown (Figure 9, 1st panel, dark blue line) as the discharge rate increased. Since all three of the SDT analysis methods provided virtually the same resulting total drawdown measured in the pumping well during the SDT, the various head loss components can be calculated with some certainty. This allows us to establish benchmark values for these individual head loss components of MJ-PW2 at its current condition as a newly constructed production well. These benchmark values represent the baseline or near optimal conditions to compare future well performance tests of MJ-PW2.

About 40 percent of the total drawdown in MJ-PW2 is attributed to natural flow restrictions within the aquifer and through the well filter pack. This is graphically depicted as the red line in panels 2, 3 and 4 of Figure 9. Commonly described as aquifer loss or laminar well loss, this head loss component considers the rate at which laminar flow contributes to the pumped well total drawdown. Aquifer loss is calculated using the aquifer loss coefficient “B”. As determined from

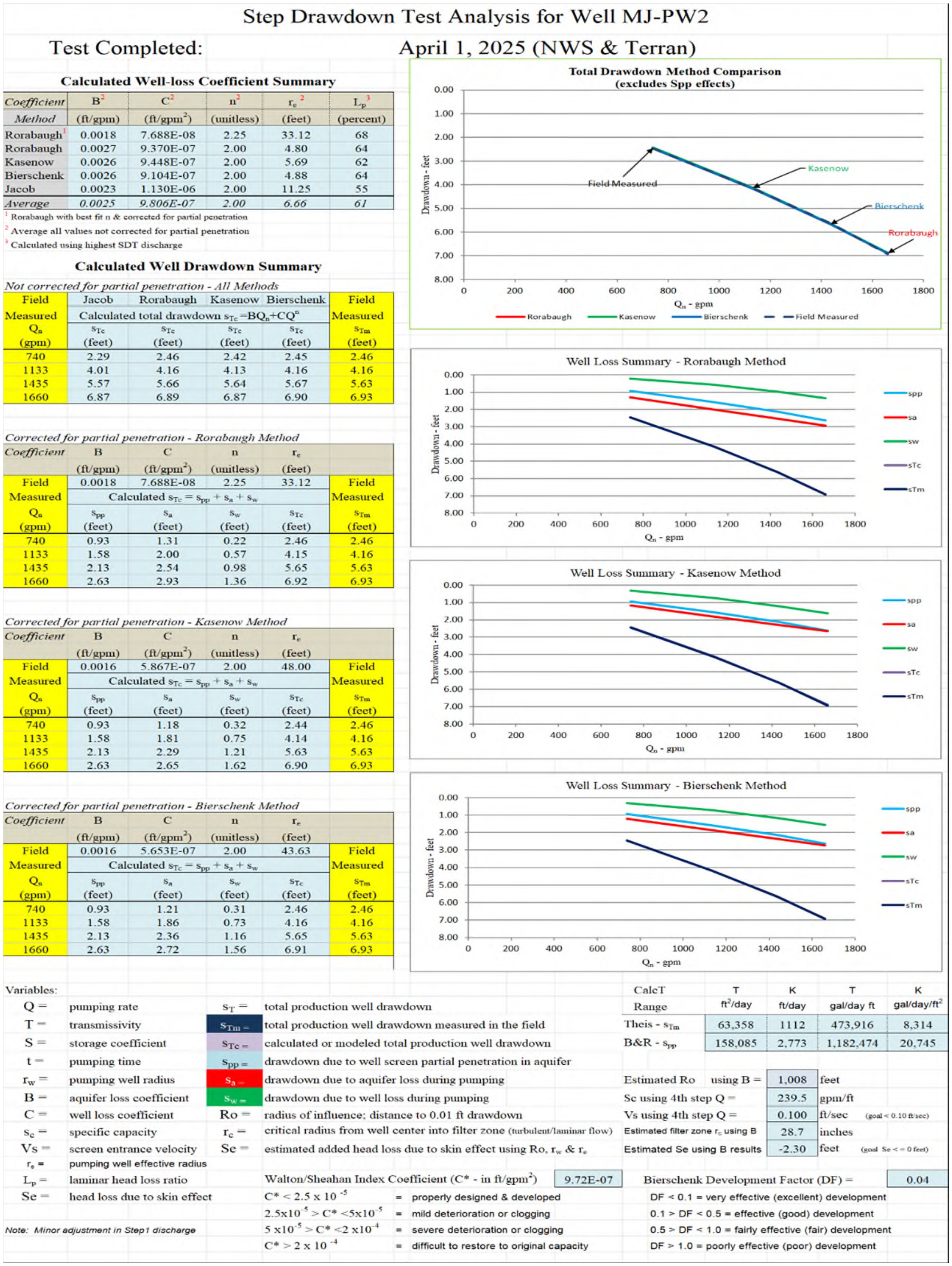
April 1, 2025 SDT, the benchmark B coefficient value for MJ-PW2 was measured to be 0.0025 ft./gpm.

Depending upon pumping rate, well loss or turbulent flow loss, as measured by the well loss coefficient “C”, causes about 13 to 23 percent of the total drawdown in MJ-PW2 (green line in panels 2, 3 and 4, Figure 9). In its current state as “new” construction, a production well benchmark C coefficient value for MJ-PW2 of $9.81E^{-07}$ ft./gpm^2 was determined from the SDT results. This qualitatively suggests the well was properly designed and developed (Walton, 1962; Bierschenk, 1964).

A third head loss component affecting total drawdown in a well is partial penetration of the well screen within the aquifer. As shown by the light blue line in panels 2, 3 and 4 of Figure 9, partial penetration effects accounted for approximately 40 percent of the total drawdown in MJ-PW2. Only a portion of the aquifer was screened for this production well to minimize effects of well interference and maintain sufficient available drawdown during seasonal variations of the groundwater piezometric levels.

From April 2025 SDT data, near-well aquifer transmissivity was estimated to be about 63,560 ft^2/day. Assuming a 71-foot aquifer thickness at MJ-PW2, a hydraulic conductivity value 1,110 ft./day was calculated using the near-well transmissivity estimate (Figure 9). This high K value assumes no hydraulic recharge or barrier boundaries were encountered within the short duration SDT radius of influence. Boundary conditions effects on MJ-PW2 potential production will be discussed as part of the CRT data analysis.

A common technique to judge production well performance is to calculate the well’s specific capacity at various discharge rates. Figure 10 graphically summarizes the changes in specific capacity and drawdown observed at MJ-PW2 during the April 2025 SDT.



Step Drawdown Test Analysis for Well MJ-PW2

Test Completed: April 1, 2025 (NWS & Terran)

Calculated Well-loss Coefficient Summary

Coefficient	B[2]	C[2]	n[2]	r_e[2]	L_p[3]
Method	(ft/gpm)	(ft/gpm^2)	(unitless)	(feet)	(percent)
Rorabaugh[1]	0.0018	7.688E-08	2.25	33.12	68
Rorabaugh	0.0027	9.370E-07	2.00	4.80	64
Kasenow	0.0026	9.448E-07	2.00	5.69	62
Bierschenk	0.0026	9.104E-07	2.00	4.88	64
Jacob	0.0023	1.130E-06	2.00	11.25	55
Average	*0.0025*	*9.806E-07*	*2.00*	*6.66*	*61*

[1] Rorabaugh with best fit n & corrected for partial penetration

[2] Average all values not corrected for partial penetration

[3] Calculated using highest SDT discharge

Calculated Well Drawdown Summary

Not corrected for partial penetration - All Methods

Field Measured Q_n (gpm)	Jacob	Rorabaugh	Kasenow	Bierschenk	Field Measured s_{Tm} (feet)
	Calculated total drawdown $s_{Tc} = BQ_n + CQ^n$				
	s_{Tc} (feet)	s_{Tc} (feet)	s_{Tc} (feet)	s_{Tc} (feet)	
740	2.29	2.46	2.42	2.45	2.46
1133	4.01	4.16	4.13	4.16	4.16
1435	5.57	5.66	5.64	5.67	5.63
1660	6.87	6.89	6.87	6.90	6.93

Corrected for partial penetration - Rorabaugh Method

Coefficient	B	C	n	r_e	
	(ft/gpm)	(ft/gpm^2)	(unitless)	(feet)	
Field Measured Q_n (gpm)	0.0018	7.688E-08	2.25	33.12	Field Measured s_{Tm} (feet)
	Calculated $s_{Tc} = s_{pp} + s_a + s_w$				
	s_{pp} (feet)	s_a (feet)	s_w (feet)	s_{Tc} (feet)	
740	0.93	1.31	0.22	2.46	2.46
1133	1.58	2.00	0.57	4.15	4.16
1435	2.13	2.54	0.98	5.65	5.63
1660	2.63	2.93	1.36	6.92	6.93

Corrected for partial penetration - Kasenow Method

Coefficient	B	C	n	r_e	
	(ft/gpm)	(ft/gpm^2)	(unitless)	(feet)	
Field Measured Q_n (gpm)	0.0016	5.867E-07	2.00	48.00	Field Measured s_{Tm} (feet)
	Calculated $s_{Tc} = s_{pp} + s_a + s_w$				
	s_{pp} (feet)	s_a (feet)	s_w (feet)	s_{Tc} (feet)	
740	0.93	1.18	0.32	2.44	2.46
1133	1.58	1.81	0.75	4.14	4.16
1435	2.13	2.29	1.21	5.63	5.63
1660	2.63	2.65	1.62	6.90	6.93

Corrected for partial penetration - Bierschenk Method

Coefficient	B	C	n	r_e	
	(ft/gpm)	(ft/gpm^2)	(unitless)	(feet)	
Field Measured Q_n (gpm)	0.0016	5.653E-07	2.00	43.63	Field Measured s_{Tm} (feet)
	Calculated $s_{Tc} = s_{pp} + s_a + s_w$				
	s_{pp} (feet)	s_a (feet)	s_w (feet)	s_{Tc} (feet)	
740	0.93	1.21	0.31	2.46	2.46
1133	1.58	1.86	0.73	4.16	4.16
1435	2.13	2.36	1.16	5.65	5.63
1660	2.63	2.72	1.56	6.91	6.93

Variables:

Q = pumping rate
T = transmissivity
S = storage coefficient
t = pumping time
r_w = pumping well radius
B = aquifer loss coefficient
C = well loss coefficient
S_c = specific capacity
Vs = screen entrance velocity
r_e = pumping well effective radius
L_p = laminar head loss ratio
Se = head loss due to skin effect

s_T = total production well drawdown
s_{Tm} = total production well drawdown measured in the field
s_{Tc} = calculated or modeled total production well drawdown
s_{pp} = drawdown due to well screen partial penetration in aquifer
s_a = drawdown due to aquifer loss during pumping
s_w = drawdown due to well loss during pumping
Ro = radius of influence; distance to 0.01 ft drawdown
r_c = critical radius from well center into filter zone (turbulent/laminar flow)
Se = estimated added head loss due to skin effect using Ro, r_w & r_e

CalcT Range	T ft^2/day	K ft/day	T gal/day ft	K gal/day/ft^2
Theis - s_{Tm}	63,358	1112	473,916	8,314
B&R - s_{pp}	158,085	2,773	1,182,474	20,745

Estimated Ro using B =	1,008	feet
Sc using 4th step Q =	239.5	gpm/ft
Vs using 4th step Q =	0.100	ft/sec (goal < 0.10 ft/sec)
Estimated filter zone r_c using B	28.7	inches
Estimated Se using B results	-2.30	feet (goal Se < = 0 feet)

Walton/Sheahan Index Coefficient (C* - in ft/gpm^2) 9.72E-07

$C^* < 2.5 \times 10^{-5}$ = properly designed & developed
$2.5\times10^{-5} > C^* < 5\times10^{-5}$ = mild deterioration or clogging
$5 \times10^{-5} > C^* < 2 \times10^{-4}$ = severe deterioration or clogging
$C^* > 2 \times 10^{-4}$ = difficult to restore to original capacity

Bierschenk Development Factor (DF) = 0.04

DF < 0.1 = very effective (excellent) development
0.1 > DF < 0.5 = effective (good) development
0.5 > DF < 1.0 = fairly effective (fair) development
DF > 1.0 = poorly effective (poor) development

Note: Minor adjustment in Step1 discharge

Figure 9. Summary graphic of step-drawdown test analysis for MJ-PW2.

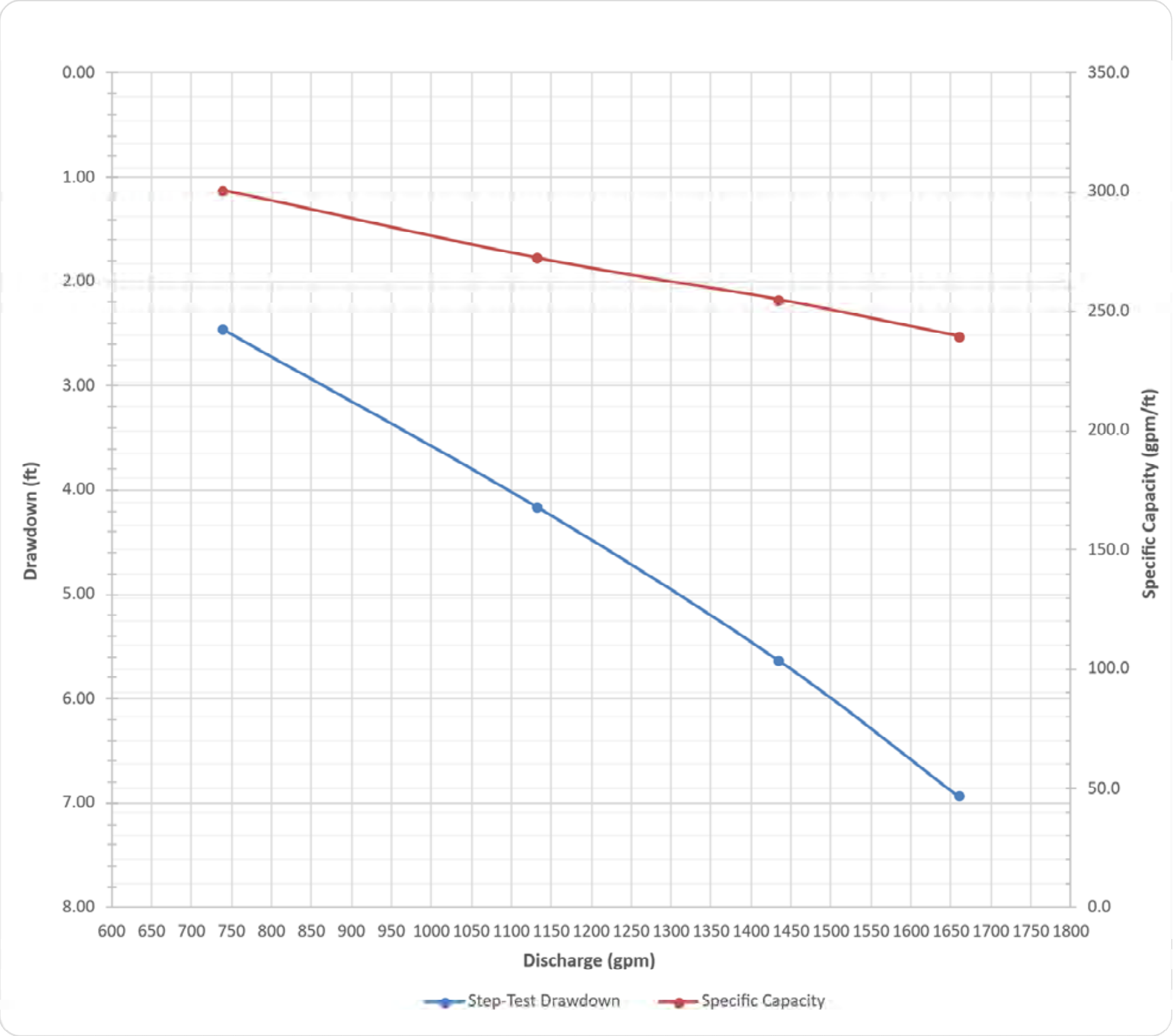


Figure 10. Changes in drawdown and specific capacity in MJ-PW2 during April 1, 2025 SDT.

Constant Rate Test Description

Beginning April 2nd and concluding April 3rd, 2025, a 24-hour CRT and nominal 12-hour RT was completed by Terran and National Water Services at MJ-PW2. The pumping portion of the CRT began at 09:00 hours on April 2nd and continued until April 3rd at 09:00 hours. Discharge remained stable throughout the duration of the CRT, averaging 1,660 gpm. During the 1,440-minute pumping phase of the test, approximately 2.4 million gallons of water (2.4 MGD) were extracted.

Recording of water levels in the pumping and monitoring wells for the recovery phase of the CRT began immediately upon pumping ending on April 3rd at 09:00 hours and continued until 10:00 hours on December 19th. The aquifer water levels recovered at MJ-PW2 to the pre-pumping static water level in about 2400 minutes (Figure 11).

Approximately 85 feet of 8-inch flexible discharge line extended the test pump discharge away from MJ-PW1 to the north, connecting to a 10x7-inch orifice meter and manometer (Figures 6 and 7). Water levels in MJ-PW2 at the wellhead were monitored using both pressure transducer/datalogger and manual measurements. The transducer/data logger combination was programmed to record water level changes to a hundredth (0.01) of a foot using a one-minute sampling schedule. A pressure transducer/datalogger was also installed on the discharge pipe manometer to record changes in discharge every minute (Figure 7).

Figure 11 graphically summarizes the drawdown and recovery measured in the pumping well as the function of CRT elapse time. Figure 12 is a corresponding graphical summary of discharge changes recorded at the manometer with elapse time. These data are used to calculate the well performance parameters and aquifer hydraulic characteristics at and near the production well.

In addition to collecting water level measurements manually and electronically at the pumping well, two additional locations were monitored using transducers and dataloggers: MJ-PW1 and MJ-PW3. (Figure 1). Additional analysis results from previous pump tests using MJ-TW2 (now MJ-PW2) and other monitoring wells are included in Figures 15, 16 and 17. Table 2 provides specific details of each monitoring location as it pertains to their use in the CRT analysis.

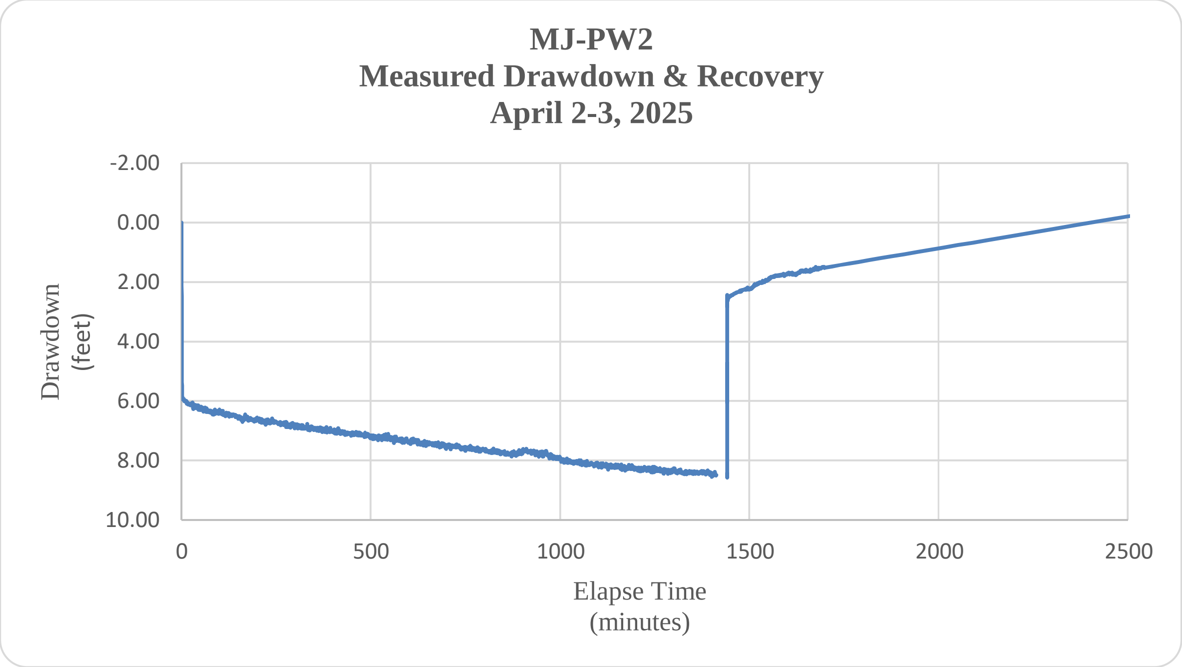


Figure 11. Graphical summary of drawdown and recovery vs. CRT elapse time at MJ-PW2.

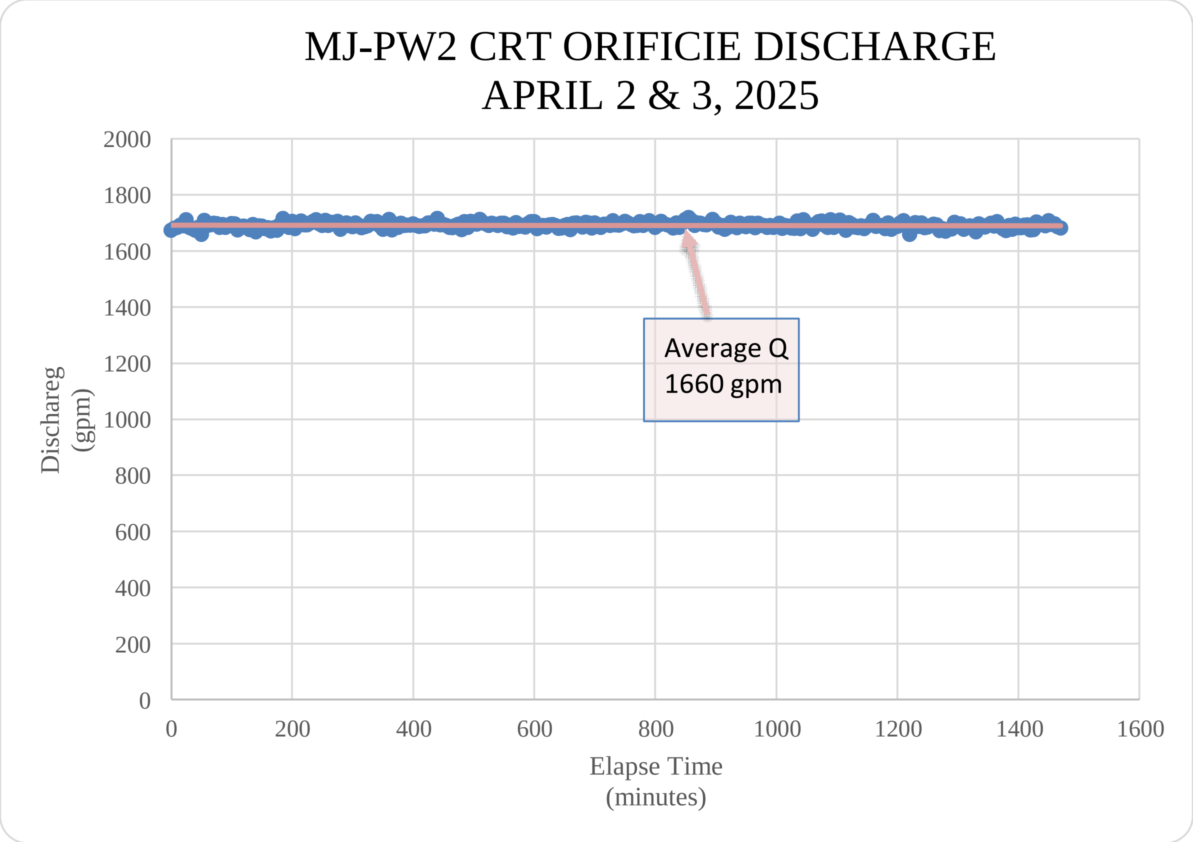


Figure 12. Graphical summary of discharge vs. elapse time during MJ-PW2 CRT pumping phase.

Table 2. Pumping and monitoring wells utilized in April 2025 MJ-PW2 SDT & CRT.

Well ID	Location		Ground Elevation (ft MSL)	Casing Stickup (feet)	Meas. Pt. Elevation (ft MSL)	Screen Diameter (inches)	Screen Length (feet)	Distance to Pump Well (feet)
	Northing/Y (feet)	Easting/X (feet)						
MJ-PW1	501775	1476820	613	3.5	616	16	20	322
MJ-PW2 (MJ-TW2)	501809	1476503	610.2	2.2	612.4	16	20	0
MJ-PW3	501446	1476503	~612	3.6	~616	8	20	405

Note: Measuring point elevations are estimated for MJ-PW2 & MJ-PW3

Constant Rate Test Results

Transmissivity and storativity may be estimated using the change in drawdown as a function of the production well discharge with time and distance to an observation well. Many aquifer analysis techniques have been developed for the evaluation of time-drawdown data. For the MJ-PW2 CRT, several of these techniques were used to determine key aquifer coefficients. The computer program AQTESOLV™ was used to apply the analytical methods of Neuman-Witherspoon (1969), Theis (1935), Cooper-Jacob (1946), Papadopulos-Cooper (1967) and others to evaluate the CRT data. A representative analysis graph is shown in Figure 13 using the drawdown data from the pumping well and MJ-PW3, about 405 feet distal. Figure 14 shows residual drawdown curves of monitoring wells superimposed upon MJ-PW2 recovery data. Table 3 summarizes the transmissivity and storativity values calculated for the pumped and observation wells using applicable analytical models.

Analyses of water level data obtained during the CRT confirm the outwash aquifer in the study area behaves as a semi-confined hydrologic unit. In the vicinity of MJ-PW2 during the recent CRT, the predominate flow regime was bilinear. The induced flow regime at the remaining monitoring wells appeared to start at radial moving to spherical at test end. A representative apparent late-time transmissivity value for the portion of the Middle-Junction property affected during the MJ-PW2 CRT would be ± 25,300 ft^2/day. Assuming the saturated aquifer thickness is 57 feet, a representative hydraulic conductivity would be ± 440 ft./day (Table 3).

Storativity is the measure of the volume of water retained in or released from storage in the aquifer, expressed as a function of surface area and change in head. The smaller the value for storativity, typically the more confined the aquifer. As shown in Table 3, once the cone of depressions extends beyond the immediate area of MJ-PW2, a representative calculated storage value from the CRT would be 0.0011 ($1.1x10^{-3}$).

Groundwater Production Potential at Middletown-Junction Property

The current groundwater conceptual site model of the Middletown-Junction property suggests the underlying aquifer consists of coarse outwash materials deposited in an erosional channel bounded by shale bedrock walls (Figure 9, Terran Corp., 2022a,b). This type of aquifer formation is commonly referred to as strip, channel or buried-valley aquifer. Groundwater flow in strip aquifers is strongly influenced by boundaries, usually resulting in an unexpectedly large drawdown of groundwater levels over large distances. When developing a wellfield in a strip aquifer, the underestimation of drawdowns can result in an overestimation of sustainable yields.

Beginning in 1993, to determine representative values for transmissivity (T) and hydraulic conductivity (K) of the aquifer beneath Middletown-Junction, SDTs and CRTs were completed using MJ-TW2 (now designated as MJ-PW2) and MJ-TW1 as pumping wells while measuring water level drawdown in nearby monitoring wells. Depending upon the pumping rate and duration of each test, the cone of depression may or may not encounter the aquifer boundaries. If no-flow or barrier boundaries are not reached during the pumping process of a test, the calculated T and K values will be higher and drawdown less than results for tests that are affected by boundaries.

We will use current and historical pumping tests at MJ-TW1 and MJ-TW2 to illustrate the effects of barrier boundaries. In 1993, a 2-hour SDT was completed at MJ-TW1 using 3-steps of 300, 600 and 715 gpm discharge rates. Calculated test results for T and K were 60,800 ft^2/day and 822 ft/day, respectively. This SDT was followed by a 2,880-minute CRT pumping at 700 gpm. Data from this test resulted in a calculated T value of 51,500 ft^2/day and 757 ft/day for hydraulic conductivity. A 2023 CRT pumped MJ-TW1 at 222 gpm for 1,560 minutes. Results for T were 50,800 ft^2/day and 747 ft/day for K. It was noted that in the interpretation of these tests, the cone of depression did not extend sufficiently far to encounter significant barrier or recharge boundaries.

The geometric mean for these MJ-TW1 pump tests results would be 54,200 ft^2/day for transmissivity and 775 ft/day for hydraulic conductivity. These mean aquifer coefficient values are used to estimate the theoretical water level drawdown in MJ-TW1 if stressed at a higher pumping rate for a longer pumping duration. Using appropriate analytical equations, if MJ-TW1 could be pumped at 1,700 gpm for ten days, about 9.3 feet of drawdown in the pumping well would be realized.

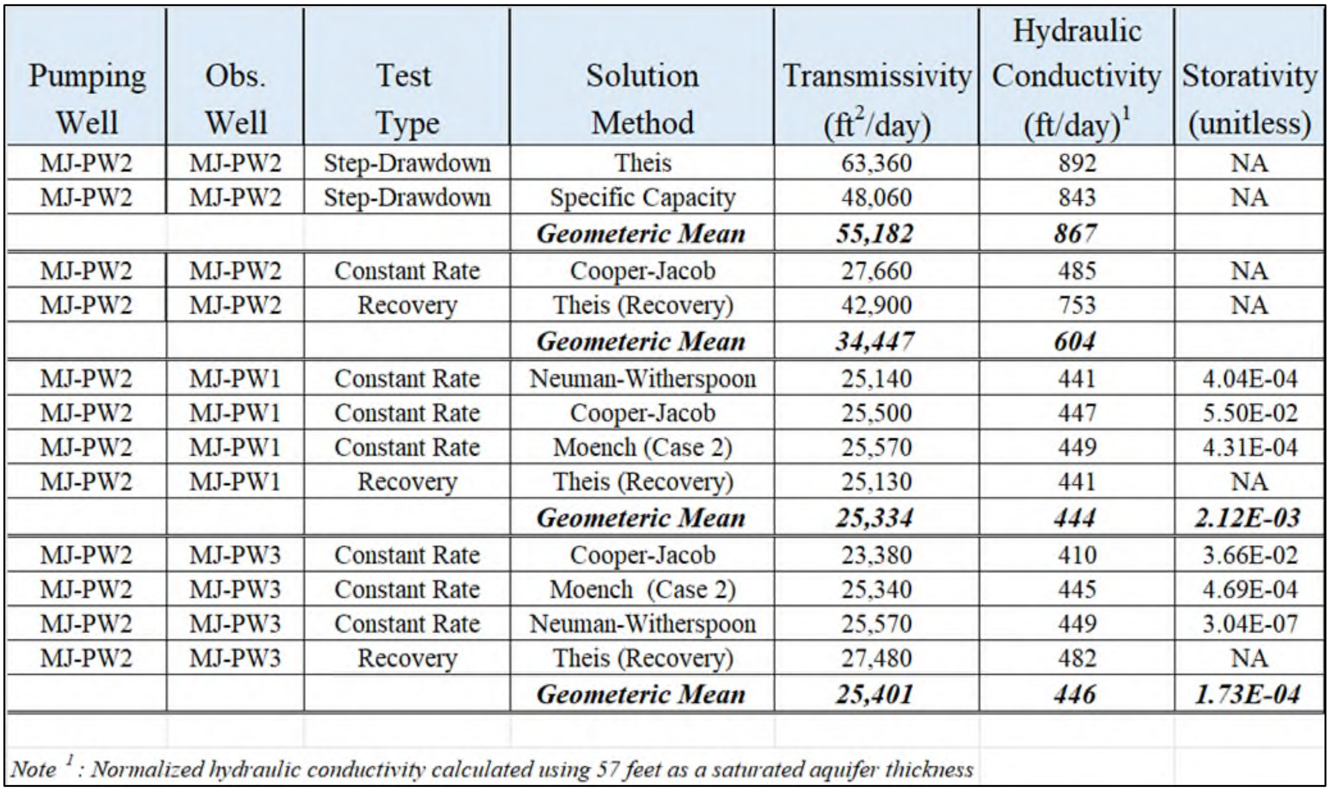
For comparison, in 2023 a 3-hour SDT was completed at MJ-TW2 using 3-steps of 409, 557 and 730 gpm discharge rates. Calculated test results for T and K were 56,600 ft^2/day and 922 ft/day, respectively. Corrected for aquifer thickness, T and K values from the SDTs at MJ-TW1 and MJ-TW2 are very similar if not the same. Specific capacity for the MJ-TW1 SDT 3rd step was

268 gpd/ft compared to MJ-TW2 SDT 3rd step of 266 gpm/ft. This is to be expected since both wells are completed in the same strip aquifer spaced only 310 feet apart.

In 1994, a CRT using well MJ-TW2 pumping at 1,700 gpm for ten days was performed. The total drawdown in this test production well at the end of ten days pumping was about 26 feet. The cause for the unusually large drawdown response appears to be barrier boundaries. The 1994 CRT sufficiently stressed the aquifer over the ten-day period to reduce the effective transmissivity from 56,600 ft^2/day to 15,400 ft^2/day. Effective hydraulic conductivity was lowered from about 901 ft./day to 250 ft./day (Figures 15, 16 and 17).

Similar to the 1994 tests, recently completed SDT and CRT using MJ-PW2 provided ample stress to the aquifer to measure the initial effects of barrier boundaries on water level drawdowns. Figure 18 summarizes a portion of this data to determine representative T and K values throughout the aquifer when one-day pumping stresses invoke barrier boundary effects. This information will be used to update and utilize the numerical groundwater model for the Middletown-Junction property in determining possible production well(s) sustainable production potential.

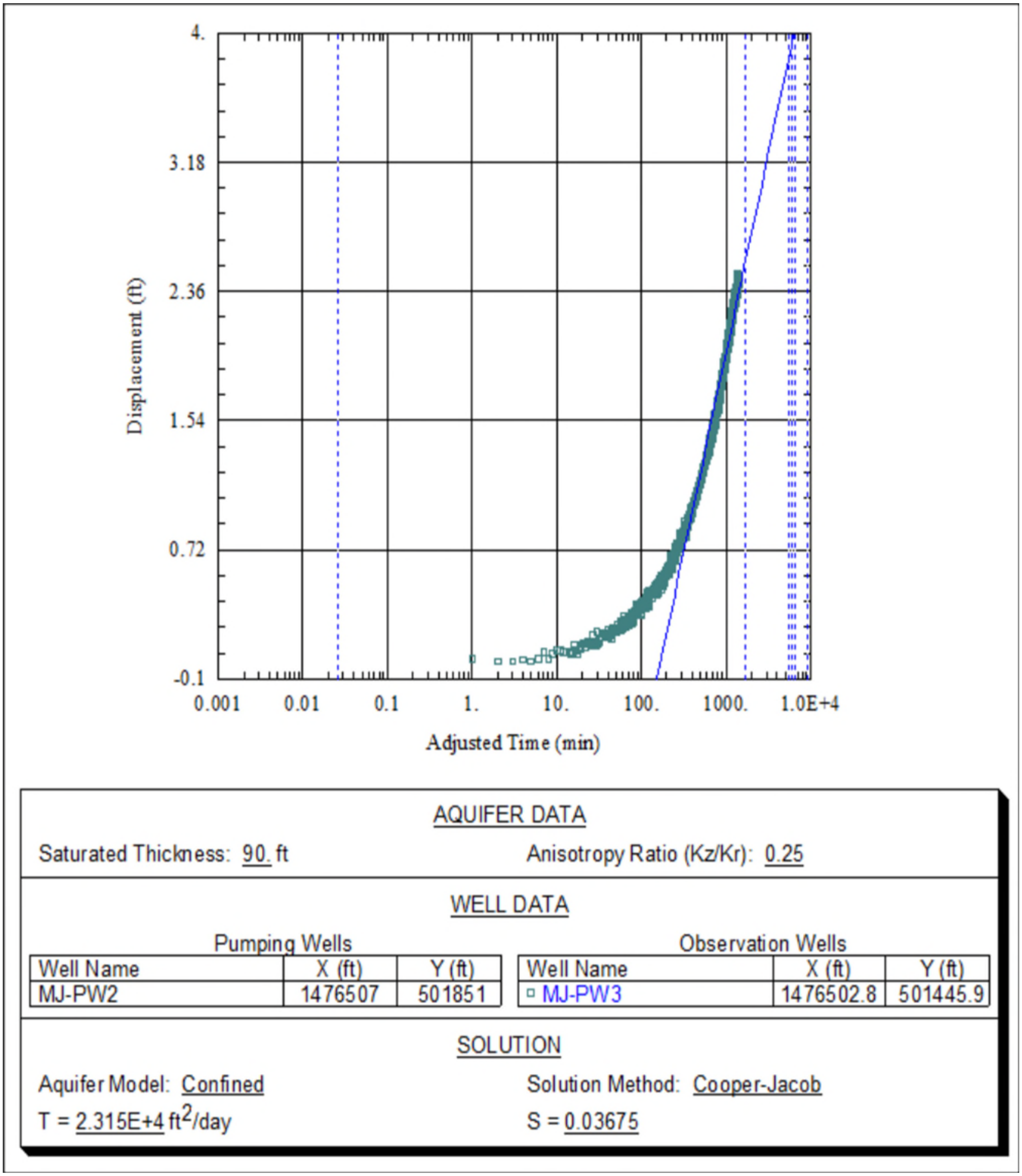
Table 3. Calculated aquifer transmissivity and storativity values for MJ-PW2 and selected monitoring wells.



Pumping Well	Obs. Well	Test Type	Solution Method	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)[1]	Storativity (unitless)
MJ-PW2	MJ-PW2	Step-Drawdown	Theis	63,360	892	NA
MJ-PW2	MJ-PW2	Step-Drawdown	Specific Capacity	48,060	843	NA
			Geometeric Mean	***55,182***	***867***	
MJ-PW2	MJ-PW2	Constant Rate	Cooper-Jacob	27,660	485	NA
MJ-PW2	MJ-PW2	Recovery	Theis (Recovery)	42,900	753	NA
			Geometeric Mean	***34,447***	***604***	
MJ-PW2	MJ-PW1	Constant Rate	Neuman-Witherspoon	25,140	441	4.04E-04
MJ-PW2	MJ-PW1	Constant Rate	Cooper-Jacob	25,500	447	5.50E-02
MJ-PW2	MJ-PW1	Constant Rate	Moench (Case 2)	25,570	449	4.31E-04
MJ-PW2	MJ-PW1	Recovery	Theis (Recovery)	25,130	441	NA
			Geometeric Mean	***25,334***	***444***	***2.12E-03***
MJ-PW2	MJ-PW3	Constant Rate	Cooper-Jacob	23,380	410	3.66E-02
MJ-PW2	MJ-PW3	Constant Rate	Moench (Case 2)	25,340	445	4.69E-04
MJ-PW2	MJ-PW3	Constant Rate	Neuman-Witherspoon	25,570	449	3.04E-07
MJ-PW2	MJ-PW3	Recovery	Theis (Recovery)	27,480	482	NA
			Geometeric Mean	***25,401***	***446***	***1.73E-04***

Note [1] : Normalized hydraulic conductivity calculated using 57 feet as a saturated aquifer thickness

Notes: NA = Calculation method does not provide estimates of this variable



AQUIFER DATA

Saturated Thickness: 90. ft

Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MJ-PW2	1476507	501851

Observation Wells

Well Name	X (ft)	Y (ft)
□ MJ-PW3	1476502.8	501445.9

SOLUTION

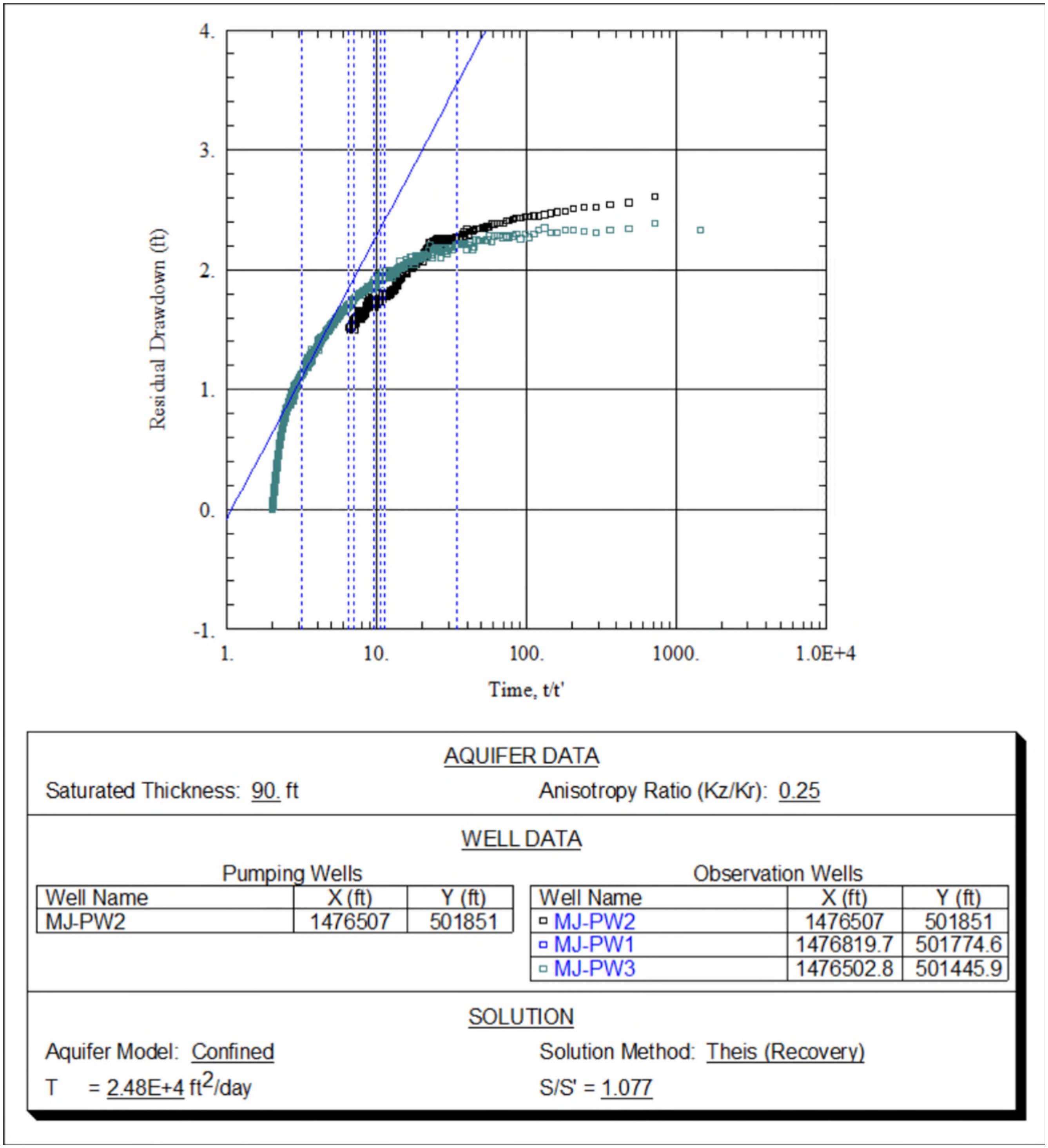
Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 2.315E+4 ft^2/day

S = 0.03675

Figure 13. Analysis hydrograph of drawdown in MJ-PW3 used as a monitoring well for the April 2025 MJ-PW2 CRT.



AQUIFER DATA

Saturated Thickness: 90. ft

Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MJ-PW2	1476507	501851

Observation Wells

Well Name	X (ft)	Y (ft)
□ MJ-PW2	1476507	501851
□ MJ-PW1	1476819.7	501774.6
□ MJ-PW3	1476502.8	501445.9

SOLUTION

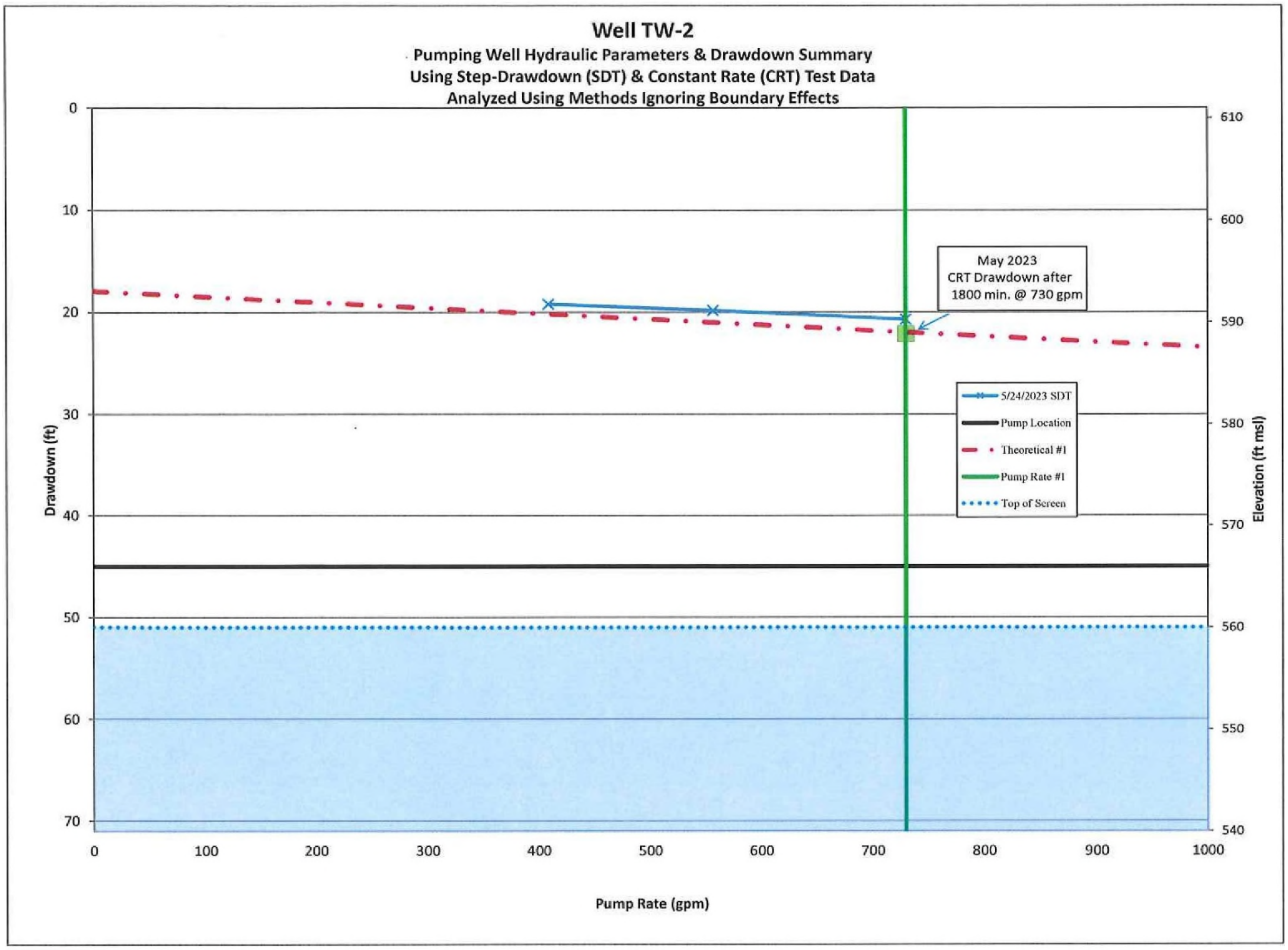
Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 2.48E+4 ft^2/day

S/S' = 1.077

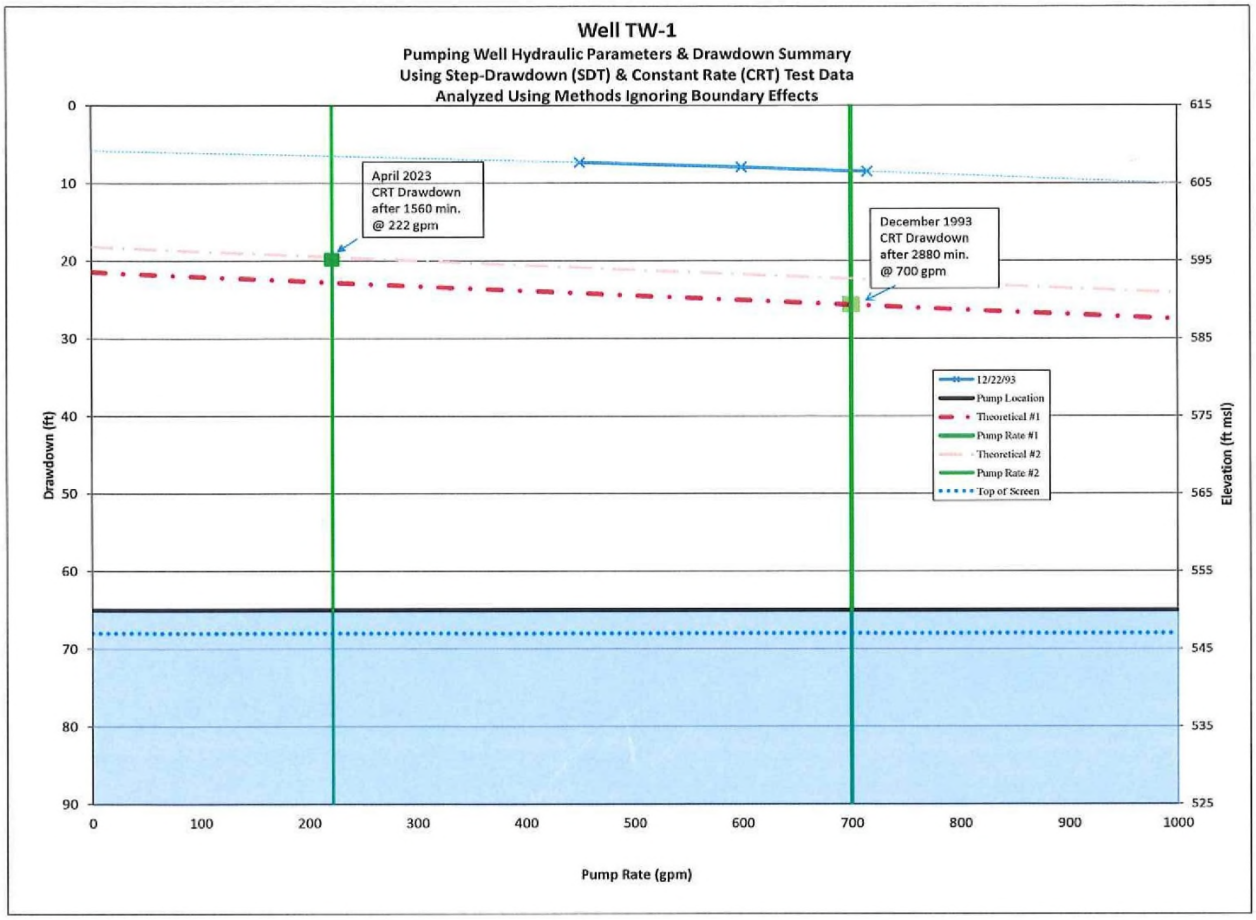
Figure 14. Composite residual recovery analysis of April 2025 MJ-PW2 CRT.



Test Date	Test Analysis Type	Total Pumping Duration (minutes)	Highest Pumping Stress (gpm)	SDT Step Duration (minutes)	SDT Step Events (each)	Loss Coefficients Aquifer B (ft/gpm)	Loss Coefficients Well C (ft/gpm^2)	Near-Well Aquifer Parameters T (gal/day/ft)	K (ft/d)	S (unitless)	S_y (unitless)	Comments
5/24/2023	SDT	180	730	60	3	0.0021	2.27E-06	423,000	992			B & C - four analysis methods; T & K by Theis; b=53 ft
5/24/2023	Spc. Cap.	180	730					399,600	937			Driscoll unconfined method; b=53 ft
5/25-26/2023	CRT	1800	730					380,000	958			Theis method; b=53 feet
5/25-26/2023	CRT	1800	730					376,500	950			Theis recovery method; b=53 ft.
5/25-26/2023	CRT	1800	730					383,000	966			Cooper-Jacob method; b=53 ft.
5/25-26/2023	Obs	1800	730					291,000	734		0.109	Jaeger method using TW-1; b=53 ft
5/25-26/2023	Obs	1800	730					311,800	787		0.118	Jaeger method using TRN-2; b=53 ft
5/25-26/2023	D-D	1800	730					363,500	917	0.002		Kasenow method of D-D using TW-1; b=53 ft
Existing data analysis representative well/aquifer coefficients:						0.0021	2.27E-06	363,600	901	0.002	0.113	

Notes:
SDT are Step-Drawdown Tests
Spc. Cap. are analyses techniques to calculated T & K values using Specific Capacity values
CRT are Constant Rate Tests
D-D are Distance Drawdown analyses methods
Obs are Observation well analysis methods. The pumping well being evaluated was used as an observation well during a nearby well pump or aquifer test.
🟥 due to the test data not meeting the analysis method assumptions or boundaries, these values are incorrect and should not be considered representative

Figure 15. Summary graphic illustrating aquifer coefficients calculated for MJ-TW2 ignoring boundaries.


Well TW-1
Pumping Well Hydraulic Parameters & Drawdown Summary
Using Step-Drawdown (SDT) & Constant Rate (CRT) Test Data
Analyzed Using Methods Ignoring Boundary Effects

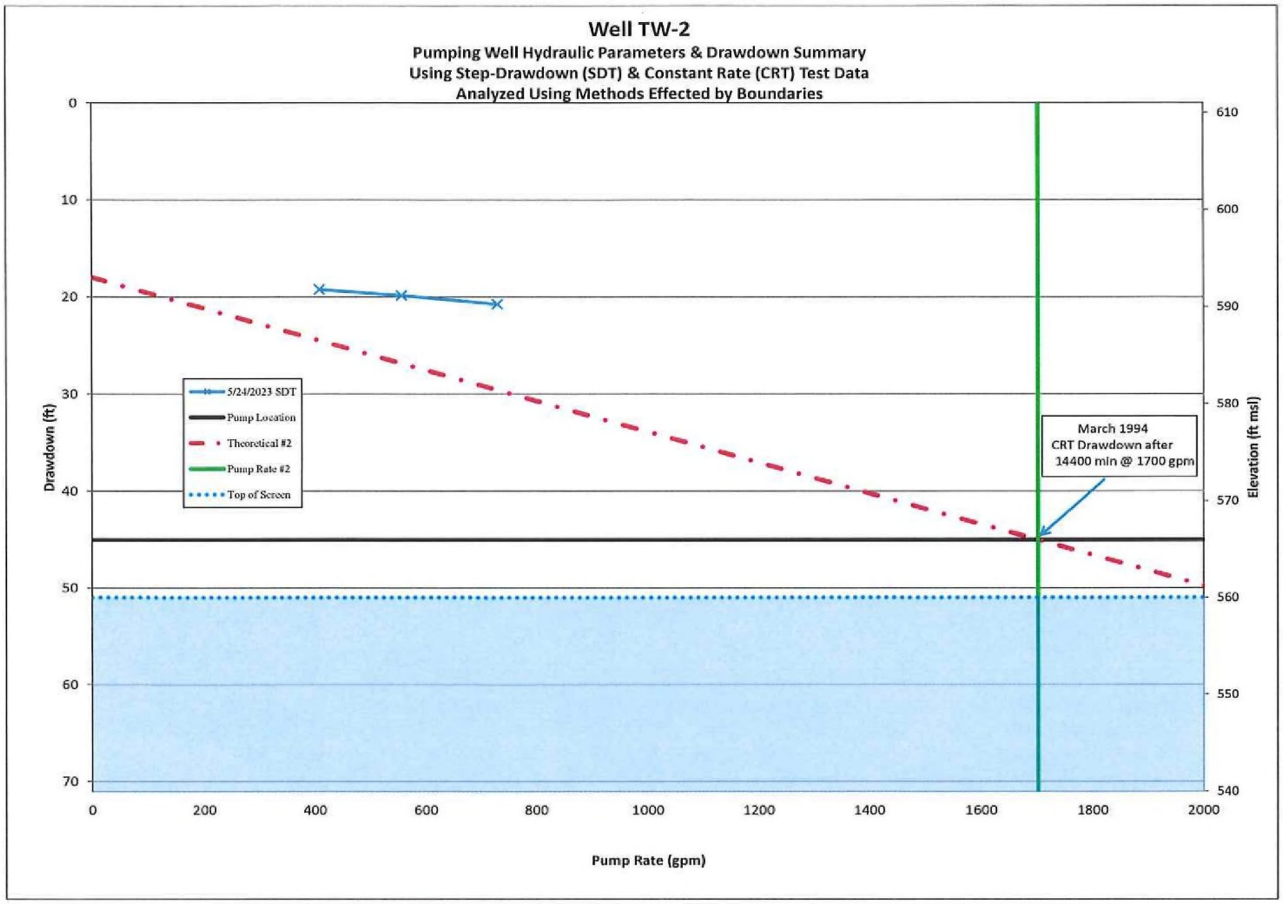
April 2023
CRT Drawdown
after 1560 min.
@ 222 gpm

December 1993
CRT Drawdown
after 2880 min.
@ 700 gpm

Test Date	Test Analysis Type	Total Pumping Duration (minutes)	Highest Pumping Stress (gpm)	SDT Step Duration (minutes)	SDT Step Events (each)	Loss Coefficients		Near-Well Aquifer Parameters				Comments
						Aquifer B (ft/gpm)	Well C (ft/gpm^2)	T (gal/day/ft)	K (ft/d)	S (unitless)	S_y (unitless)	
12/22/1993	SDT	360	715	120	3	0.0025	1.77E-06	509,040	920			B & C - four analysis methods; T & K by Theis; b=68 ft
12/27-28/1993	CRT	2880	700					385,000	757			Theis method; b=68 feet
12/27-28/1993	CRT	2880	700					542,900	1067			Theis recovery method; b=68 ft.
12/27-28/1993	CRT	2880	700					477,200	938			Cooper-Jacob method; b=68 ft.
12/27-28/1993	Obs	2880	700					449,900	885	0.0015	0.278	Neuman method using MJ-P1 by CEC; b=68 ft
12/27-28/1993	Spc. Cap.	2880	700					283,600	722			GeoMean T & K from six unconfined methods; b=53 ft
4/11-12/2023	CRT	1560	222					380,000	747			Theis method; b=68 feet
4/11-12/2023	CRT	1560	222					514,200	923			Cooper-Jacob method; b=68 ft.
4/11-12/2023	Obs	1560	222					451,600	888			Theis recovery method using TRN-1; b=68 ft.
4/11-12/2023	Obs	1560	222					275,300	541			Cooper-Jacob method using TRN-1 & boundaries; b= 68 ft
4/11-12/2023	Obs	1560	222					493,200	969	0.0025	0.102	Tartakovsky-Neuman method using TRN-1; b=68 ft.
4/11-12/2023	Obs	1560	222					298,900	588	0.0020	0.162	Neuman method using TRN-1; b=68 ft.
4/11-12/2023	Spc. Cap.	1560	222					256,200	614			GeoMean T & K from six unconfined methods; b=56 ft
Existing data analysis representative well/aquifer coefficients:						**0.0025**	**1.77E-06**	**396,282**	**796**	**0.0020**	**0.166**	

Notes:
SDT are Step-Drawdown Tests
Spc. Cap. are analyses techniques to calculated T & K values using Specific Capacity values
CRT are Constant Rate Tests
D-D are Distance Drawdown analyses methods
Obs are Observation well analysis methods. The pumping well being evaluated was used as an observation well during a nearby well pump or aquifer test.
due to the test data not meeting the analysis method assumptions or boundaries, these values are incorrect and should not be considered representative

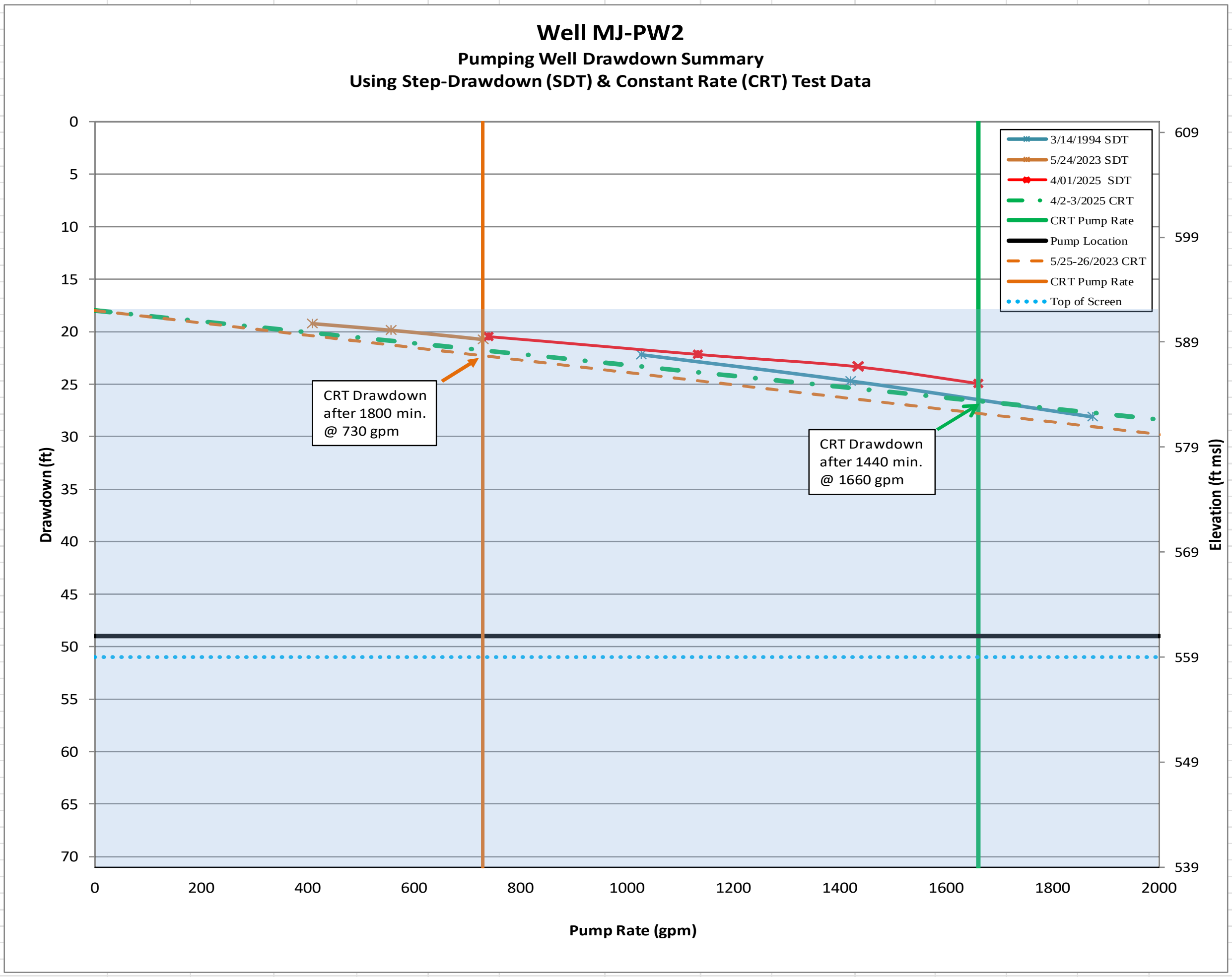
Figure 16. Summary graphic illustrating aquifer coefficients calculated for MJ-TW1 ignoring boundaries.



Test Date	Test Analysis Type	Total Pumping Duration (minutes)	Highest Pumping Stress (gpm)	SDT Step Duration (minutes)	SDT Step Events (each)	Loss Coefficients		Near-Well Aquifer Parameters				Comments
						Aquifer B (ft/gpm)	Well C (ft/gpm^2)	T (gal/day/ft)	K (ft/d)	S (unitless)	S_y (unitless)	
4/18-28/1994	CRT	14400	1702					120,000	303			Theis method; b=53 feet
4/18-28/1994	Spc. Cap.	14400	1702					125,800	295			GeoMean T & K from six unconfined methods; b=53 ft
5/25-26/2023	Obs	1800	730					85,700	216	0.0005	0.114	Neuman/Agarwal unconfined method using TRN-1: b=53 ft.
5/25-26/2023	Obs	1800	730					80,500	203	0.0005	0.114	Tart/Neu/Agarwal unconfined method using TRN-1: b=53 ft.
5/25-26/2023	Obs	1800	730					89,800	226	0.0005	0.391	Neuman/Agarwal unconfined method using TRN-2: b=53 ft.
5/25-26/2023	Obs	1800	730					86,800	219	0.0005	0.392	Tart/Neu/Agarwal unconfined method using TRN-2: b=53 ft.
5/25-26/2023	Obs	1800	730					80,700	206	0.0005	0.14	Neuman/Agarwal unconfined method using TW-1: b=53 ft.
5/25-26/2023	Obs	1800	730					76,900	194	0.0005	0.141	Tart/Neu/Agarwal unconfined method using TW-1: b=53 ft.
5/25-26/2023	Obs	1800	730					123,900	313	0.0005	0.391	Neuman/Agarwal unconfined method using TRN-5: b=53 ft.
5/25-26/2023	Obs	1800	730					117,400	296	0.0004	0.03	Tart/Neu/Agarwal unconfined method using TRN-5: b=53 ft.
5/25-26/2023	Obs	1800	730					132,700	335		0.013	Cooper-Jacob method for TRN-5; b=53 ft.
5/25-26/2023	Obs	1800	730					119,600	302		0.049	Cooper-Jacob method for TRN-1; b=53 ft.
5/25-26/2023	Obs	1800	730					115,600	292		0.033	Cooper-Jacob method for TRN-3; b=53 ft.
Existing data analysis representative well/aquifer coefficients:								**98,952**	**250**	**0.0005**	**0.100**	

Notes:
SDT are Step-Drawdown Tests
Spc. Cap. are analyses techniques to calculated T & K values using Specific Capacity values
CRT are Constant Rate Tests
D-D are Distance Drawdown analyses methods
Obs are Observation well analysis methods. The pumping well being evaluated was used as an observation well during a nearby well pump or aquifer test.
🟥 due to the test data not meeting the analysis method assumptions or boundaries, these values are incorrect and should not be considered representative

Figure 17. Summary graphic illustrating aquifer coefficients calculated for MJ-TW2 that includes boundary effects.



Test Date	Test Analysis Type	Total Pumping Duration (minutes)	SDT Step Duration (minutes)	SDT Step Events (each)	Loss Coefficients		Near-Well Aquifer Parameters			Comments
					Aquifer B (ft/gpm)	Well C (ft/gpm^2)	T (ft^2/day)	K (ft/d)	S/S$_y$ (unitless)	
3/14/1994	SDT	360	120	3	0.0026	1.53E-06	39,450	692		Theis method; b=71 ft.; no barrier boundaries
5/24/2023	SDT	180	60	3	0.0021	2.27E-06	56,554	797		Theis method; b=71 ft.; no barrier boundaries
4/1/2025	SDT	480	120	4	0.0025	9.81E-07	63,360	892		Theis method; b=71 ft.; no barrier boundaries
5/25-26/2023	CRT	1800					41,440	584		Theis method; b=71 ft.; no barrier boundaries
4/2-3/2025	CRT	1440					46,790	659		Theis method; b=71 ft.; no barrier boundaries
4/2-3/2025	CRT	1440					23,740	334		Theis Recovery method; b=71 feet
4/2-3/2025	CRT	1440					25,370	357	0.00047	Paired w/MJ-PW1, Neuman ; r=457 ft.
4/2-3/2025	CRT	1440					25,130	354		Paired w/MJ-PW1, Theis Recovery method; r=457 ft.
4/2-3/2025	CRT	1440					28,550	402	0.00043	Paired w/MJ-PW1, Moench (Case 2) method; r=457 ft.
4/2-3/2025	CRT	1440					25,570	360	0.00033	Paired w/MJ-PW3, Moench (Case 2) method; r=405 ft.
4/2-3/2025	CRT	1440					23,150	326	0.03670	Paired w/MJ-PW3. Cooper-Jacob; r=405 ft.
4/2-3/2025	CRT	1440					25,570	360	0.03885	Paired w/MJ-PW3, Papadop-Cooper method; r=405 ft.
Existing data analysis representative well/aquifer coefficients:					**0.00239**	**1.50E-06**	**33,199**	**476**	**0.00249**	*(Using geometric means)*

Notes:	SDT	are Step-Drawdown Tests
	Spc. Cap.	are analyses techniques to calculated T & K values using Specific Capacity values
	CRT	are Constant Rate Tests
	D-D	are Distance Draw-down analyses methods
	▨	due to the test data not meeting the analysis method assumptions or boundaries, these values are incorrect and should not be considered representative

Figure 18. Summary graphic illustrating aquifer coefficients calculated from the 2025 MJ-PW2 CRT data that suggest the onset of boundary effects in the analysis when compared to the earlier SDT results.

Groundwater Quality Results

A groundwater sample was collected from test well MJ-PW2 on April 3, 2025. The sample was collected at the conclusion of the 24-hour constant rate test from a metal sample port located off the pump casing. The lab results for a groundwater samples from test wells TW-1 and TW-2 are also provided for comparison purposes (Tables 4 and 5). A copy of the MJ-PW2 lab results is provided in Attachment #4 of this technical memorandum.

Groundwater samples from MJ-PW2 were analyzed for the water quality parameters of volatile organic compounds (VOCs), synthetic organic compounds (SOCs), total metals (Sb, As, Ba, Be, Cd, Ca, Cr, Cu, Fe, Hg, Pb, Mg, Mn, Ni, Se, Ag, Na, Tl and Zn), fluoride, chloride, total dissolved solids (TDS), alkalinity, pH, sulfate, nitrate, nitrate, cyanide and Polyfluoroalkyl Substances (PFAS) (Tables 4 and 5).

The inorganic metal constituents reported for MJ-PW2 included barium (0.123 mg/L), calcium (108 mg/L), iron (0.029J), magnesium (26.1 mg/L), manganese (0.005J mg/L), sodium (30.7 mg/L) and zinc (0.016 mg/L). General chemistry parameters included total alkalinity (287 mg/L), chloride (59.2 mg/L), fluoride (0.20 mg/L), pH (7.3 s.u.), TDS (456 mg/L), nitrate (0.553 mg/L) and sulfate (50.3 mg/L) (Table 4). All of the reported inorganic constituents are of a natural occurrence, commonly found in soil and groundwater. Of the reported inorganic levels in MJ-PW2, none of the common constituents have exceeded their respective U.S. EPA Maximum Contaminant Levels (MCLs).

Organic constituents analyzed included VOCs, SOCs and PFAS constituents (Tables 4 and 5). No detectable concentrations of VOCs or SOCs were reported for MJ-PW2. The PFAS constituent of perfluorooctane sulfonate (PFOS) was reported at 0.0164 µg/L, exceeding the MCL of 0.004 µg/L. Two other PFAS constituents reported included perfluorobutane sulfonate (PFBS) at 0.00226 µg/L and perfluorooctanoic acid (PFOA) at 0.0024 µg/L; both PFAS constituents are reported at concentrations below federal action levels.

Two total coliform bacteria water samples were also collected, respectively at 8:30 and 9:00 a.m. at the conclusion of the MJ-PW2 24-hour CRT pump test; both sample results tested negative for total coliform (Table 5).

Table 4. Summary of Analytical Results for Ground Water Samples from MJ-PW2 (and test wells TW-1 and TW-2 for comparison), Middletown-Junction Property, Ohio.

PARAMETER	TW-1*	TW-2**	MJ-PW2	MCL	SMCL
Inorganic Parameters					
Alkalinity, total (as $CaCO_3$) (mg/l)	344	311	287	NA	NA
Antimony, total (mg/l)	ND	<0.005	<0.003	0.006	
Arsenic, total (mg/l)	ND	<0.010	<0.003	0.010	
Barium, total (mg/l)	0.216	0.127	0.123	2	
Beryllium, total (mg/l)	ND	<0.001	<0.001	0.004	
Cadmium, total (mg/l)	0.71	<0.002	<0.001	0.005	
Calcium, total (mg/l)	109	114	108		
Chloride (mg/l)	43.3	52.1	59.2		250
Chromium, total (mg/l)	ND	<0.005	<0.005	0.1	
Copper, total (mg/l)	ND	<0.005	0.005J	1.3	1.0
Cyanide, total (mg/l)	ND	<0.0050	<0.003	0.2	
Fluoride (mg/l)	ND	0.24	0.20	4	2
Iron, total (mg/l)	**2.44**	<0.2	0.029J		0.3
Lead, total (mg/l)	ND	<0.005	<0.005	0.015	
Magnesium, total (mg/l)	29.8	28.2	26.1		
Manganese, total (mg/l)	**0.365**	<0.100	0.005J		0.05
Mercury, total (mg/l)	ND	NA	<0.0005	0.002	
Nickel, total (mg/l)	ND	<0.005	<0.010		
Nitrate-N as NO3-N (mg/l)	ND	0.59	0.553	10	
Nitrite-N as NO2-N (mg/l)	ND	NA	0.02J	1	
pH (s.u.)	7	8.1	7.3		6.5-8.5
Total Dissolved Solids (mg/l)	**529**	360	456		500
Selenium, total (mg/l)	ND	<0.010	<0.005	0.05	
Silver, total (mg/l)	ND	<0.002	<0.010		0.1
Sodium, total (mg/l)	20.7	28.0	30.7		
Sulfate (mg/l)	53.9	39.5	50.3		250
Thallium, total (mg/l)	ND	***<0.050***	<0.001	0.002	
Zinc, total (mg/l)	ND	<0.160	0.016		5
Volatile Organic Chemicals (VOCs)					
Benzene (µg/l)	ND	<1.0	<0.5	5	
Bromobenzene (µg/l)	ND	<1.0	NA		
Bromochloromethane (µg/l)	ND	<1.0	NA		
Bromodichloromethane (µg/l)	ND	<1.0	NA		
Bromoform (µg/l)	ND	<1.0	NA		
Bromomethane (µg/l)	ND	<1.0	NA		
n-Butylbenzene (µg/l)	ND	<1.0	NA		
sec-Butylbenzene (µg/l)	ND	<1.0	NA		

** Sample results from Tetra Tech (2007), ** TW-2 is renamed MJ-PW2.*

Table 4. Summary of Analytical Results for Ground Water Samples from MJ-PW2 (and test wells TW-1 and TW-2 for comparison), Middletown-Junction Property, Ohio.

PARAMETER	TW-1*	TW-2**	MJ-PW2	MCL	SMCL
Volatile Organic Chemicals (VOCs) (Continued)					
tert-Butylbenzene (µg/l)	ND	<1.0	NA		
Carbon Tetrachloride (µg/l)	ND	<1.0	<0.5	5	
Chlorobenzene (µg/l)	ND	<1.0	<0.5	100	
Chloroethane (µg/l)	ND	<1.0	NA		
Chloroform (µg/l)	ND	<1.0	NA		
Chloromethane (µg/l)	ND	<1.0	NA		
2-Chlorotoluene (µg/l)	ND	<1.0	NA		
4-Chlorotoluene (µg/l)	ND	<1.0	NA		
Dibromochloromethane (µg/l)	ND	<1.0	NA		
Dibromomethane (µg/l)	ND	<1.0	NA		
1,2-Dichlorobenzene (µg/l)	ND	<1.0	<0.5	600	
1,3-Dichlorobenzene (µg/l)	ND	<1.0	NA		
1,4-Dichlorobenzene (µg/l)	ND	<1.0	<0.5	75	
Dichlorodifluoromethane (µg/l)	ND	<1.0	NA		
1,1-Dichloroethane (µg/l)	ND	<1.0	NA		
1,2-Dichloroethane (µg/l)	ND	<1.0	<0.5	5	
1,1-Dichloroethene (µg/l)	ND	<1.0	<0.5	7	
cis-1,2-Dichloroethene (µg/l)	ND	<1.0	<0.5	70	
trans-1,2-Dichloroethene (µg/l)	ND	<1.0	<0.5	100	
Dichloromethane (methylene chloride) (µg/l)	0.94	<1.0	<0.5	5	
1,2-Dichloropropane (µg/l)	ND	<1.0	<0.5	5	
1,3-Dichloropropane (µg/l)	ND	<1.0	NA		
2,2-Dichloropropane (µg/l)	ND	<1.0	NA		
1,1-Dichloropropene (µg/l)	ND	<1.0	NA		
1,3-Dichloropropene (cis & trans) (µg/l)	ND	<1.0	NA		
1,2-Dibromo-3-chloropropane (µg/l)	ND	<5.0	NA		
1,2-Dibromoethane (EDB) (µg/l)	ND	<1.0	NA		
Ethylbenzene (µg/l)	ND	<1.0	<0.5	700	
Fluorotrichloromethane (µg/l)	ND	<1.0	NA		
Hexachlorobutadiene (µg/l)	ND	<1.0	NA		
Isopropylbenzene (µg/l)	ND	<1.0	NA		
p-Isopropyltoluene (µg/l)	ND	<1.0	NA		
Naphthalene (µg/l)	ND	<1.0	NA		
n-Propylbenzene (µg/l)	ND	<1.0	NA		
Styrene (µg/l)	ND	<1.0	<0.5	100	
1,1,1,2-Tetrachloroethane (µg/l)	ND	<1.0	NA		
1,1,2,2-Tetrachloroethane (µg/l)	ND	<1.0	NA		
Tetrachloroethene (µg/l)	ND	<1.0	<0.5	5	
Toluene (µg/l)	ND	<1.0	<0.5	1000	

** Sample results from Tetra Tech (2007), ** TW-2 is renamed MJ-PW2.*

Table 4. Summary of Analytical Results for Ground Water Samples from MJ-PW2 (and test wells TW-1 and TW-2 for comparison), Middletown-Junction Property, Ohio.

PARAMETER	TW-1*	TW-2**	MJ-PW2	MCL	SMCL
Volatile Organic Chemicals (VOCs) (Continued)					
1,2,3-Trichlorobenzene (µg/l)	ND	<1.0	NA		
1,2,4-Trichlorobenzene (µg/l)	ND	<1.0	<0.5	70	
1,1,1-Trichloroethane (µg/l)	ND	<1.0	<0.5	200	
1,1,2-Trichloroethane (µg/l)	ND	<1.0	<0.5	5	
Trichloroethylene (µg/l)	ND	<1.0	<0.5	5	
1,2,3-Trichloropropane (µg/l)	ND	<1.0	NA		
1,2,4-Trimethylbenzene (µg/l)	ND	<1.0	NA		
1,3,5-Trimethylbenzene (µg/l)	ND	<1.0	NA		
Vinyl Chloride (µg/l)	ND	<1.0	<0.5	2	
Xylenes, total (µg/l)	ND	<1.0	<0.5	10,000	

** Sample results from Tetra Tech (2007), ** TW-2 is renamed MJ-PW2*

Table 5. Summary of Analytical Results for Ground Water Samples from MJ-PW2 (and test wells TW-1 and TW-2 for comparison), Middletown-Junction Property, Ohio.

PARAMETER	TW-1*	TW-2**	MJ-PW2	MCL	SMCL
Synthetic Organic Chemicals (SOCs)					
Alachlor (mg/l)	<0.000020	NA	<0.00020	0.002	
Atrazine (mg/l)	<0.000030	NA	<0.00030	0.003	
Simazine (mg/l)	<0.000040	NA	<0.00035	0.004	
Radiological Parameters					
Gross Alpha (pCi/L)	<3	NA	<3		
Gross Beta (pCi/L)	NA	NA	<4		
Radium-226 and Radium-228 (Combined)	3	NA	<1	*5 pCi/L*	
Uranium	NA	NA	NA	*30 pCi/L*	
Per and Polyfluoroalkyl Substances (PFAS)					
Perfluorooctanoic acid (PFOA) (µg/L)	NA	<0.0044	0.0024	0.004	
Perfluorooctane sulfonate (PFOS) (µg/l)	NA	**0.014**	**0.0164**	0.004	
Perfluorononanoic acid (PFNA) (µg/L)	NA	<0.0046	<0.00188	1.0*	
Perfluorobutane sulfonate (PFBS) (µg/L)	NA	<0.0044	0.00226		
Perfluorohexane sulfonate (PFHxS) (µg/L)	NA	<0.0044	<0.00188		
Hexafluoropropylene oxide dimer acid (HFPO-DA) (µg/L)	NA	<0.0023	<0.00188		
Biological Parameters					
Total Coliform	Negative	NA	Negative		
Fecal Coliform	Negative	NA	NA		
Indicator Parameters					
Redox Potential (Eh)	NA	-206.1 mV	NA		
Dissolved Oxygen	NA	5.24 mg/L	NA		
Temperature	NA	14.62˚C	NA		
Specific Conductance	NA	820 $^{\mu\text{mhos}}$/cm	NA		
pH (field)	NA	6.82 s.u.	NA		
Turbidity	NA	0.30 NTU	NA		

Note: Highlighted Results exceed either MCL or SMCL levels.

BDL – Below Detection Limit
MCL – Maximum Contaminant Level
SMCL – Secondary Maximum Contaminant Level

NTU – Nephelometric Turbidity Units* Hazard Index (Unitless)

**Sample results from Tetra Tech (2007), ** TW-2 is renamed MJ-PW02*

REFERENCES

Bierschenk, W.H., 1964. Determining well efficiency by multiple step-drawdown tests, Proceedings of the General Assembly Berkeley, Publication 64, pp 493-507.

Cooper, H.H., Jr. and C.E. Jacob, 1946, A Generalized Graphical Method of Evaluating Formation Constants and Summarizing Well-Field History: American Geophysical Union, V27, pp. 526-534.

Kasenow M, 2001. Applied Ground-Water Hydrology and Well Hydraulics: Water Resources Publications, LLC., Highlands Ranch, Colorado, USA, 831 p.

Moench, A.F., 1985. Transient flow to a large-diameter well in an aquifer with storatitive semi-confining layers, Water Resources Research, vol. 21, no. 8 pp. 1121-1131.

Moench, A.F. and T.A. Prickett, 1972. Radial flow in an infinite aquifer undergoing conversion from artesian to water-table conditions, Water Resources Research, vol. 8, no. 2, pp. 494-499.

Neuman, S.P. and P.A. Witherspoon, 1969. Theory of flow in a confined two aquifer system, Water Resources Research, vol. 5, no. 4, pp. 803-816.

Ohio Environmental Protection Agency, 2023, Guidelines for Design of Small Public Ground Water Systems: Guidance Document prepared by the Ohio EPA, Division of Drinking and Ground Waters, June 2023, 78p.

Papadopulos, I.S. and H.H. Cooper, 1967. Drawdown in a well of large diameter, Water Resources Research, vol. 3, pp. 241-244.

Rorabaugh, M.I., 1953. Graphical and theoretical analysis of step-drawdown tests of artesian well, Am. Soc. Of Civil Engineers, vol. 79, No. 362, 23p.

Terran Corporation, 2022a, Wellfield Production Analysis for the East, Revis, Sod Farm and Thompson Wellfields, Warren County, Ohio: consultant report TB-2203, May 18, 2022, prepared for the Warren County Water & Sewer Dept., 357p.

Terran Corporation, 2022b, Technical Memorandum for Hydrogeologic Investigation, Middletown Junction Property, Warren County, Ohio: Consultant report, December 8, 2022, prepared for the Warren County Water & Sewer Dept., 72p.

Terran Corporation, 2023, Technical Memorandum for Test Well TW-2 Evaluation, Middletown-Junction Property, Warren County, Ohio: Consultant report, August 4, 2023, prepared for the Warren County Water & Sewer Dept., 82p.

Terran Corporation, 2024a, Technical Memorandum for F&T Modeling Evaluation of the Potential Outfall Effluent Impact, Proposed Middletown-Junction Well Field, Warren County, Ohio: Consultant report, January 22, 2024, prepared for the Warren County Water & Sewer Dept., 70p.

Terran Corporation, 2024b, Technical Memorandum #2 for F&T Modeling Evaluation of the Potential Outfall Effluent Impact, Test Well TW-2 Utilization as Backup Production Well at the Proposed Middletown-Junction Well Field, Warren County, Ohio: Consultant report, March 6, 2024, prepared for the Warren County Water & Sewer Dept., 21p.

Tetra Tech EM, Inc., 2007, Little Miami River Wellfield Development: Consultant Report prepared for the City of Lebanon, March 6, 2007, 18p.

Theis, C.V., 1935, The Relation between the lowering of the Piezometric Surface and the Rate and duration of discharge of a Well using Ground-Water Storage: American Geophysical Union Transaction, Vol. 16., pp 519-524.

ATTACHMENT #1

ODNR WELL LOG
FOR
PRODUCTION WELL MJ-PW2

DNR 7802.93

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

785540

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

Permit Number

COUNTY WARREN

TOWNSHIP HAMILTON

SECTION/~~LOT~~ ~~No.~~ (CIRCLE ONE) N W

OWNER/BUILDER (CIRCLE ONE OR BOTH) WARREN COUNTY (WATER)

PROPERTY ADDRESS FOREST PRESERVE MIDDLETOWN JUNCTION (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY BEND OF LITTLE MIAMI RIVER APPROX 5000' W OF SR48 @ SOUTH LEBANON

CONSTRUCTION DETAILS

CASING

Borehole Diameter 24 in.

1 Diameter 16 in. Length 53 ft. Wall Thickness .375 in.

2 Diameter __ in. Length __ ft. Wall Thickness __ in.

Type: ☒ Steel ☐ Galv. ☐ PVC ☐ Other __

Joints: ☐ Threaded ☒ Welded ☐ Solvent ☐ Other __

Liner: Length __ Type __ Wall Thickness __ in.

SCREEN

Type (wire wrapped, louvered, etc.) WIRE WRAP Material SS

Length 20 ft. Diameter 16" in.

Set between 51 ft. and 71 ft. Slot .110

GROUT

Material CONCRETE Volume used 3 CU YD

Method of installation POUR

Depth: placed from 5 ft. to 30 ft.

GRAVEL PACK (Filter Pack)

Material SILICA Volume used 130 CU FT

Method of installation POUR

Depth: placed from 45 ft. to 71 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well PRODUCTION TEST

☐ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other BUCKET

Date of Completion 3/11/94

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
TOP SOIL	0	2'
BROWN CLAY	2'	10'
BROWN SANDY CLAY	10	14'
BROWN SAND & GRAVEL W/SOME LARGE COBBLES	14'	67'
GRAY FINE SAND	67	71'
GRAY CLAY	71'	

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☒ Pumping* ☐ Other

Test rate 1702 gpm Duration of test 10 DAYS hrs.

Drawdown 26' ft.

Measured from: ☒ top of casing ☐ ground level ☐ Other

Static Level (depth to water) 18' ft. Date: 3/18 → 3/28

Quality (clear, cloudy, taste, odor) CLEAR

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

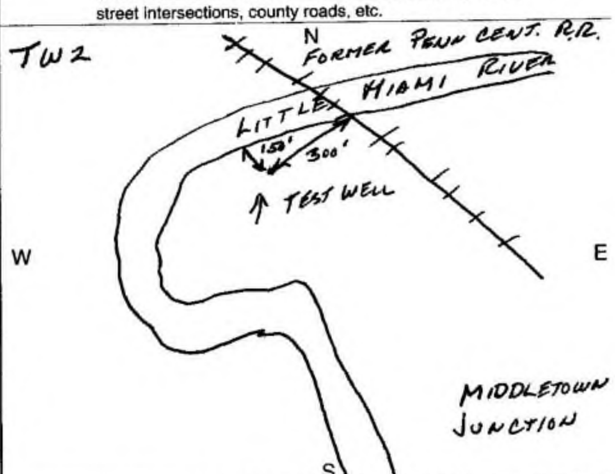
Type of pump NONE Capacity __ gpm

Pump set at __ ft.

Pump installed by

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm REYNOLDS, INC

Signed E.S. Schlaach

Address 6451 GERMANTOWN RD

Date APRIL 1, 1994

City, State, Zip MIDDLETOWN OH 45042

ODH Registration Number

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

5483

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

ATTACHMENT #2

MW-PW2 SUBMERSIBLE PUMP
PERFORMANCE SHOP DRAWINGS DOCUMENTS

Customer : Envirolutions LLC
Reference :

Pump Performance Datasheet

American-Marsh Pumps Quotation System 24.6.5

Item number : 001
Service :
Quantity : 1
Quote number : 2210666

Size : 13MC
Stages : 4
Based on curve number : 13MC
Basic model number : -
Date last saved : 08 Apr 2025 11:26 AM

Operating Conditions

Flow, rated : 1,100.0 USgpm
Differential head / pressure, rated (requested) : 282.0 ft
Differential head / pressure, rated (actual) : 284.4 ft
Suction pressure, rated / max : 0.00 / 0.00 psi.g
NPSH available, rated : Ample
Site Supply Frequency : 60 Hz

Performance

Speed criteria : Synchronous
Speed, rated : 1750 rpm
Impeller diameter, rated : 9.69 in
Impeller diameter, maximum : 9.94 in
Impeller diameter, minimum : 8.63 in
Efficiency (bowl / pump) : 82.65 / - %
PEI (CL) : -
NPSH required / margin required : 14.36 / 0.50 ft
Ns (total flow) / Nss (imp. eye flow) : 2,665 / 7,615 US Units
MCSF : 772.8 USgpm
Head, maximum, rated diameter : 336.8 ft
Head rise to shutoff (bowl / pump) : 19.42 / - %
Flow, best eff. point (bowl / pump) : 1,296.8 / - USgpm
Flow ratio, rated / BEP (bowl / pump) : 84.83 / - %
Diameter ratio (rated / max) : 97.48 %
Head ratio (rated dia / max dia) : 91.98 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010] : 1.00 / 1.00 / 1.00 / 1.00
Selection status : Acceptable

Liquid

Liquid type : Water
Additional liquid description :
Solids diameter, max : 0.00 in
Solids concentration, by volume : 0.00 %
Temperature, max : 68.00 deg F
Fluid density, rated / max : 0.998 / 0.998 g/cm3
Viscosity, rated : 1.00 cP
Vapor pressure, rated : 0.34 psi.a

Material

Material selected : Cast iron - Standard

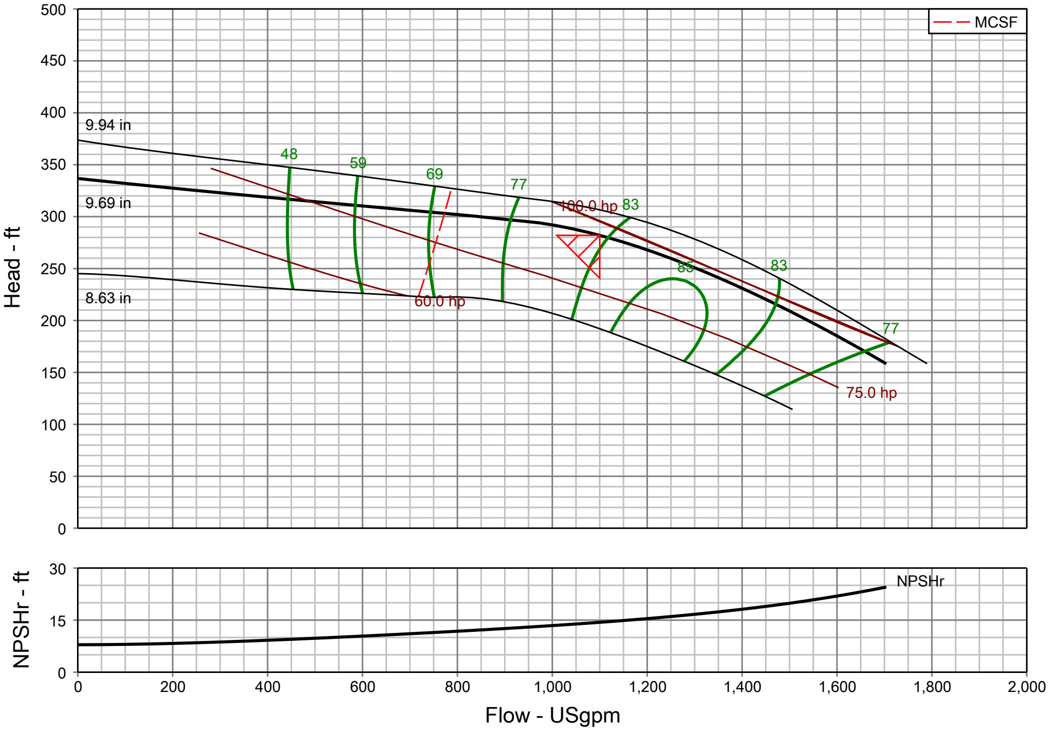
Pressure Data

Maximum working pressure : See the Additional Data page
Maximum allowable working pressure : See the Additional Data page
Maximum allowable suction pressure : N/A
Hydrostatic test pressure : See the Additional Data page

Driver & Power Data (@Max density)

Driver sizing specification : Maximum power
Margin over specification : 0.00 %
Service factor : 1.15
Power, hydraulic : 78.31 hp
Power (bowl / pump) : 94.75 / - hp
Power, maximum, rated diameter : 97.25 hp
Minimum recommended motor rating : 100 hp / 74.57 kW

Bowl performance. Adjusted for construction and viscosity.
The duty point represents the head at the bowl.



Pump Performance - Additional Data

American-Marsh Pumps Quotation System 24.6.5

Item number	: 001	Size	: 13MC
Service	:	Stages	: 4
Quantity	: 1	Speed, rated	: 1750 rpm
Quote number	: 2210666	Intellicode	:
		Date last saved	: 08 Apr 2025 11:26 AM

Performance Data

Head, maximum diameter, rated flow	: 306.6 ft
Head, minimum diameter, rated flow	: 192.1 ft
Head, maximum, rated diameter	: 336.8 ft
Efficiency adjustment factor, total	: 0.99
Power adjustment, total	: 0.95 hp
Head adjustment factor, total	: 1.00
Flow adjustment factor, total	: 1.00
NPSHR adjustment factor, total	: 1.00
User applied performance adjustment comments	:
NPSH margin dictated by pump supplier	: 0.50 ft
NPSH margin dictated by user	: 0.00 ft
NPSH margin used (added to 'required' values)	: 0.50 ft

Mechanical Limits

Torque, rated power, rated speed	: 5.41 hp/100 rpm
Torque, maximum power, rated speed	: 5.56 hp/100 rpm
Torque, driver power, full load speed	: 5.62 hp/100 rpm
Torque, driver power, rated speed	: 5.62 hp/100 rpm
Torque, pump shaft limit	: 22.99 hp/100 rpm
Radial load, worst case	: -
Radial load limit	: -
Impeller peripheral speed, rated	: -
Impeller peripheral speed limit	: -

Stage, Speed and Solids Limits

Stages, maximum	: 21
Stages, minimum	: 1
Pump speed limit, maximum	: 2200 rpm
Pump speed limit, minimum	: 800 rpm
Curve speed limit, maximum	: 2200 rpm
Curve speed limit, minimum	: 300 rpm
Variable speed limit, maximum	: -
Variable speed limit, minimum	: 100 rpm
Solids diameter limit	: 0.75 in

Energy Indexes

Bare pump model number	: 13MC
Basic model number	: -
PEI CL/VL	: - / -
ER CL/VL	: - / -

Typical Driver Data

Driver speed, full load	: 1780 rpm
Driver speed, rated load	: 1781 rpm
Driver efficiency, 100% load	: N/A
Driver efficiency, 75% load	: N/A
Driver efficiency, 50% load	: N/A

Various Performance Data	Flow (USgpm)	Head (ft)	Efficiency (%)	NPSHr (ft)	Power (hp)
Shutoff, rated	0.00	336.8	-	-	63.47
Shutoff, maximum	0.00	373.7	-	-	71.59
MCSF	772.8	303.2	70.59	11.59	83.78
Rated flow, minimum	1,100.0	192.1	84.56	-	63.08
Rated flow, maximum	1,100.0	306.6	81.87	-	104
BEP flow, rated	1,296.8	251.5	84.72	16.62	97.17
120% rated flow, rated	1,320.0	247.1	84.69	16.94	97.23
End of curve, rated	1,703.9	158.3	74.84	24.52	90.99
End of curve, minimum	1,506.4	114.3	71.61	0.00	60.72
End of curve, maximum	1,789.8	158.5	73.91	27.07	96.88
Maximum value, rated	-	336.8	84.72	-	97.25
Maximum value, maximum	-	-	84.15	-	109

System differential pressure	@ Density, rated	@ Density, max
Differential pressure, rated flow, rated (psi)	122.0	122.0
Differential pressure, shutoff, rated (psi)	145.7	145.7
Differential pressure, shutoff, maximum (psi)	161.7	161.7

Discharge pressure	@ Suction pressure, rated	@ Suction pressure, max	@ Suction pressure, rated	@ Suction pressure, max
Discharge pressure, rated flow, rated (psi.g)	122.0	122.0	122.0	122.0
Discharge pressure, shutoff, rated (psi.g)	145.7	145.7	145.7	145.7
Discharge pressure, shutoff, maximum (psi.g)	161.7	161.7	161.7	161.7

Ratios

Maximum flow / rated flow, rated	: 154.90 %	Head rated diameter / head minimum diameter, rated flow	: 146.82 %

Customer : Envirolutions LLC
Reference :

Pump Performance - Additional Data

American-Marsh Pumps Quotation System 24.6.5

Head and Power Losses

Friction loss rate, column	: -
Friction loss, column	: -
Friction loss, discharge head	: -
Friction loss, can/barrel	: -
Friction loss, suction bell and strainer	: 0.00 ft
Friction loss, bowl/column adaptor	: -
Friction loss, total	: -
Power loss, lineshaft bearings	: -
Power loss, thrust bearing	: -
Power loss, total	: -

Bowl vs. Pump Performance

Head (bowl / pump)	: 282.0 ft / -
Efficiency (bowl / pump)	: 82.65 % / -
Power (bowl / pump)	: 94.75 hp / -
NPSH required at first stage impeller eye	: 14.36 ft

Weights and Down Thrust

Weight, lineshaft	: -
Weight, bowl assembly rotating element	: 86.04 lb
Thrust factor	: 7.90 lb/ft
Thrust, hydraulic (rated / max)	: 2,224.0 / 2,655.9 lbf
Thrust, bowl shaft end (rated / max)	: 0.00 / 0.00 lbf
Thrust, shaft step (rated / max)	: - / -
Thrust, stuffing box sleeve (rated / max)	: - / -
Thrust, total (rated / max)	: 2,310.1 / 2,741.9 lbf
Thrust Limit	: -

* Rated thrust @ rated head, density, and suction pressure where applicable
* Max thrust @ max head, density, and suction pressure where applicable

Pressure Data	Maximum working pressure (psi.g)	Maximum allowable working pressure (psi.g)	Hydrostatic test pressure (psi.g)
Bowl	145.7	230.0	345.0
Column	-	-	-
Discharge head	-	-	-
Can/Barrel	-	-	-

Torque Limits

Torque, lineshaft limit	: -

Dimensions

Minimum clearance below suction bell lip/case	: 6.00 in
Minimum well diameter	: 0.00 in
Suction nozzle centerline height	: -
Suction to first stage impeller centerline	: -
Bowl assembly length, first stage	: 23.63 in
Bowl assembly length, upper stage	: 10.75 in
Bowl assembly length, total	: 55.88 in
Suction bearing hub length	: 0.00 in
Strainer length	: 0.00 in
Bowl to column adaptor length	: -
Discharge head stick-down	: -
Submersible motor adaptor length	: -
Submersible motor length	: -
Column length	: -
Total pump length	: -
Can / barrel length	: -
Stuffing box sleeve diameter	: -
Suction bell diameter	: 12.00 in
Minimum submergence to prevent vortexing	: 24.00 in
Discharge head height	: -
Discharge nozzle centerline height	: -
Min distance discharge nozzle centerline to suction bell	: 0.00
Lineshaft length	: -
Bowl shaft diameter	: 1.69 in
Bowl diameter, outside	: 12.13 in
Bowl diameter, exit	: 9.14 in
Column diameter, inside	: -
Column internal obstruction diameter	: -
Can/barrel diameter, inside	: -
Can/barrel obstruction diameter	

NPSH

NPSH at bowl (available / required)	: Ample / 14.36 ft
NPSH at low liquid level (available / required)	: - / -
NPSH at suction flange (available / required)	: - / -

Liquid Velocities

Column liquid velocity	: -
Discharge head liquid velocity	: -
Can liquid velocity	: -
Suction nozzle liquid velocity	: -

Additional Design Conditions

NSF/ANSI/CAN 61 & 372 Certification Required	: NO	Head Measurement Location	: Top of bowl
Pump Design	: Bowl only	Well Inside Diameter	: in
Impeller Type	: Enclosed Impeller	NPSH Measurement Location	: Bowl

Bowl Options

Impeller Fastener	: Collet	Bowl Suction Connection Size	: 8 inch
Bowl Shaft Material	: 416ss	Bowl Suction Type	: Threaded
Bolting	: Standard Bolting	Suction Strainer Type	: None
Bowl Discharge Type	: Threaded		

PLEUGER

Submersible Motors

Ranges 6” - 16”

60 Hz

Highest Reliability & Durability
Energy Efficiencies up to

95%

PLEUGER. Reliable. Always.

Table of Content

About PLEUGER

PLEUGER is an international manufacturer and supplier of submersible motors, pumps, thrusters and plunger pumps and related services with headquarters in Hamburg, Germany. Renowned worldwide across the energy, mining, water, industrial processing and the oil & gas industries for absolute reliability and outstanding longevity, our products are designed, engineered and manufactured to solve some of the toughest applications in the most challenging and harshest environments. With over 90 years experience we are experts in electric submersible motors and pumps for various applications in the Water and General Industry, including Mining and Oil & Gas market sector. With German engineering know-how and many years of industry experience, PLEUGER meets the demands of customers worldwide for performance, durability, energy efficiency and total cost of ownership.

PLEUGER CRAFTSMANSHIP

PLEUGER stands for true craftsmanship, combining vision, precision and attention to detail.

From our unique manufacturing processes for stators, to our unrivalled winding capabilities for submersible motors, each element is part of our journey to absolute perfection.

Nothing is more important to us than the reliability and durability of our products.

DESIGN & ENGINEERING

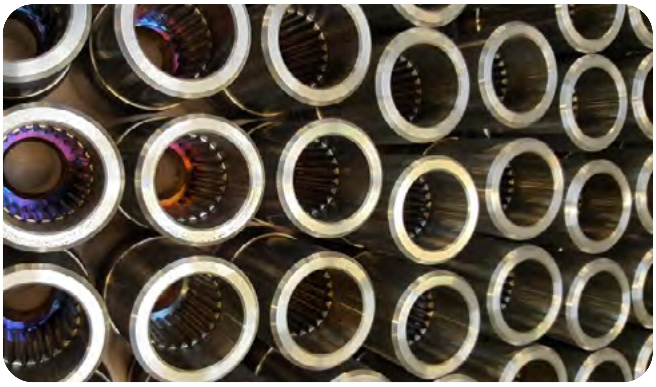
PLEUGER believes in total reliability and the very best quality. We achieve this through precision design and engineering. Proven throughout our decades of experience in consulting, engineering and manufacturing for the most demanding applications around the world.

We offer you the best fit for your submersible pump solution. Engineered for performance. Built to last.

TECHNOLOGIES

Our design engineers, production engineers and data analysts are always investigating how new technologies, materials and approaches can enhance what we do, to maximise performance and reliability and minimize energy consumption.

PLEUGER submersible pump units keep critical systems running across the world in energy, drinking water, industrial processes, dewatering and geothermal heating applications.



PLEUGER SUBMERSIBLE PUMPS

Best-in-class submersible pumps built for reliability and performance.

PLEUGER Submersible Motors — Made in Germany

As a manufacturer of world-class submersible motors, every PLEUGER product is designed, engineered and manufactured to the highest standards for efficiency, corrosion protection, and an extended power range.

Standard Motors

- 6″ to 50″
- Induction motor, Asynchronous motor
- Power output: 5.5 kW to 5 MW (7.4 HP to 6,705 HP)
- Operating speed: 200 to 3600 rpm – 2,4,6,8 pole designs
- 200 V to 6.6 kV / 50 and 60 Hz

PMM Motors

- 6″ to 8″
- Synchronous motor
- Power output: 4.0 to 165 kW (5.36 to 221 HP), 200 kW (268 HP) on request
- Operating speed: 2100 to 3600 rpm (max 3800 rpm) 4 pole design
- Driven by Variable Frequency Drive (VFD)
- VFD input voltage 400 to 500 V / 70 and 120 Hz

Key Features

- Water-filled motors as standard
- Oil-filled motors on request
- Rewindable
- Operating temperatures: -20°C to +50°C / -4°F to +122°F, on request -30°C to +85°C / +22°F to +185°F
- Suitable for VFD operation

International Design Standards

Design Standards: ANSI / ASTM / DIN / ISO / Hydraulic Institute / CE / API 610

Hydraulic Standards: ANSI/HI / EN ISO / API610 / NFPA20

Electrical Standards: NEMA / IEC / IEEE

Certifications: DNV GL / ABS / CSA / ATEX/ NSF61

Approvals: ISO 9001

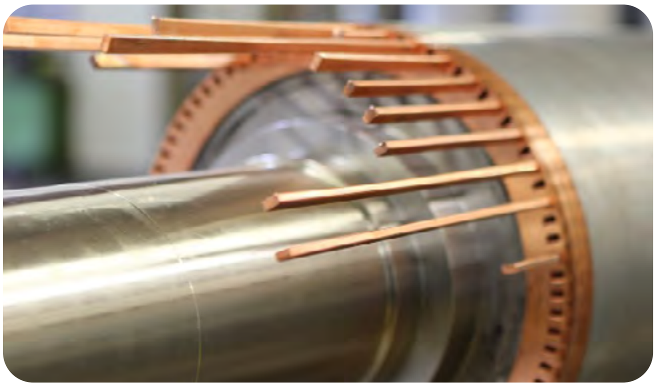
PLEUGER. Reliable. Always.

NSF

Made in Germany

Significant savings in energy costs

High-performance pumps with increased efficiency of up to 85% (average η opt > 83%) available



PLEUGER Motors/

PLEUGER PMM Motors

Our engineers and analysts are always investigating how new technologies, materials and approaches can enhance what we do, to maximise performance and reliability and minimize energy consumption.

PLEUGER PMM motors are rewindable, synchronous electric motors with significant Increase of Motor Efficiency (up to 95%) and Power Output.

Available from 4 kW (5.4 HP) to 165 kW (to 221 HP), 200 kW (268 HP) on request with efficiencies up to 94%

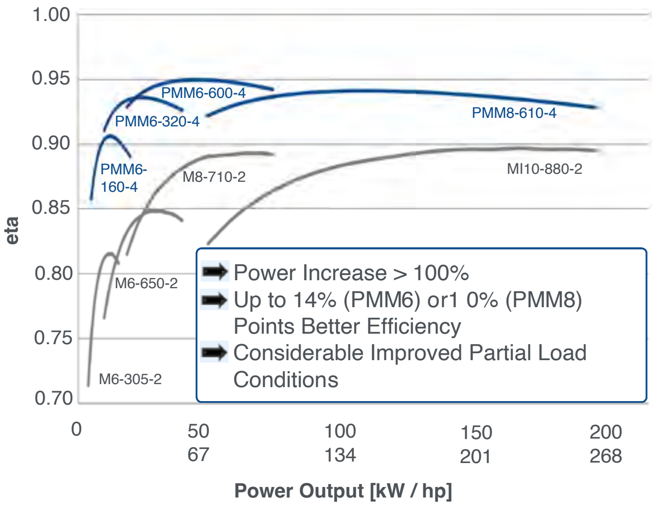
- Designed to minimize life cycle costs
- Design based on the reliable PLEUGER asynchronous / induction motor
- Operated via variable frequency drive (VFD) ensures most efficient operation
- PLEUGER offers the complete system of pump, motor and VFD

PLEUGER PMM Motors

Designed for increased performance and reduced life-cycle costs.

Features and Benefits

- Up to 14 percent points better efficiency than asynchronous motors
- Increased power output of more than 100%, motors allow smaller unit sizes with reduced installation costs
- Wide efficiency curves drastically reduce number of motor sizes and simplify storage
- No special VFD required; standard VFDs from various manufacturers can be used
- No sinus filter or du/dt filter required, reduce investment and energy cost

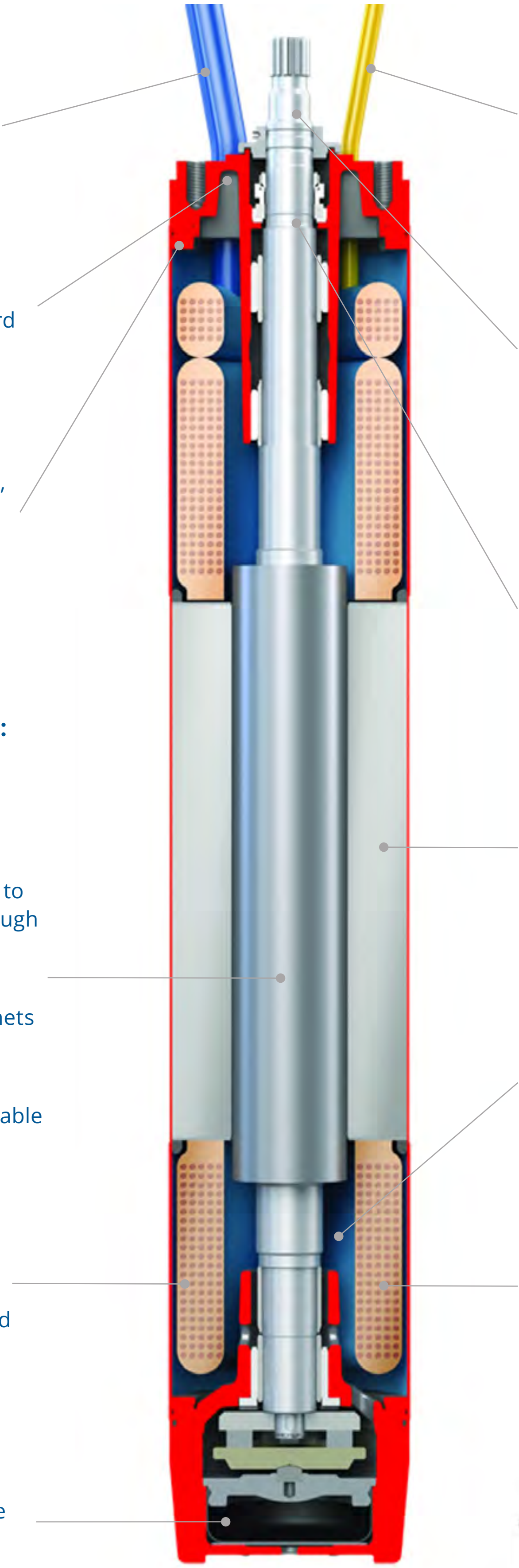


Motor Type	Power Output * kW (HP)	Current * A	Efficiency * %	Cos Phi *	Length, L mm (inch)	Diameter, D mm (inch)	Weight kg (lb)	Maximum Permissible Thrust kN (lbf)	
								Down	Up
PMM6-160-4	4.0 (5.4)	8.2	87.0%	0.995	696 (27.40)	144 (5.669)	46 (101)	27.5 (6100)	6 (1350)
	5.5 (7.4)	11.0	89.0%	0.990					
	9.2 (12.3)	17.9	91.0%	0.975					
	11.0 (14.3)	21.5	91.5%	0.965					
	13.0 (17.4)	25.5	91.0%	0.955					
	15.0 (20.1)	29.0	91.0%	0.940					
PMM6-320-4	15.0 (20.1)	28.5	92.5%	0.990	856 (33.70)	144 (5.669)	64 (141)	27.5 (6100)	6 (1350)
	18.5 (24.8)	35.0	93.0%	0.985					
	22.0 (29.5)	41.5	93.5%	0.975					
	26.0 (34.9)	48.5	93.5%	0.970					
	30.0 (40.2)	57.0	93.0%	0.960					
	33.0 (44.3)	63.0	93.0%	0.950					
	37.0 (49.6)	71.0	92.5%	0.935					
	40.0 (53.6)	77.0	92.5%	0.925					
PMM6-600-4	40.0 (53.6)	79.0	94.5%	0.980	1136 (44.72)	144 (5.669)	101 (223)	27.5 (6100)	6 (1350)
	46.0 (61.7)	92.0	94.5%	0.970					
	50.0 (67.1)	100.0	94.5%	0.965					
	55.0 (73.8)	110.0	94.5%	0.960					
	60.0 (80.5)	121.0	94.5%	0.950					
	68.0 (91.2)	137.0	94.5%	0.935					
	75.0 (100.6)	153.0	94.0%	0.920					
PMM8-610-4	75.0 (100.6)	140.0	93.5%	0.985	1438 (56.61)	186 (7.323)	179 (395)	40.0 (9000)***	12.5 (2800)
	83.0 (111.3)	153.0	94.0%	0.985					
	90.0 (120.7)	166.0	94.0%	0.985					
	110.0 (147.5)	205.0	94.0%	0.975					
	140.0 (187.7)	260.0	94.0%	0.960					
	165.0 (221.0)	285.0	93.0%	0.940					
	**								

* at 120 Hz and 3600 rpm, max. water temperature: 30°C/86°F, min. water velocity at motor surface: 0,5 m/s /1.64 ft/s, at Service Factor 1.0

** up to 200.0 (268) on request, *** max downthrust capacity 80KN/17,985 lbf on request

PLEUGER Standard and PMM Motors



Flat- or round cable

Space-saving cable design. Certified for drinking water applications.

NEMA or IEC flange connection

Universal connector to standard hydraulics.

Motor housing

Cast housing designed for reliability, corrosion resistance, strength and durability.

Induction Motor: Squirrel Cage Rotor for Asynchronous Motor
or
Permanent Magnet Motor: Rotor equipped with Permanent Magnets for Synchronous Motor

- Up to 14 % points higher motor efficiency compared to asynchronous motors, through reduction in copper loss
- Hermetically sealed rotor ensures protection of magnets against corrosion and mechanical damage
- Up to 200 kW (268 HP) available

Rewindable winding

Ease of maintenance and cost saving. PE or PE2 insulation.

PE2+PA insulation for optimized winding lifetime.

Breather diaphragm

Liquid pressure compensation to extend the service life of the mechanical seal and O-ring.

Signal Cable (Optional)

Used with temperature sensor PT100
For monitoring motor temperature.

Motor Shaft End

Standard duplex stainless steel for best combination of corrosion resistance, mechanical strength and stiffness. Special materials available upon request.

Mechanical Seal

High-grade SIC/SIC/Viton® as standard ensures wear resistance and ultra-low maintenance requirements.

Stator Tube

Standard 316 stainless steel construction for excellent corrosion resistance over the service life. Special materials available on request.

Motor Filling

Prefilled and tested with water/ glycol mixture, or potable water on request.

Thrust Bearing

Heavy-duty, custom polymer to ensure ultra-low maintenance and maximum reliability

PLEUGER. Reliable. Always.

Thrust Bearings

PLEUGER motors are equipped with heavy duty motor axial thrust bearings made of high-performance polymers for highest axial thrust loads ensuring extraordinary lifetime and reliability.

- Developed by PLEUGER Industries
- Benchmark in submersible motor technology
- In operation since 2013
- Custom Polymer Material
- Heavy-duty design, up to 300kN axial thrust
- Ensures extraordinary lifetime of motor

Advantages

- Tilting pads made of proprietary synthetic material
- Rotating runner made of Stainless Steel
- Increase of lifetime
- Maintenance free
- Allowed axial thrust increased by 100% (up to 300kN)
- Lower absorbed power by 20%

- Increased wear resistance by using new polymers
- Improved dry run capabilities
- Increased water hammer resistance
- Lower starting torque
- Bi-directional operation
- High temperature resistance
- No contamination based on carbon wear

VPI

ROTOR MANUFACTURE - VACUUM PRESSURE IMPREGNATION (VPI)

The manufacture of our rotors includes a vacuum pressure impregnation process that ensures complete penetration of the epoxy into the micro laminations which are used to build up the layers of the rotor.

The VPI process results in a far stronger and more durable construction than traditional processes, allowing for final milling and honing to ensure the perfect rotor balance.

Due to the vacuum, air and moisture between the rotor laminations are extracted and replaced by liquid epoxy resin.

This prevents the occurrence of harmful:

- imbalance due to air pockets during operation of the motor
- corrosion between the rotor blades

The subsequent heat treatment of the rotor solidifies the already impregnated rotor pack into a solid block, which further increases the stiffness of the complete rotor.

Consequently, the bending of the rotor and thus the bending moment in the radial bearings are reduced, which leads to a longer service life of the bearings and thus of the motor.

COOLING CIRCUIT

Efficient Motor Cooling

- internal cooling system manufactured with a highly efficient cooling impeller
- Customized impeller for each motor size
- The design ensures sufficient thermal motor reserves and minimizes energy losses
- Re-windable / water filled
- Sealed winding wire (PE, PE+PA, etc.)

Cooling and lubrication options:

- Water-Glycol Mixture (standard)
- Drinking Water
- Pure Glycol
- Oil

Glycol plus additives prevent corrosion and serve as anti freeze, as well as being environmentally safe.

PLEUGER. Reliable. Always.

Pleuger Submersible Motor range for Low Voltages SF 1.0

	Model	Power Output	Voltage	Frequency	Speed	Current	Thrust Capacity max.		Length	Power Factor			Efficiency			Standard motor leads		
	d.o.l.	HP 3)	V 4) - 3Ph	Hz	RPM	A	Down(lbf) 5)	Up (lbf)	inches	1/1	3/4	1/2	1/1	3/4	1/2	No. of leads shape	Length ft	Cross section mm²
6" Motors	M6-160-2	8.5	460	60	3440	13.3	2800	1350	21.81	0.810	0.765	0.670	0.745	0.755	0.730	1Fl	9.8	4x2,5
	M6-200-2	11.5	460	60	3430	16.8	2800	1350	23.39	0.830	0.790	0.705	0.765	0.780	0.765	1Fl	9.8	4x2,5
	M6-240-2	15	460	60	3430	21	2800	1350	24.96	0.830	0.790	0.700	0.800	0.810	0.790	1Fl	9.8	4x2,5
	M6-270-2	17.5	460	60	3425	24	2800	1350	26.14	0.835	0.795	0.715	0.810	0.820	0.805	1Fl	9.8	4x2,5
	M6-305-2	21	460	60	3420	29	2800	1350	27.52	0.845	0.810	0.730	0.800	0.815	0.805	1Fl	9.8	4x2,5 1)
	M6-340-2	24	460	60	3420	33	2800	1350	28.90	0.845	0.810	0.725	0.810	0.825	0.815	1Fl	9.8	4x2,5 1)
	M6-400-2	29.5	460	60	3415	39.5	2800	1350	31.26	0.855	0.820	0.735	0.815	0.830	0.820	1Fl	9.8	4x4 1)
	M6-460-2	35	460	60	3430	47	6100	1350	34.49	0.840	0.800	0.710	0.830	0.840	0.825	1Fl	9.8	4x6
	M6-530-2	41.5	460	60	3425	55	6100	1350	37.24	0.850	0.810	0.725	0.830	0.845	0.835	1Fl	9.8	4x6 1)
	M6-600-2	48.5	460	60	3425	63	6100	1350	40.00	0.850	0.810	0.720	0.840	0.850	0.840	1Fl	9.8	4x10
	M6-650-2	53.5	460	60	3415	70	6100	1350	41.97	0.860	0.825	0.745	0.835	0.850	0.840	1Fl	9.8	4x10 1)
	M6-720-2	60.5	460	60	3415	78	6100	1350	44.72	0.860	0.825	0.740	0.840	0.850	0.845	1Fl	9.8	4x10 1)
8" Motors	M8-330-2	53.5	460	60	3470	70	17985	2800	40.87	0.855	0.840	0.790	0.840	0.850	0.835	1Fl	16.4	4x10 1)
	M8-410-2	64.5	460	60	3485	83	17985	2800	44.02	0.855	0.840	0.785	0.850	0.855	0.835	1Fl	23.0	4x16
	M8-480-2	74	460	60	3490	92	17985	2800	46.77	0.870	0.845	0.785	0.865	0.865	0.840	1Fl	23.0	4x16 1)
	M8-530-2	80.5	460	60	3485	102	17985	2800	48.74	0.860	0.850	0.795	0.860	0.865	0.845	1Fl	23.0	4x16 1)
	M8-580-2	88.5	460	60	3490	111	17985	2800	50.71	0.875	0.855	0.800	0.855	0.860	0.845	1Fl	23.0	4x16 1)
	M8-650-2	94	460	60	3495	116	17985	2800	53.46	0.875	0.855	0.805	0.865	0.860	0.845	1Rd	23.0	4x25
	M8-710-2	107	460	60	3490	133	17985	2800	55.83	0.850	0.835	0.780	0.885	0.890	0.885	1Rd	23.0	4x25 1)
	M8-820-2	121	460	60	3490	149	17985	2800	60.16	0.855	0.845	0.795	0.885	0.890	0.885	4Rd	23.0	1x16P 1)
	M8-930-2	134	460	60	3495	165	17985	2800	64.49	0.850	0.835	0.785	0.895	0.895	0.885	4Rd	23.0	1x25P
	M8-990-2	142	460	60	3500	175	17985	2800	66.85	0.850	0.830	0.775	0.895	0.895	0.885	4Rd	23.0	1x25P
	M8-135-4	6.5	460	60	1750	10.5	17985	2800	33.19	0.765	0.685	0.565	0.750	0.750	0.720	1Fl	23.0	4x2.5
	M8-170-4	9	460	60	1755	14.3	17985	2800	34.57	0.745	0.665	0.540	0.780	0.775	0.740	1Fl	23.0	4x2.5
	M8-210-4	12	460	60	1755	18.8	17985	2800	36.14	0.750	0.675	0.555	0.800	0.800	0.775	1Fl	23.0	4x2.5
	M8-280-4	18	460	60	1750	26.5	17985	2800	38.90	0.800	0.730	0.615	0.795	0.805	0.790	1Fl	23.0	4x2.5
	M8-340-4	24	460	60	1750	35	17985	2800	41.26	0.790	0.720	0.605	0.815	0.820	0.805	1Fl	23.0	4x4
	M8-420-4	29.5	460	60	1745	41	17985	2800	44.41	0.810	0.750	0.645	0.830	0.840	0.825	1Fl	23.0	4x4 1)
	M8-520-4	35	460	60	1750	48.5	17985	2800	48.35	0.800	0.740	0.630	0.840	0.845	0.835	1Fl	23.0	4x6
	M8-700-4	49.5	460	60	1745	69	17985	2800	55.43	0.820	0.765	0.655	0.820	0.835	0.825	1Fl	23.0	4x10 1)
	M8-870-4	60	460	60	1750	84	17985	2800	62.13	0.795	0.735	0.620	0.850	0.850	0.835	1Fl	23.0	4x16
	M8-1050-4	72.5	460	60	1750	101	17985	2800	73.15	0.785	0.720	0.600	0.855	0.855	0.840	1Fl	23.0	4x16 1)
10" Motors	MI10-420-2	121	460	60	3465	156	17985	5000	53.27	0.830	0.800	0.720	0.875	0.885	0.875	4Rd	23.0	1x25P
	MI10-490-2	141	460	60	3470	179	17985	5000	56.02	0.835	0.800	0.720	0.880	0.885	0.875	4Rd	23.0	1x25P 1)
	MI10-600-2	177	460	60	3465	220	17985	5000	60.35	0.850	0.820	0.745	0.880	0.890	0.880	4Rd	23.0	1x35P 1)
	MI10-740-2	221	460	60	3470	275	17985	5000	65.87	0.845	0.810	0.730	0.890	0.895	0.885	4Rd	23.0	1x50P 1) 2)
	MI10-880-2	268	460	60	3470	330	17985	5000	71.38	0.845	0.805	0.725	0.895	0.895	0.885	3/4Rd	32.8	1x25PII 1)
	MI10-960-2	295	460	60	3460	360	17985	5000	74.53	0.860	0.835	0.765	0.890	0.895	0.890	3/4Rd	32.8	1x25PII 1)
	MI10-1070-2	322	460	60	3465	395	17985	5000	78.86	0.860	0.830	0.760	0.890	0.895	0.885	3/4Rd	32.8	1x25PII 1)
	MI10-1200-2	355	460	60	3475	435	17985	5000	83.98	0.855	0.820	0.745	0.895	0.895	0.890	3/4Rd	32.8	1x35PII 1)
	MI10-420-4	50	460	60	1750	66	17985	5000	53.27	0.805	0.765	0.685	0.870	0.875	0.860	1Fl	23.0	4x10
	MI10-420-4	72	460	60	1740	98	17985	5000	53.27	0.805	0.770	0.680	0.860	0.870	0.865	1Fl	23.0	4x16 1)
	MI10-490-4	88	460	60	1735	118	17985	5000	56.02	0.810	0.780	0.695	0.865	0.875	0.875	4Rd	23.0	1x16P
	MI10-600-4	115	460	60	1730	154	17985	5000	60.35	0.815	0.785	0.705	0.860	0.875	0.875	4Rd	23.0	1x25P
	MI10-740-4	145	460	60	1730	193	17985	5000	65.87	0.810	0.775	0.690	0.865	0.880	0.880	4Rd	23.0	1x25P 1)
	MI10-880-4	177	460	60	1735	235	17985	5000	71.38	0.810	0.780	0.695	0.870	0.880	0.880	4Rd	23.0	1x35P 1)
	MI10-960-4	193	460	60	1735	255	17985	5000	74.53	0.810	0.775	0.695	0.875	0.885	0.885	4Rd	23.0	1x35P 1)
	MI10-1070-4	212	460	60	1735	280	17985	5000	78.86	0.810	0.775	0.690	0.870	0.880	0.880	4Rd	23.0	1x50P 1) 2)
	MI10-1200-4	241	460	60	1735	320	17985	5000	83.98	0.805	0.770	0.685	0.880	0.890	0.885	4Rd	23.0	1x50P 1) 2)
12" 6)	VNI12-65-2	248	460	60	3495	300	26977	5000	67.48	0.875	0.860	0.815	0.885	0.880	0.860	2Rd	32.8	3/4x25II 1)
	VNI12-75-2	288	460	60	3495	345	26977	5000	71.42	0.880	0.870	0.830	0.885	0.880	0.860	2Rd	32.8	3/4x35II 1)
	VNI12-90-2	322	460	60	3505	385	26977	5000	77.32	0.880	0.860	0.810	0.885	0.880	0.855	2Rd	32.8	3/4x50II 1)
	VNI12-65-4	168	460	60	1720	215	26977	5000	67.48	0.825	0.805	0.745	0.875	0.885	0.880	1Rd	32.8	4x50 1)
	VNI12-75-4	201	460	60	1720	260	26977	5000	71.42	0.825	0.810	0.750	0.875	0.885	0.885	2Rd	32.8	3/4x25II 1)
	VNI12-90-4	248	460	60	1720	320	26977	5000	77.32	0.825	0.810	0.755	0.880	0.890	0.885	2Rd	32.8	3/4x35II 1)
	VNI12-100-4	275	460	60	1720	350	26977	5000	81.26	0.830	0.810	0.755	0.880	0.890	0.885	2Rd	32.8	3/4x35II 1)
	VNI12-110-4	308	460	60	1720	400	26977	5000	85.20	0.825	0.805	0.740	0.880	0.890	0.885	2Rd	32.8	3/4x50II 1)
	VNI12-120-4	350	460	60	1715	450	26977	5000	89.13	0.830	0.815	0.750	0.870	0.885	0.885	2Rd	32.8	3/4x50II 1)
14" 6)	VNI14-50-2	288	460	60	3500	355	33721	9000	71.81	0.850	0.850	0.810	0.895	0.890	0.870	2Rd	32.8	3/4x35II 1)
	VNI14-60-2	322	460	60	3515	395	33721	9000	75.75	0.850	0.835	0.780	0.895	0.890	0.865	2Rd	32.8	3/4x50II 1)
	VNI14-50-4	177	460	60	1730	230	33721	9000	71.81	0.810	0.790	0.720	0.880	0.885	0.875	1Rd	32.8	4x70
	VNI14-60-4	214	460	60	1730	280	33721	9000	75.75	0.820	0.800	0.735	0.880	0.885	0.875	1Rd	32.8	4x70 1)
	VNI14-70-4	241	460	60	1730	310	33721	9000	79.09	0.820	0.795	0.735	0.885	0.885	0.875	2Rd	32.8	3/4x35II 1)
	VNI14-80-4	275	460	60	1730	355	33721	9000	83.62	0.820	0.800	0.730	0.885	0.890	0.875	2Rd	32.8	3/4x35II 1)
	VNI14-90-4	308	460	60	1735	400	33721	9000	87.56	0.820	0.795	0.725	0.885	0.890	0.875	2Rd	32.8	3/4x50II 1)
	VNI14-100-4	335	460	60	1735	430	33721	9000	91.50	0.820	0.795	0.725	0.890	0.890	0.875	2Rd	32.8	3/4x50II 1)
16" 6)	MI16-65-4	322	460	60	1725	425	33721	9000	78.11	0.800	0.790	0.735	0.890	0.900	0.895	2Rd	32.8	3/4x50II 1)

1) Cable must be submerged, 2) PE conductor outside the motor, 3) max. water temperature: 30°C/86°F, min. water velocity at motor surface: 0,5 m/s /1.64 ft/s, 4) +14/-6%, other voltages up to 1000V on request, 5) max. value for thrust bearing only, motor values see pages "motor measures & specifications", 6) higher power output on request

Pleuger Submersible Motor range for Low Voltages SF 1.15

		Power Output		Frequency		Current			Length					Efficiency		Standard motor leads		
	Model		Voltage		Speed		Thrust Capacity max.				Power Factor							
	d.o.l.	HP 3)	V 4) - 3Ph	Hz	RPM	A	Down(lbf) 5)	Up (lbf)	inches	1/1	3/4	1/2	1/1	3/4	1/2	No. of leads shape	Length ft	Cross section mm²
6" Motors	M6-160-2	7.5	460	60	3470	11.6	2800	1350	21.81	0.790	0.730	0.630	0.755	0.750	0.715	1Fl	9.8	4x2,5
	M6-200-2	10	460	60	3460	14.9	2800	1350	23.39	0.815	0.770	0.670	0.775	0.780	0.750	1Fl	9.8	4x2,5
	M6-240-2	12.5	460	60	3460	18.3	2800	1350	24.96	0.810	0.760	0.665	0.805	0.805	0.780	1Fl	9.8	4x2,5
	M6-270-2	15	460	60	3450	21.5	2800	1350	26.14	0.820	0.775	0.685	0.815	0.820	0.795	1Fl	9.8	4x2,5
	M6-305-2	18	460	60	3450	25	2800	1350	27.52	0.830	0.785	0.695	0.810	0.815	0.795	1Fl	9.8	4x2,5 1)
	M6-340-2	21	460	60	3450	28.5	2800	1350	28.90	0.830	0.785	0.690	0.820	0.825	0.805	1Fl	9.8	4x2,5 1)
	M6-400-2	25.5	460	60	3450	34.5	2800	1350	31.26	0.840	0.795	0.700	0.825	0.830	0.815	1Fl	9.8	4x4 1)
	M6-460-2	30.5	460	60	3460	41	6100	1350	34.49	0.820	0.770	0.670	0.835	0.840	0.815	1Fl	9.8	4x6
	M6-530-2	36	460	60	3450	48.5	6100	1350	37.24	0.830	0.785	0.685	0.840	0.840	0.825	1Fl	9.8	4x6 1)
	M6-600-2	42	460	60	3450	56	6100	1350	40.00	0.830	0.785	0.685	0.845	0.850	0.830	1Fl	9.8	4x10
	M6-650-2	47	460	60	3440	62	6100	1350	41.97	0.845	0.805	0.715	0.845	0.850	0.835	1Fl	9.8	4x10 1)
	M6-720-2	52.5	460	60	3445	69	6100	1350	44.72	0.845	0.800	0.705	0.845	0.850	0.835	1Fl	9.8	4x10 1)
8" Motors	M8-330-2	46.5	460	60	3495	61	17985	2800	40.87	0.855	0.830	0.765	0.845	0.845	0.825	1Fl	16.4	4x10 1)
	M8-410-2	55.5	460	60	3505	72	17985	2800	44.02	0.850	0.825	0.760	0.855	0.850	0.825	1Fl	23.0	4x16
	M8-480-2	64.5	460	60	3505	81	17985	2800	46.77	0.860	0.830	0.760	0.865	0.860	0.830	1Fl	23.0	4x16 1)
	M8-530-2	70	460	60	3505	89	17985	2800	48.74	0.855	0.835	0.770	0.860	0.860	0.830	1Fl	23.0	4x16 1)
	M8-580-2	77	460	60	3505	98	17985	2800	50.71	0.865	0.840	0.775	0.855	0.860	0.835	1Fl	23.0	4x16 1)
	M8-650-2	82	460	60	3510	102	17985	2800	53.46	0.870	0.840	0.780	0.865	0.860	0.835	1Rd	23.0	4x25
	M8-710-2	94	460	60	3505	117	17985	2800	55.83	0.845	0.820	0.760	0.890	0.890	0.880	1Rd	23.0	4x25 1)
	M8-820-2	105	460	60	3505	129	17985	2800	60.16	0.850	0.830	0.775	0.890	0.890	0.880	4Rd	23.0	1x16P 1)
	M8-930-2	117	460	60	3510	144	17985	2800	64.49	0.845	0.820	0.760	0.895	0.895	0.880	4Rd	23.0	1x25P
	M8-990-2	123	460	60	3515	153	17985	2800	66.85	0.840	0.815	0.745	0.900	0.895	0.880	4Rd	23.0	1x25P
	M8-135-4	5.5	460	60	1760	9.3	17985	2800	33.19	0.715	0.630	0.510	0.755	0.740	0.695	1Fl	23.0	4x2.5
	M8-170-4	7.5	460	60	1765	12.7	17985	2800	34.57	0.695	0.610	0.485	0.780	0.765	0.720	1Fl	23.0	4x2.5
	M8-210-4	10.5	460	60	1760	17.3	17985	2800	36.14	0.725	0.640	0.520	0.800	0.795	0.755	1Fl	23.0	4x2.5
	M8-280-4	15.5	460	60	1755	23.5	17985	2800	38.90	0.765	0.690	0.565	0.805	0.800	0.775	1Fl	23.0	4x2.5
	M8-340-4	21	460	60	1755	31.5	17985	2800	41.26	0.755	0.680	0.560	0.820	0.820	0.795	1Fl	23.0	4x4
	M8-420-4	25.5	460	60	1755	36.5	17985	2800	44.41	0.780	0.715	0.600	0.835	0.835	0.815	1Fl	23.0	4x4 1)
	M8-520-4	30	460	60	1755	43.5	17985	2800	48.35	0.770	0.705	0.585	0.845	0.845	0.825	1Fl	23.0	4x6
	M8-700-4	43	460	60	1755	61	17985	2800	55.43	0.795	0.730	0.610	0.830	0.835	0.815	1Fl	23.0	4x10 1)
	M8-870-4	52.5	460	60	1755	75	17985	2800	62.13	0.770	0.695	0.575	0.850	0.850	0.825	1Fl	23.0	4x16
	M8-1050-4	63	460	60	1760	91	17985	2800	73.15	0.755	0.680	0.560	0.855	0.855	0.830	1Fl	23.0	4x16 1)
10" Motors	MI10-420-2	105	460	60	3485	136	17985	5000	53.27	0.820	0.775	0.680	0.880	0.880	0.865	4Rd	23.0	1x25P
	MI10-490-2	122	460	60	3490	157	17985	5000	56.02	0.820	0.775	0.680	0.885	0.885	0.865	4Rd	23.0	1x25P 1)
	MI10-600-2	154	460	60	3485	194	17985	5000	60.35	0.840	0.800	0.715	0.885	0.890	0.875	4Rd	23.0	1x35P 1)
	MI10-740-2	192	460	60	3490	240	17985	5000	65.87	0.830	0.785	0.695	0.895	0.890	0.875	4Rd	23.0	1x50P 1) 2)
	MI10-880-2	233	460	60	3490	295	17985	5000	71.38	0.830	0.780	0.685	0.895	0.895	0.880	3/4Rd	32.8	1x25PII 1)
	MI10-960-2	256	460	60	3480	315	17985	5000	74.53	0.850	0.815	0.735	0.895	0.895	0.880	3/4Rd	32.8	1x25PII 1)
	MI10-1070-2	280	460	60	3485	345	17985	5000	78.86	0.850	0.810	0.730	0.895	0.895	0.880	3/4Rd	32.8	1x25PII 1)
	MI10-1200-2	308	460	60	3490	385	17985	5000	83.98	0.840	0.795	0.710	0.895	0.895	0.880	3/4Rd	32.8	1x35PII 1)
	MI10-420-4	43	460	60	1760	58	17985	5000	53.27	0.790	0.740	0.645	0.875	0.870	0.850	1Fl	23.0	4x10
	MI10-420-4	63	460	60	1750	86	17985	5000	53.27	0.790	0.740	0.640	0.865	0.870	0.860	1Fl	23.0	4x16 1)
	MI10-490-4	76.5	460	60	1745	103	17985	5000	56.02	0.795	0.755	0.660	0.875	0.880	0.870	4Rd	23.0	1x16P
	MI10-600-4	100	460	60	1740	135	17985	5000	60.35	0.805	0.760	0.670	0.865	0.875	0.870	4Rd	23.0	1x25P
	MI10-740-4	126	460	60	1745	169	17985	5000	65.87	0.800	0.750	0.655	0.875	0.880	0.875	4Rd	23.0	1x25P 1)
	MI10-880-4	154	460	60	1745	205	17985	5000	71.38	0.800	0.755	0.660	0.875	0.885	0.875	4Rd	23.0	1x35P 1)
	MI10-960-4	168	460	60	1745	225	17985	5000	74.53	0.800	0.750	0.660	0.880	0.890	0.880	4Rd	23.0	1x35P 1)
	MI10-1070-4	184	460	60	1745	245	17985	5000	78.86	0.800	0.750	0.650	0.875	0.885	0.875	4Rd	23.0	1x50P 1) 2)
	MI10-1200-4	210	460	60	1745	280	17985	5000	83.98	0.795	0.745	0.645	0.885	0.890	0.880	4Rd	23.0	1x50P 1) 2)
12" 6)	VNI12-65-2	216	460	60	3510	260	26977	5000	67.48	0.870	0.845	0.790	0.885	0.875	0.845	2Rd	32.8	3/4x25II 1)
	VNI12-75-2	250	460	60	3510	305	26977	5000	71.42	0.875	0.860	0.805	0.885	0.875	0.850	2Rd	32.8	3/4x35II 1)
	VNI12-90-2	280	460	60	3520	340	26977	5000	77.32	0.870	0.850	0.790	0.885	0.875	0.840	2Rd	32.8	3/4x50II 1)
	VNI12-65-4	146	460	60	1735	190	26977	5000	67.48	0.820	0.790	0.715	0.880	0.885	0.875	1Rd	32.8	4x50 1)
	VNI12-75-4	175	460	60	1735	225	26977	5000	71.42	0.820	0.790	0.720	0.885	0.890	0.880	2Rd	32.8	3/4x25II 1)
	VNI12-90-4	216	460	60	1730	275	26977	5000	77.32	0.825	0.795	0.730	0.885	0.890	0.880	2Rd	32.8	3/4x35II 1)
	VNI12-100-4	239	460	60	1730	305	26977	5000	81.26	0.825	0.795	0.725	0.885	0.890	0.880	2Rd	32.8	3/4x35II 1)
	VNI12-110-4	268	460	60	1735	345	26977	5000	85.20	0.820	0.785	0.710	0.890	0.890	0.880	2Rd	32.8	3/4x50II 1)
	VNI12-120-4	303	460	60	1730	390	26977	5000	89.13	0.825	0.795	0.720	0.880	0.885	0.880	2Rd	32.8	3/4x50II 1)
14" 6)	VNI14-50-2	250	460	60	3515	305	33721	9000	71.81	0.855	0.840	0.790	0.895	0.885	0.860	2Rd	32.8	3/4x35II 1)
	VNI14-60-2	280	460	60	3530	350	33721	9000	75.75	0.845	0.820	0.755	0.895	0.885	0.855	2Rd	32.8	3/4x50II 1)
	VNI14-50-4	154	460	60	1740	205	33721	9000	71.81	0.805	0.770	0.690	0.885	0.885	0.865	1Rd	32.8	4x70
	VNI14-60-4	186	460	60	1740	240	33721	9000	75.75	0.815	0.780	0.705	0.885	0.885	0.865	1Rd	32.8	4x70 1)
	VNI14-70-4	210	460	60	1740	275	33721	9000	79.09	0.810	0.780	0.705	0.885	0.885	0.870	2Rd	32.8	3/4x35II 1)
	VNI14-80-4	239	460	60	1745	310	33721	9000	83.62	0.815	0.780	0.700	0.890	0.885	0.870	2Rd	32.8	3/4x35II 1)
	VNI14-90-4	268	460	60	1745	350	33721	9000	87.56	0.810	0.775	0.695	0.890	0.885	0.870	2Rd	32.8	3/4x50II 1)
	VNI14-100-4	291	460	60	1745	380	33721	9000	91.50	0.810	0.770	0.680	0.890	0.885	0.870	2Rd	32.8	3/4x50II 1)
16" 6)	MI16-65-4	280	460	60	1735	365	33721	9000	78.11	0.800	0.775	0.700	0.895	0.900	0.890	2Rd	32.8	3/4x50II 1)

1) Cable must be submerged, 2) PE conductor outside the motor, 3) max. water temperature: 30°C/86°F, min. water velocity at motor surface: 0,5 m/s /1.64 ft/s, 4) +14/-6%, other voltages up to 1000V on request, 5) max. value for thrust bearing only, motor values see pages "motor measures & specifications", 6) higher power output on request

Pleuger Submersible Motor range for Medium Voltages SF 1.0

		Power Output		Frequency		Current			Length				Efficiency			Standard motor leads		
	Model		Voltage		Speed		Thrust Capacity max.			Power Factor								
	d.o.l.	HP$^{2)}$	V$^{3)}$ - 3Ph	Hz	RPM	A	Down(lbf)$^{4)}$	Up (lbf)	inches	1/1	3/4	1/2	1/1	3/4	1/2	No. of leads shape	Length ft	Cross section mm^2
14" Motors - 2300V	VNI14-60-4	115	2300	60	1755	33	33721	9000	75.75	0.775	0.720	0.615	0.855	0.845	0.815	3Rd	39.37	1x16
	VNI14-70-4	173	2300	60	1740	47	33721	9000	79.09	0.800	0.755	0.665	0.865	0.865	0.845	3Rd	39.37	1x16
	VNI14-80-4	230	2300	60	1730	61	33721	9000	83.62	0.815	0.780	0.710	0.870	0.875	0.860	3Rd	39.37	1x16
	VNI14-90-4	288	2300	60	1725	76	33721	9000	87.56	0.810	0.780	0.705	0.870	0.880	0.865	3Rd	39.37	1x16
	VNI14-100-4	316	2300	60	1730	84	33721	9000	91.50	0.805	0.775	0.695	0.875	0.880	0.870	3Rd	39.37	1x16
	VNI14-110-4	345	2300	60	1730	81	33721	9000	95.43	0.810	0.775	0.700	0.880	0.885	0.870	3Rd	39.37	1x16
	VNI14-120-4	403	2300	60	1725	106	33721	9000	99.37	0.805	0.775	0.700	0.880	0.885	0.875	3Rd	39.37	1x16
16" Motors - 4160V	MI16-120-4	230	4160	60	1760	34	33721	9000	99.76	0.810	0.765	0.680	0.860	0.845	0.815	3Rd	39.37	1x16
	MI16-130-4	288	4160	60	1760	42	33721	9000	103.70	0.810	0.765	0.680	0.870	0.860	0.830	3Rd	39.37	1x16
	MI16-145-4	403	4160	60	1760	60	33721	9000	109.61	0.785	0.730	0.630	0.880	0.875	0.845	3Rd	39.37	1x16
	MI16-165-4	575	4160	60	1750	84	33721	9000	117.48	0.795	0.745	0.645	0.890	0.885	0.865	3Rd	39.37	1x16
	MI16-185-4	690	4160	60	1745	99	33721	9000	125.35	0.810	0.770	0.685	0.890	0.890	0.875	3Rd	39.37	1x16

1) Cable must be submerged, 2) max. water temperature: 30°C/86°F, min. water velocity at motor surface: 0,5 m/s /1.64 ft/s, 3) +10/-10%, other voltages up to 1000V on request
4) max. value for thrust bearing only, motor values see pages "motor measures & specifications"

Pleuger Submersible Motor range for Medium Voltages SF 1.15

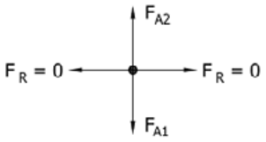
		Power Output		Frequency		Current			Length				Efficiency			Standard motor leads		
	Model		Voltage		Speed		Thrust Capacity max.			Power Factor								
	d.o.l.	HP$^{2)}$	V$^{3)}$ - 3Ph	Hz	RPM	A	Down(lbf)$^{4)}$	Up (lbf)	inches	1/1	3/4	1/2	1/1	3/4	1/2	No. of leads shape	Length ft	Cross section mm^2
14" Motors - 2300V	VNI14-60-4	100	2300	60	1760	30	33721	9000	75.75	0.750	0.685	0.575	0.850	0.840	0.800	3Rd	39.37	1x16
	VNI14-70-4	150	2300	60	1750	42	33721	9000	79.09	0.780	0.730	0.630	0.865	0.860	0.835	3Rd	39.37	1x16
	VNI14-80-4	200	2300	60	1740	54	33721	9000	83,62	0.800	0.760	0.675	0.870	0.870	0.850	3Rd	39.37	1x16
	VNI14-90-4	250	2300	60	1740	67	33721	9000	87.56	0.800	0.760	0.670	0.875	0.875	0.860	3Rd	39.37	1x16
	VNI14-100-4	275	2300	60	1740	74	33721	9000	91.50	0.795	0.750	0.665	0.880	0.880	0.860	3Rd	39.37	1x16
	VNI14-110-4	300	2300	60	1740	80	33721	9000	95.43	0.795	0.755	0.665	0.885	0.880	0.865	3Rd	39.37	1x16
	VNI14-120-4	350	2300	60	1740	93	33721	9000	99.37	0.795	0.755	0.670	0.885	0.885	0.870	3Rd	39.37	1x16
16" Motors - 4160V	MI16-120-4	200	4160	60	1765	31	33721	9000	99.76	0.790	0.735	0.645	0.855	0.835	0.800	3Rd	39.37	1x16
	MI16-130-4	250	4160	60	1765	38	33721	9000	103.70	0.790	0.735	0.645	0.865	0.850	0.815	3Rd	39.37	1x16
	MI16-145-4	350	4160	60	1765	54	33721	9000	109.61	0.760	0.700	0.590	0.880	0.865	0.835	3Rd	39.37	1x16
	MI16-165-4	500	4160	60	1760	76	33721	9000	117.48	0.770	0.710	0.605	0.890	0.880	0.855	3Rd	39.37	1x16
	MI16-185-4	600	4160	60	1755	88	33721	9000	125.35	0.795	0.745	0.645	0.890	0.885	0.865	3Rd	39.37	1x16

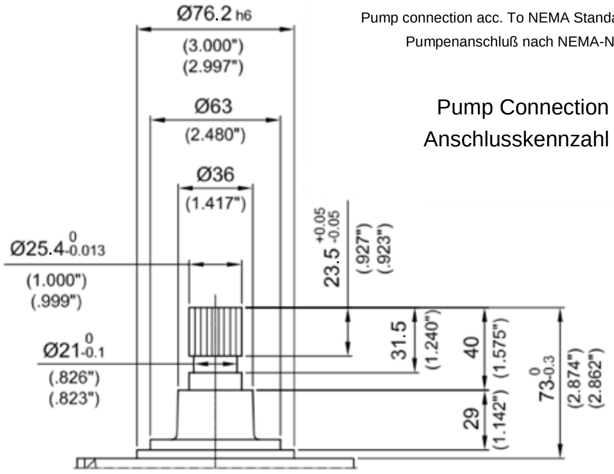
1) Cable must be submerged, 2) max. water temperature: 30°C/86°F, min. water velocity at motor surface: 0,5 m/s /1.64 ft/s, 3) +10/-10%, other voltages up to 1000V on request
4) max. value for thrust bearing only, motor values see pages "motor measures & specifications"

PLEUGER	**Submersible motor** **Unterwassermotor**	**3626/0** 09.18
	M6 – 2 Pol.	Zeichnungs-Nr.: Drawing-No.: 893 5-3/4

Spline data:	**Daten der Verzahnung:**
ANSI B92.1	ANSI B92.1
15 teeth	15 Zähne
30° pressure angle	30° Eingriffswinkel

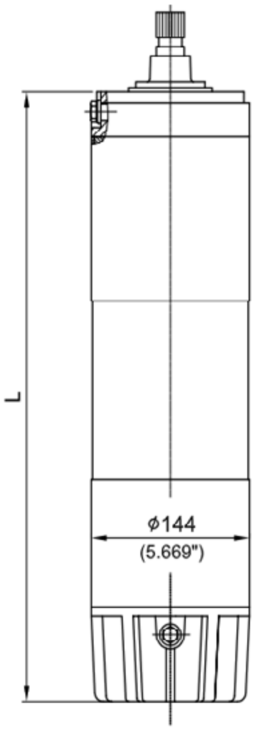
Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm





Pump connection acc. To NEMA Standards
Pumpenanschluß nach NEMA-Norm

Pump Connection 38
Anschlusskennzahl 38

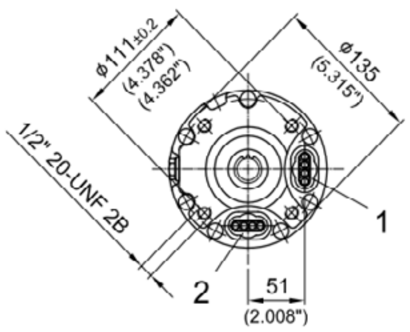


Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity max. Max. Axialkraft F_{A1}		F_{A2}		Series No. Baustufe
	mm	inch	kg	lb	kN	lbf	kN	lbf	
M6-160-2	554	21.81	38	84	12.5	2800	6	1350	3
M6-200-2	594	23.39	42	93	12.5	2800	6	1350	
M6-240-2	634	24.96	46	102	12.5	2800	6	1350	
M6-270-2	664	26.14	49	109	12.5	2800	6	1350	
M6-305-2	699	27.52	53	117	12.5	2800	6	1350	
M6-340-2	734	28.90	57	126	12.5	2800	6	1350	
M6-400-2	794	31.26	64	142	12.5	2800	6	1350	
M6-460-2	876	34.49	71	157	27.5	6100	6	1350	4
M6-530-2	946	37.24	79	175	27.5	6100	6	1350	
M6-600-2	1016	40.00	87	192	27.5	6100	6	1350	
M6-650-2	1066	41.97	93	206	27.5	6100	6	1350	
M6-720-2	1136	44.72	100	221	27.5	6100	6	1350	

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity
Ma. Axialkraft in Richtung Motor

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe



Cross Section Leitungs-querschnitt mm²	Motor Leads Herausführbare Stromzuführungsleitungen Single / Einfachleitung				Double / Doppelleitung			
	Flat / Flach No. of cores / Anzahl der Adern							
	3x		4x		3x		4x	
2,5	●	●	ϴ	●	ϴ	●	●	ϴ
4	●	●	ϴ	●	ϴ	●	●	ϴ
6 2)	●	●	●	ϴ	●	●	●	●
10 2)	●	●		ϴ	●	●		●
16 2)	●	●						
Position of leads Lage d. Leitungsdurchführung	1	2	1	2	1	2	1	2

2) For installation into 6"-well please check O.D. of pumping unit
Bei Einbau in 6"-Brunnen, bitte den max. Aggregatdurchmesser beachten

ϴ	Standard cable / Standardleitung
●	Special cable / Sonderleitung

Max. cable dimensions **Max. Leitungsabmessungen**	
Position	1 + 2
Round / Rund	Ø22
Flat / Flach	17 x 36,5

PLEUGER

Submersible motor
Unterwassermotor

3630/0

09.18

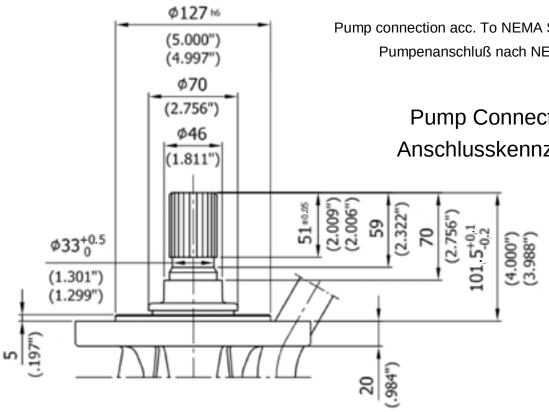
M8 – 2 Pol.

Zeichnungs-Nr.:
Drawing-No.: 894 5-4

Spline data:
ANSI B92.1
23 teeth
30° pressure angle

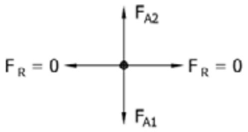
Daten der Verzahnung:
ANSI B92.1
23 Zähne
30° Eingriffswinkel

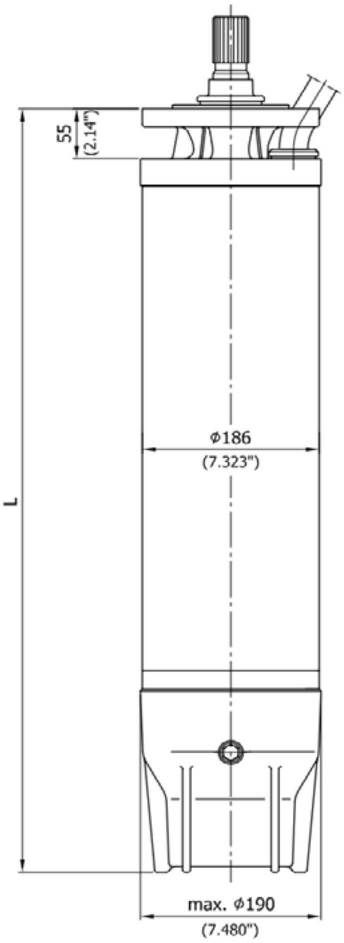
Axial clearance approx.. 0.02” / Axiales Spiel ca. 0,5 mm

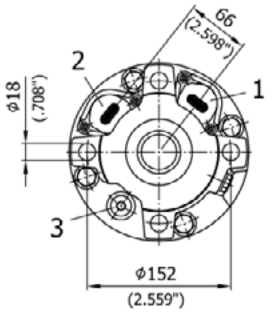


Pump connection acc. To NEMA Standards
Pumpenanschluß nach NEMA-Norm

Pump Connection 39
Anschlusskennzahl 39







Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_{A1}		F_{A2}	
	mm	inch	kg	lb	kN	lbf	kN	lbf
M8-330-2	1038	40.87	126	278	40	9000	12.5	2800
M8-410-2	1118	44.02	139	307	40	9000	12.5	2800
M8-480-2	1188	46.77	154	340	40	9000	12.5	2800
M8-530-2	1238	48.74	163	360	40	9000	12.5	2800
M8-580-2	1288	50.71	172	380	40	9000	12.5	2800
M8-650-2	1358	53.46	185	408	40	9000	12.5	2800
M8-710-2	1418	55.83	196	433	40	9000	12.5	2800
M8-820-2	1528	60.16	216	477	40	9000	12.5	2800
M8-930-2	1638	64.49	237	523	40	9000	12.5	2800
M8-990-2	1698	66.85	247	545	40	9000	12.5	2800

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (80 kN/17,985 lbf on request)
Ma. Axialkraft in Richtung Motor (80 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungsquerschnitt	Motor Leads Herausführbare Stromzuführungsleitungen													
	Single / Einfachleitung						Double / Doppelleitung							
	Round Rund		Flat Flach		1 Whip 1 Peitsche 2)		Round Rund			Flat Flach		2 Whips 2 Peitschen 2)		
	No. of cores / Anzahl der Adern													
mm²	1x3	1x4	1x3	1x4	1x3	1x4	2x3	1x3 1x4	2x4	2x3	1x3 1x4	2x3	1x3 1x4	2x4
2,5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	●	●	●		●	●	●	●						
Position of leads Lage d. Leitungsdurchführung	1	1	1	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

2) Three or four single core round cables, vulcanized (whip)
Mehrere 1-Adr. Rundleitungen mit gemeinsamer Vulkanisation im Bereich der Kabeldurchführung

● Special cable / Sonderleitung

Max. cable dimensions / Max. Leitungsabmessungen			
Position	1	2	3
Round / Rund	Ø42	Ø42	Ø21
Flat / Flach	17 x 44 19 x 40	17 x 44 19 x 40	-

PLEUGER

Submersible motor
Unterwassermotor

3631/0
09.18

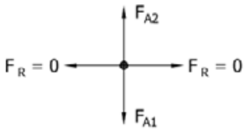
M8 – 4 Pol.

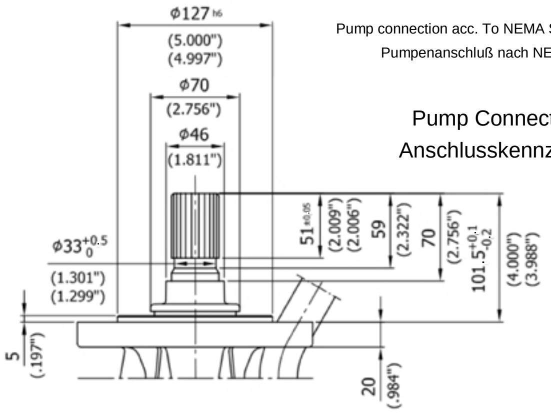
Zeichnungs-Nr.:
Drawing-No.: 894 5-4

Spline data:
ANSI B92.1
23 teeth
30° pressure angle

Daten der Verzahnung:
ANSI B92.1
23 Zähne
30° Eingriffswinkel

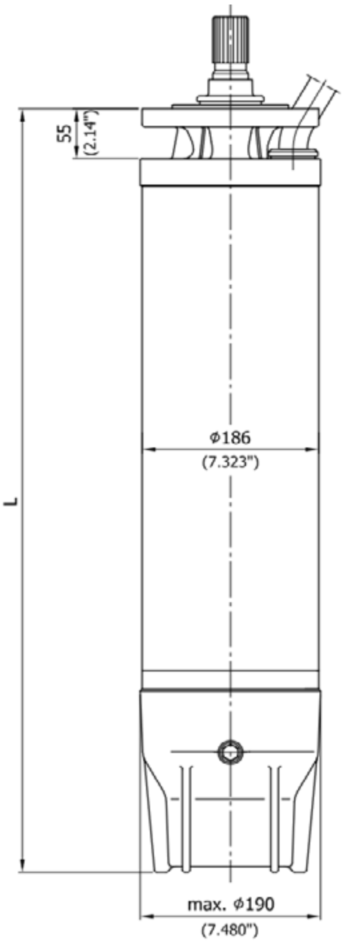
Axial clearance approx.. 0.02” / Axiales Spiel ca. 0,5 mm

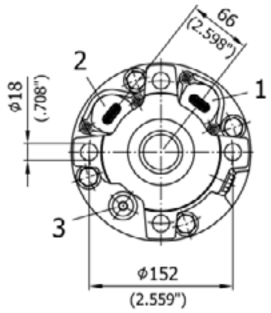




Pump connection acc. To NEMA Standards
Pumpenanschluß nach NEMA-Norm

Pump Connection 39
Anschlusskennzahl 39





Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_A1		F_A2	
	mm	inch	kg	lb	kN	lbf	kN	lbf
M8-135-4	843	33.19	87	192	40	9000	12.5	2800
M8-170-4	878	34.57	94	208	40	9000	12.5	2800
M8-210-4	918	36.14	102	225	40	9000	12.5	2800
M8-280-4	988	38.90	113	250	40	9000	12.5	2800
M8-340-4	1048	41.26	127	280	40	9000	12.5	2800
M8-420-4	1128	44.41	143	216	40	9000	12.5	2800
M8-520-4	1228	48.35	165	364	40	9000	12.5	2800
M8-700-4	1408	55.43	205	452	40	9000	12.5	2800
M8-870-4	1578	62.13	245	541	40	9000	12.5	2800
M8-1050-4	1758	69.21	275	607	40	9000	12.5	2800

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (80 kN/17,985 lbf on request)
Ma. Axialkraft in Richtung Motor (80 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungsquerschnitt	Motor Leads Herausführbare Stromzuführungsleitungen													
	Single / Einfachleitung						Double / Doppelleitung							
	Round Rund		Flat Flach		1 Whip 1 Peitsche 2)		Round Rund			Flat Flach		2 Whips 2 Peitschen 2)		
	No. of cores / Anzahl der Adern													
mm²	1x3	1x4	1x3	1x4	1x3	1x4	2x3	1x3 1x4	2x4	2x3	1x3 1x4	2x3	1x3 1x4	2x4
2,5	✓	✓					✓	✓	✓					
4	✓	✓	✓	✓			✓	✓	✓	✓	✓			
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	●	●	●		●	●	●	●						
Position of leads Lage d. Leitungsdurchführung	1	1	1	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

2) Three or four single core round cables, vulcanized (whip)
Mehrere 1-Adr. Rundleitungen mit gemeinsamer Vulkanisation im Bereich der Kabeldurchführung

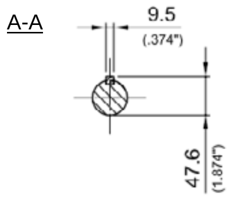
● Special cable / Sonderleitung

Max. cable dimensions / Max. Leitungsabmessungen			
Position	1	2	3
Round / Rund	Ø42	Ø42	Ø21
Flat / Flach	17 x 44 19 x 40	17 x 44 19 x 40	-

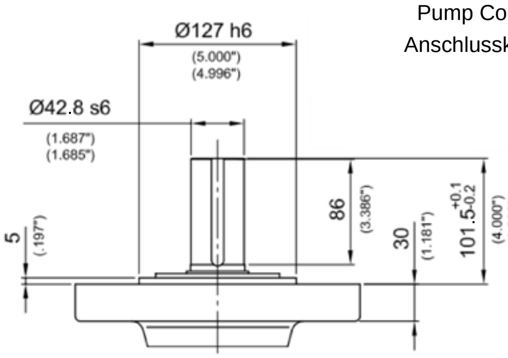
Subject to alteration / Änderungen vorbehalten

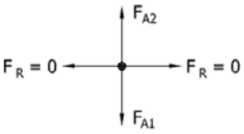
PLEUGER	**Unterwassermotor** **Submersible motor**	**3628/0** 09.18
	# MI10 – 2 Pol.	Zeichnungs-Nr.: Drawing-No.: 877 5-3

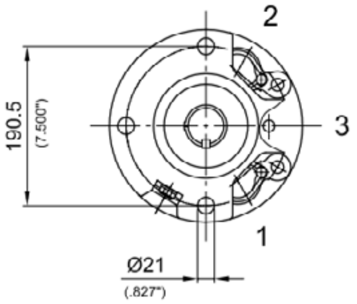
Pump Connection 43
Anschlusskennzahl 43



Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm







Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_{A1}		F_{A2}	
	mm	inch	kg	lb	kN	lbf	kN	lbf
MI10-420-2	1353	53.27	231	510	50	11250	22.5	5000
MI10-490-2	1423	56.02	249	549	50	11250	22.5	5000
MI10-600-2	1533	60.35	276	609	50	11250	22.5	5000
MI10-740-2	1673	65.87	312	688	50	11250	22.5	5000
MI10-880-2	1813	71.38	347	766	50	11250	22.5	5000
MI10-960-2	1893	74.53	367	810	50	11250	22.5	5000
MI10-1070-2	2003	78.86	395	871	50	11250	22.5	5000
MI10-1200-2	2133	83.98	428	944	50	11250	22.5	5000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (80 kN/17,985 lbf on request)
Ma. Axialkraft in Richtung Motor (80 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungsquerschnitt	Motor Leads Herausführbare Stromzuführungsleitungen													
	Single / Einfachleitung						Double / Doppelleitung							
	Round Rund		Flat Flach		1 Whip 1 Peitsche 2)		Round Rund			Flat Flach		2 Whips 2 Peitschen 2)		
	No. of cores / Anzahl der Adern													
mm²	1x3	1x4	1x3	1x4	1x3	1x4	2x3	1x3 1x4	2x4	2x3	1x3 1x4	2x3	1x3 1x4	2x4
2,5	✓	✓	✓				✓	✓	✓	✓	✓			
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
35	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓
50	✓				✓	●	✓					✓	●	
Position of leads Lage d. Leitungsdurchführung	1	1	1	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

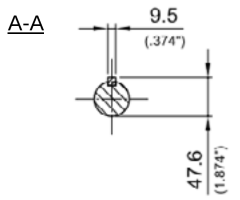
2) Three or four single core round cables, vulcanized (whip)
Mehrere 1-Adr. Rundleitungen mit gemeinsamer Vulkanisation im Bereich der Kabeldurchführung

● Special cable / Sonderleitung

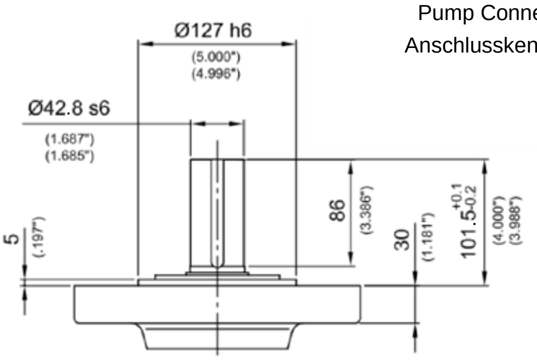
Max. cable dimensions / Max. Leitungsabmessungen			
Position	1	2	3
Round / Rund	Ø42	Ø42	Ø15
Flat / Flach	17 x 44 19 x 40	17 x 44 19 x 40	-

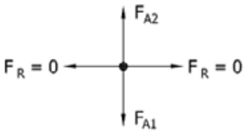
PLEUGER	**Submersible motor** **Unterwassermotor**	**3629/0** 09.18
	MI10 – 4 Pol.	Zeichnungs-Nr.: Drawing-No.: 877 5-3

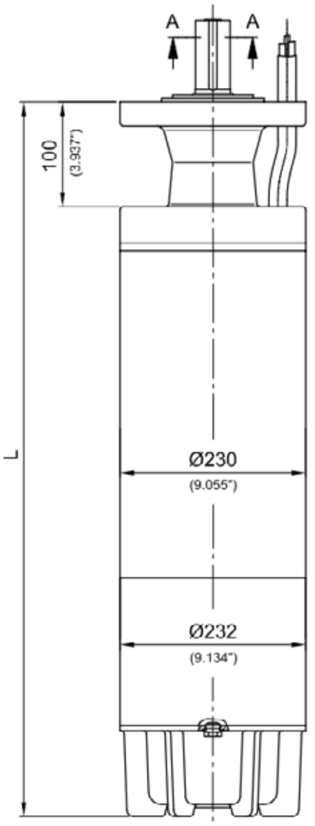
Pump Connection 43
Anschlusskennzahl 43



Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm







Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					FA1		FA2	
	mm	inch	kg	lb	kN	lbf	kN	lbf
MI10-420-4	1353	53.27	231	510	50	11250	22.5	5000
MI10-490-4	1423	56.02	249	549	50	11250	22.5	5000
MI10-600-4	1533	60.35	276	609	50	11250	22.5	5000
MI10-740-4	1673	65.87	312	688	50	11250	22.5	5000
MI10-880-4	1813	71.38	347	766	50	11250	22.5	5000
MI10-960-4	1893	74.53	367	810	50	11250	22.5	5000
MI10-1070-4	2003	78.86	395	871	50	11250	22.5	5000
MI10-1200-4	2133	83.98	428	944	50	11250	22.5	5000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

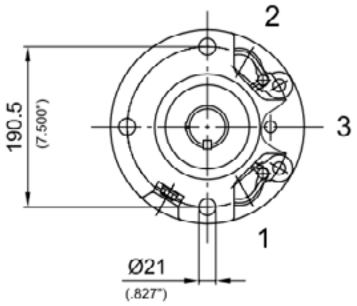
F_{A1} Max. downthrust capacity (80 kN/17,985 lbf on request)
Ma. Axialkraft in Richtung Motor (80 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungsquerschnitt	Motor Leads Herausführbare Stromzuführungsleitungen													
	Single / Einfachleitung						Double / Doppelleitung							
	Round Rund		Flat Flach		1 Whip 1 Peitsche 2)		Round Rund			Flat Flach		2 Whips 2 Peitschen 2)		
	No. of cores / Anzahl der Adern													
mm²	1x3	1x4	1x3	1x4	1x3	1x4	2x3	1x3 1x4	2x4	2x3	1x3 1x4	2x3	1x3 1x4	2x4
2,5	✓	✓	✓	✓			✓	✓	✓	✓	✓			
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
35	✓	✓			✓	✓	✓	✓	✓			✓	✓	✓
50	✓				✓	●	✓					✓	●	
Position of leads Lage d. Leitungsdurchführung	1	1	1	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

2) Three or four single core round cables, vulcanized (whip)
Mehrere 1-Adr. Rundleitungen mit gemeinsamer Vulkanisation im Bereich der Kabeldurchführung

● Special cable / Sonderleitung



Max. cable dimensions / Max. Leitungsabmessungen			
Position	1	2	3
Round / Rund	Ø42	Ø42	Ø15
Flat / Flach	17 x 44 19 x 40	17 x 44 19 x 40	-

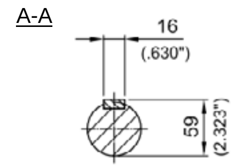
PLEUGER

Submersible motor
Unterwassermotor

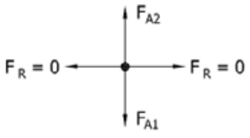
3509/0
09.18

VNI12 – 2 Pol.

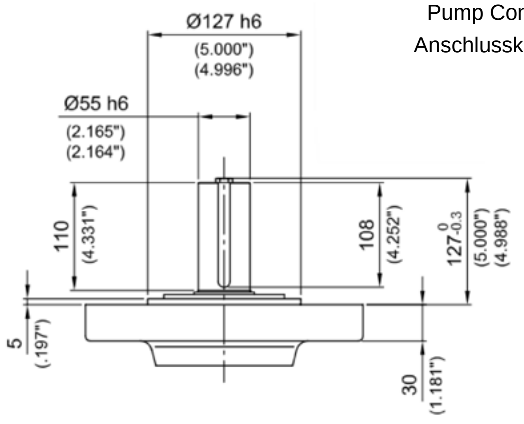
Zeichnungs-Nr.:
Drawing-No.: 878 5-2

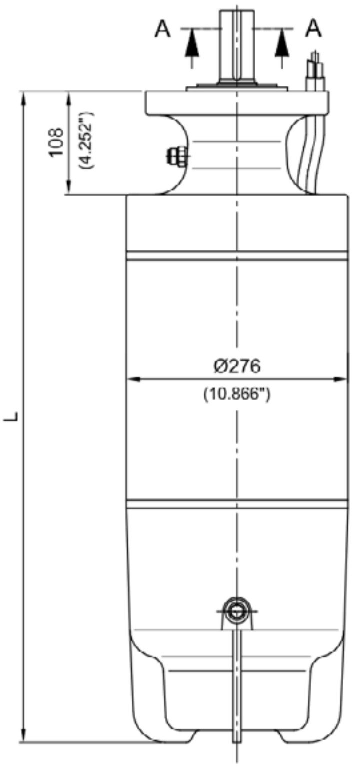


Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm



Pump Connection 41
Anschlusskennzahl 41





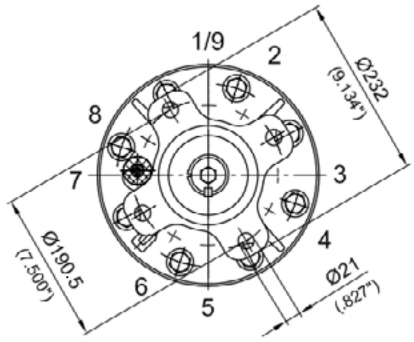
Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_{A1}		F_{A2}	
	mm	inch	kg	lb	kN	lbf	kN	lbf
VNI12-65-2	1714	67.48	475	1048	60	13500	22.5	5000
VNI12-75-2	1814	71.42	525	1158	60	13500	22.5	5000
VNI12-90-2	1964	77.32	600	1323	60	13500	22.5	5000
VNI12-100-2	2064	81.26	650	1434	60	13500	22.5	5000
VNI12-110-2	2164	85.20	700	1544	60	13500	22.5	5000
VNI12-120-2	2264	89.13	750	1654	60	13500	22.5	5000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (120 kN/26,977 lbf on request)
Ma. Axialkraft in Richtung Motor (120 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungs-querschnitt	**Motor Leads** **Herausführbare Stromzuführungsleitungen**									
	Single Einfachleitung		Double Doppelleitung			Single-Core-Cable Einzeladerleitung				
	Round 7 Multi-Core Rund / Mehradrig					Round Rund				
	No. of cores Anzahl der Adern					No. of leads Anzahl der Leitungen				
mm²	1x3	1x4	1x3 1x4	2x3	2x4	3	4	6	7	8
16	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
25	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
35	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
50	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
70	✔			✔		✔	✔	✔	✔	✔
95						✔	✔			
Position of leads Lage der Leitungsdurchführung	1/9	1/9	1,5 / 9,10	1,5 / 9,10	1,5 / 9,10	1,2,4	1…4	1…6	1…6, 8	1…8



Max. cable dimensions / Max. Leitungsabmessungen										
Position	1	2	3	4	5	6	7	8	9	10
Round / Rund	ø40	ø26	ø40	ø26	ø26	ø26	ø26	ø26	ø45	ø45

PLEUGER

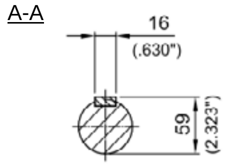
Submersible motor
Unterwassermotor

3510/0
09.18

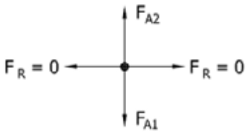
VNI12 – 4 Pol.

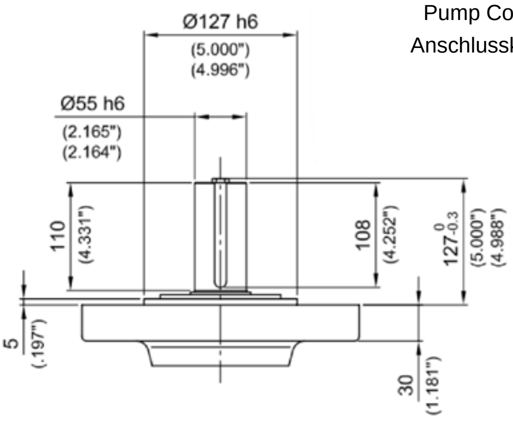
Zeichnungs-Nr.:
Drawing-No.: 878 5-2

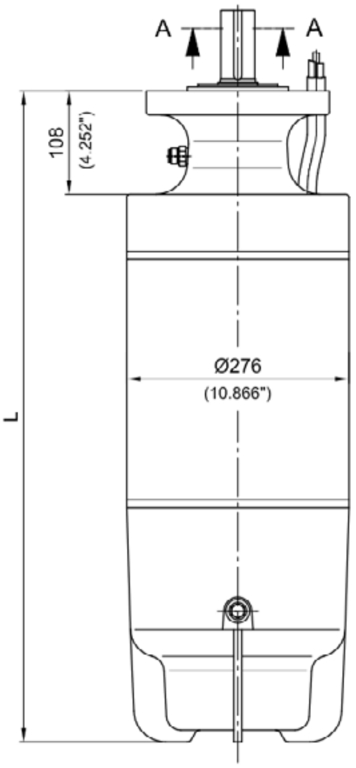
Pump Connection 41
Anschlusskennzahl 41



Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm







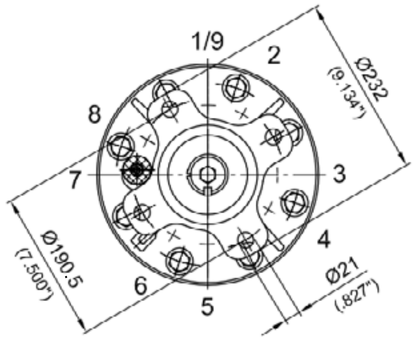
Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_{A1}		F_{A2}	
	mm	inch	kg	lb	kN	lbf	kN	lbf
VNI12-65-4	1714	67.48	475	1048	60	13500	22.5	5000
VNI12-75-4	1814	71.42	525	1158	60	13500	22.5	5000
VNI12-90-4	1964	77.32	600	1323	60	13500	22.5	5000
VNI12-100-4	2064	81.26	650	1434	60	13500	22.5	5000
VNI12-110-4	2164	85.20	700	1544	60	13500	22.5	5000
VNI12-120-4	2264	89.13	750	1654	60	13500	22.5	5000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (120 kN/26,977 lbf on request)
Ma. Axialkraft in Richtung Motor (120 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungs-querschnitt	**Motor Leads Herausführbare Stromzuführungsleitungen**									
	Single Einfachleitung		Double Doppelleitung			Single-Core-Cable Einzeladerleitung				
	Round 7 Multi-Core Rund / Mehradrig					Round Rund				
	No. of cores Anzahl der Adern					No. of leads Anzahl der Leitungen				
mm²	1x3	1x4	1x3 1x4	2x3	2x4	3	4	6	7	8
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
70	✓			✓		✓	✓	✓	✓	✓
95						✓	✓			
Position of leads Lage der Leitungsdurchführung	1/9	1/9	1 ,5 / 9 ,10	1 ,5 / 9 ,10	1 ,5 / 9 ,10	1,2,4	1…4	1…6	1…6, 8	1…8

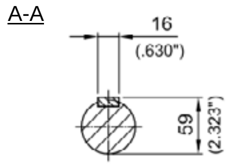


Max. cable dimensions / Max. Leitungsabmessungen										
Position	1	2	3	4	5	6	7	8	9	10
Round / Rund	ø40	ø26	ø40	ø26	ø26	ø26	ø26	ø26	ø45	ø45

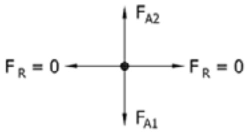
Subject to alteration / Änderungen vorbehalten

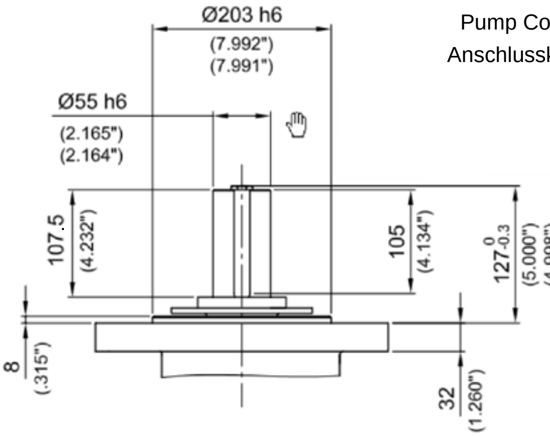
PLEUGER	**Submersible motor** **Unterwassermotor**	**3607/0** 09.18
	# VNI14 – 2 Pol.	Zeichnungs-Nr.: Drawing-No.: 879 5-3

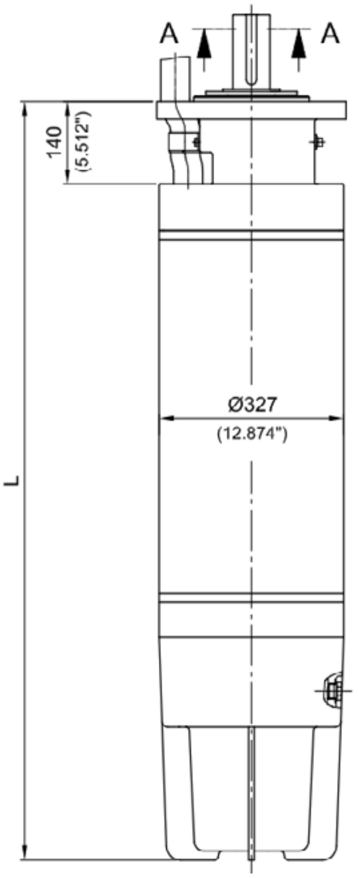
Pump Connection 40
Anschlusskennzahl 40



Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm







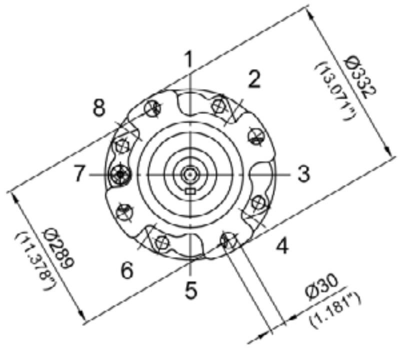
Motor type Motortyp	L mm	L inch	Weight Gewicht 1) kg	Weight Gewicht 1) lb	Thrust capacity Axialkraft F_{A1} kN	F_{A1} lbf	F_{A2} kN	F_{A2} lbf
VNI14-50-2	1824	71.81	590	1301	75	17000	40	9000
VNI14-60-2	1924	75.75	650	1334	75	17000	40	9000
VNI14-70-2	2024	79.09	710	1566	75	17000	40	9000
VNI14-80-2	2124	83.62	770	1698	75	17000	40	9000
VNI14-90-2	2224	87.56	830	1830	75	17000	40	9000
VNI14-100-2	2324	91.50	890	1963	75	17000	40	9000
VNI14-110-2	2424	95.43	950	2095	75	17000	40	9000
VNI14-120-2	2524	99.37	1010	2227	75	17000	40	9000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (150 kN/33,721 lbf on request)
Ma. Axialkraft in Richtung Motor (150 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungs-querschnitt	**Motor Leads** **Herausführbare Stromzuführungsleitungen**									
	Single Einfachleitung	Double Doppelleitung				Single-Core-Cable Einzeladerleitung				
	Round 7 Multi-Core Rund / Mehradrig					Round Rund				
	No. of cores Anzahl der Adern					No. of leads Anzahl der Leitungen				
mm²	1x3	1x4	1x3 1x4	2x3	2x4	3	4	6	7	8
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
70	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
95						✓	✓	✓	✓	✓
120						✓	✓	✓	✓	✓
Position of leads Lage der Leitungsdurchführung	1	1	1 ,5	1 ,5	1 ,5	1,3,5	1, 3 5, 7	2…4 6…8	2…8	1…8



Max. cable dimensions / Max. Leitungsabmessungen								
Position	1	2	3	4	5	6	7	8
Round / Rund	ø51	ø26	ø45	ø26	ø51	ø26	ø45	ø26

PLEUGER

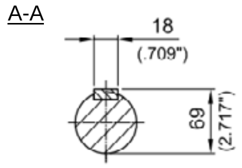
Submersible motor
Unterwassermotor

3608/0
09.18

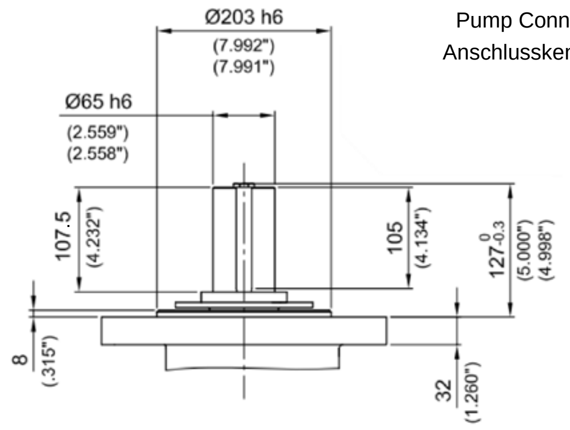
VNI14 – 4 Pol.

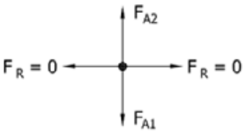
Zeichnungs-Nr.:
Drawing-No.: 879 5-3

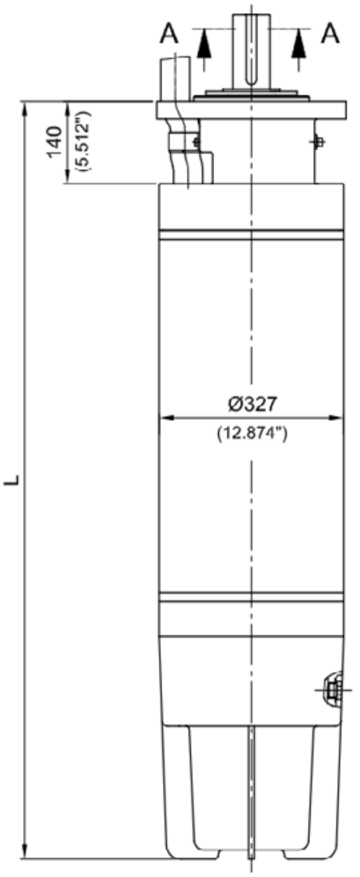
Pump Connection 42
Anschlusskennzahl 42



Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm







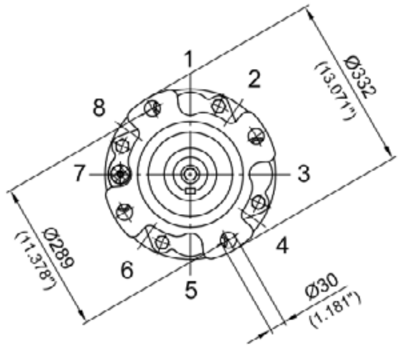
Motor type Motortyp	L mm	L inch	Weight Gewicht 1) kg	lb	Thrust capacity Axialkraft FA1 kN	lbf	FA2 kN	lbf
VNI14-50-4	1824	71.81	590	1301	75	17000	40	9000
VNI14-60-4	1924	75.75	650	1334	75	17000	40	9000
VNI14-70-4	2024	79.09	710	1566	75	17000	40	9000
VNI14-80-4	2124	83.62	770	1698	75	17000	40	9000
VNI14-90-4	2224	87.56	830	1830	75	17000	40	9000
VNI14-100-4	2324	91.50	890	1963	75	17000	40	9000
VNI14-110-4	2424	95.43	950	2095	75	17000	40	9000
VNI14-120-4	2524	99.37	1010	2227	75	17000	40	9000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (150 kN/33,721 lbf on request)
Ma. Axialkraft in Richtung Motor (150 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungs-querschnitt	**Motor Leads Herausführbare Stromzuführungsleitungen**									
	Single Einfachleitung		Double Doppelleitung			Single-Core-Cable Einzeladerleitung				
	Round 7 Multi-Core Rund / Mehradrig					Round Rund				
	No. of cores Anzahl der Adern					No. of leads Anzahl der Leitungen				
mm²	1x3	1x4	1x3 1x4	2x3	2x4	3	4	6	7	8
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
70	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
95						✓	✓	✓	✓	✓
120						✓	✓	✓	✓	✓
Position of leads Lage der Leitungsdurchführung	1	1	1, 5	1, 5	1, 5	1,3,5	1, 3 5, 7	2…4 6…8	2…8	1…8



Max. cable dimensions / Max. Leitungsabmessungen								
Position	1	2	3	4	5	6	7	8
Round / Rund	ø51	ø26	ø45	ø26	ø51	ø26	ø45	ø26

Subject to alteration / Änderungen vorbehalten

PLEUGER

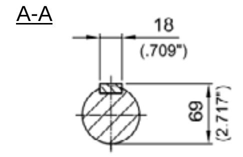
Submersible motor
Unterwassermotor

3613/0
09.18

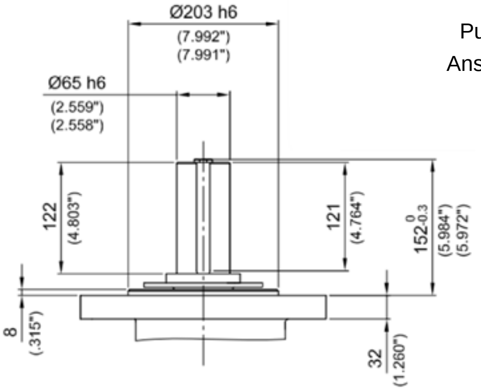
MI16 – 4 Pol.

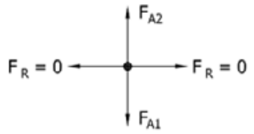
Zeichnungs-Nr.:
Drawing-No.: 881 5-2

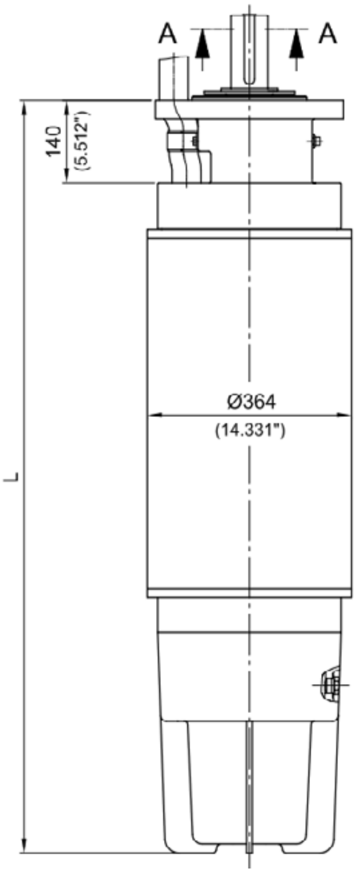
Pump Connection 47
Anschlusskennzahl 47

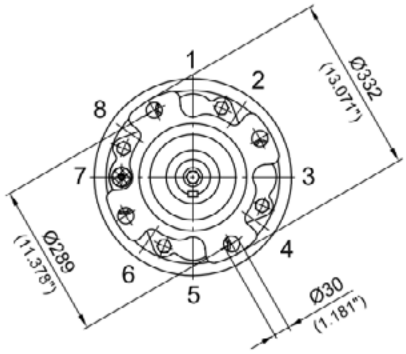


Axial clearance approx.. 0.02" / Axiales Spiel ca. 0,5 mm









Motor type Motortyp	L		Weight Gewicht 1)		Thrust capacity Axialkraft			
					F_{A1}		F_{A2}	
	mm	inch	kg	lb	kN	lbf	kN	lbf
MI16-65-4	1984	78.11	860	1896	75	17000	40	9000
MI16-75-4	2084	82.05	925	2040	75	17000	40	9000
MI16-85-4	2184	85.98	990	2183	75	17000	40	9000
MI16-95-4	2284	89.92	1055	2326	75	17000	40	9000
MI16-110-4	2434	95.83	1150	2536	75	17000	40	9000
MI16-120-4	2534	99.76	1215	2679	75	17000	40	9000
MI16-130-4	2634	103.7	1280	2822	75	17000	40	9000
MI16-145-4	2784	109.61	1375	3032	75	17000	40	9000
MI16-165-4	2984	117.48	1505	3318	75	17000	40	9000
MI16-185-4	3184	125.35	1635	3605	75	17000	40	9000

1) Weight for standard construction (G) without power supply cable
Gewicht für Standardausführung (G) ohne Stromzuführungsleitungen

F_{A1} Max. downthrust capacity (150 kN/33,721 lbf on request)
Ma. Axialkraft in Richtung Motor (150 kN auf Anfrage)

F_{A2} Max. upthrust capacity
Max. Axialkraft in Richtung Pumpe

Cross Section Leitungs-querschnitt	**Motor Leads Herausführbare Stromzuführungsleitungen**									
	Single Einfachleitung		Double Doppelleitung			Single-Core-Cable Einzeladerleitung				
	Round 7 Multi-Core Rund / Mehradrig					Round Rund				
	No. of cores Anzahl der Adern					No. of leads Anzahl der Leitungen				
mm²	1x3	1x4	1x3 1x4	2x3	2x4	3	4	6	7	8
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
70	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
95						✓	✓	✓	✓	✓
120						✓	✓	✓	✓	✓
150						●	●			
Position of leads Lage der Leitungsdurchführung	1	1	1, 5	1, 5	1, 5	1,3,5	1, 3 5, 7	2…4 6…8	2…8	1…8

● Special cable / Sonderleitung

Max. cable dimensions / Max. Leitungsabmessungen								
Position	1	2	3	4	5	6	7	8
Round / Rund	ø51	ø26	ø45	ø26	ø51	ø26	ø45	ø26

PLEUGER Motor Sensors

PLEUGER pump sensors provide the operator real-time monitoring and data for key areas of pump performance

TEMPERATURE SENSORS
Plug-in 3 wire sensor Pt100 Sub Temp

Detects temperature for real-time feedback with 3x1.5 mm^3 EPR cable

- The purpose of the measurement is to protect the motor
- Measures the temperature of the motor fill. The measurement is based on the change in resistance which is proportional to the change in temperature
- Plug-in sensor intended to be installed in PLEUGER submersible motor with an applicable interface (seal)

FEATURES

- Simple plug-in installation
- Compact, single piece design
- Retrofittable
- Flexible, water resistant cable

VIBRATION SENSORS
Vibration Sensor PI-100 Sub Accelerometer (one axes)

PI-300 Sub Accelerometer (three axes X,Y,Z)

- Sub Accelerometer detects the incorrect operating conditions of rotating components (e.g. impeller)
- Side entry for easy access
- Waterproof
- Resistant to oil

CONDUCTIVITY SENSORS
Motor fill monitoring sensor PI-100 Sub Con

- Detects an incorrect or contaminated fill of the PLEUGER motor
- System consists of the sensor, a cable and the monitoring controller. The sensor measures the conductivity of the motor fill and its temperature.
- Plug-in sensor intended to be installed in PLEUGER motor with an applicable interface (adapter and seal).

FEATURES

- Plug-in installation
- Waterproof
- Dual function
- For PLEUGER Motors M8 to MI40
- Alternative Solution for Header Tank

PLEUGER Motors for Special Applications

Hot water motor

Designed for hot water applications such as District heating and Geothermal energy

- District heating and Geothermal
- All-weather greenhouse energy
- Cooling water and process pumps
- Thermal spas

Features

- 270 kW (362 HP) up to 85°C (185°F) water temperature
- Motor sizes 6" to 12"
- Starting method DOL, Star-Delta (on request)
- Different cooling solutions available

Examples of PLEUGER Submersible Motors for customized applications

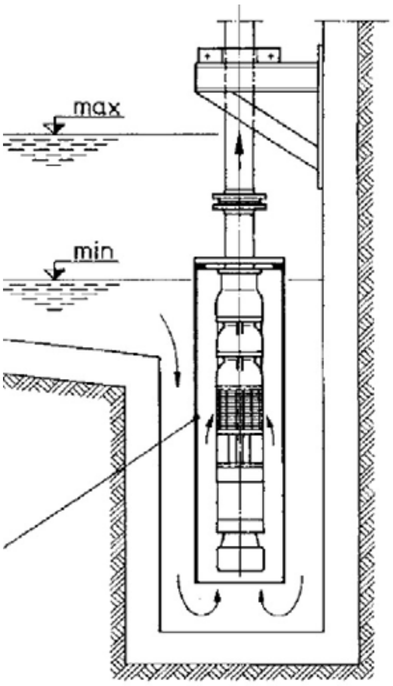
- MI10-600-4 , 10", 600 mm stator length, 4-pole design
- MIP16-130-6 Polder construction, 1300 mm stator length
- PMM6-320-4 Permanent Magnet Motor, 320 mm stator length (6" and 8" PMM)
- MIT19-130-2 Tandem configuration – two identical MI19-130-2 working together
- VNI22-200-4
- MOE8-410-2 Oil-filled motor
- MHA8-410-2 Filling liquid temperature ϑ > 90 °C or 194 °F
- MK6-460-2 Oil (petroleum) cavern installation

PLEUGER Technologies/

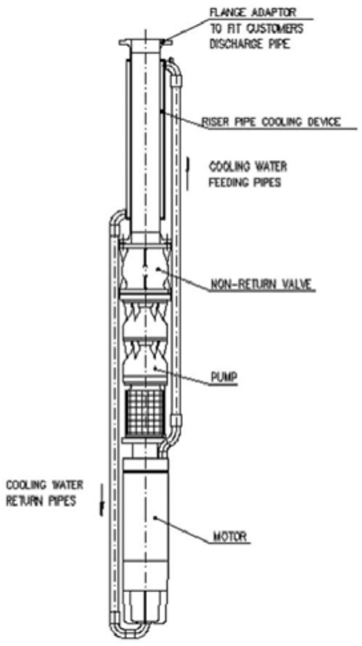
External Cooling Systems

Customized Cooling Systems for individual cooling requirements

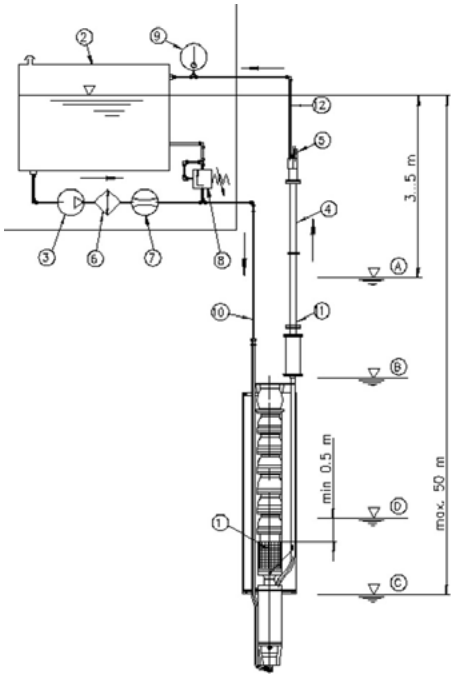
- Simple plug-in installation
- Compact, single piece design
- Retrofittable
- Flexible, water resistant cable



Cooling Shroud



Riser Pipe Cooler

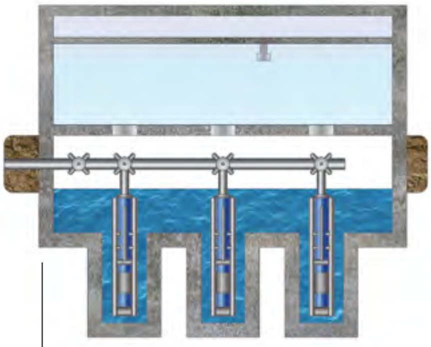


External Cooling Device

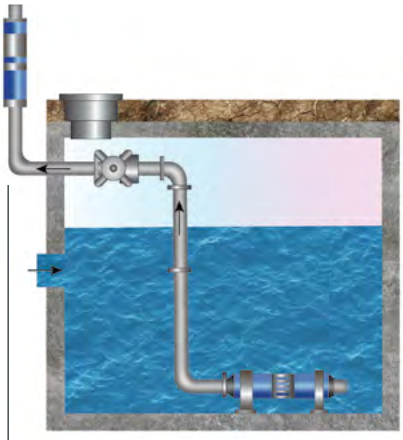
Pump installation options

With various installation options, PLEUGER's pump units are the ideal solution for almost any application in the water industry.

Vertical (e.g. bore well installation)



Parallel

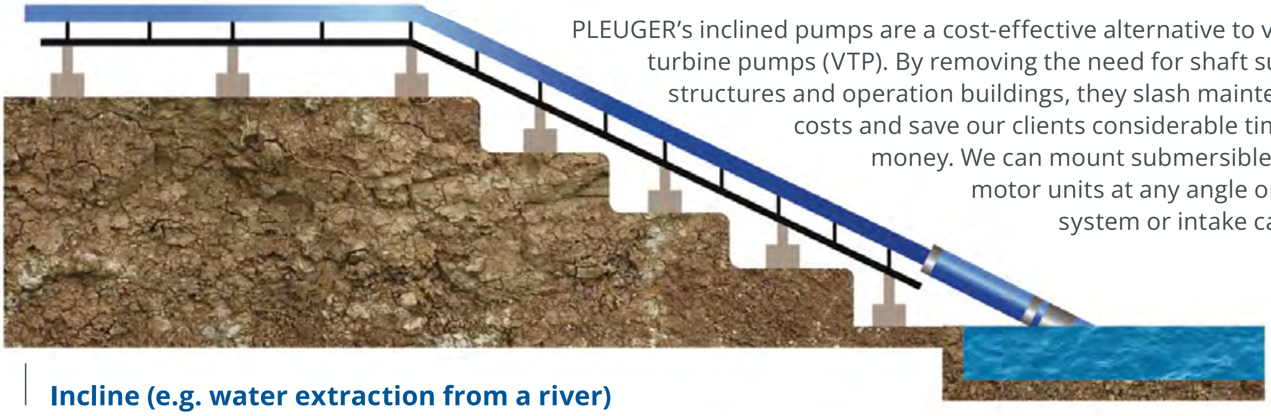


Booster pump in pipeline

Horizontal (e.g. bottom of tank)

Inclined pumps for processing and cooling water applications

PLEUGER's inclined pumps are a cost-effective alternative to vertical turbine pumps (VTP). By removing the need for shaft support structures and operation buildings, they slash maintenance costs and save our clients considerable time and money. We can mount submersible pump motor units at any angle on a rail system or intake caisson.



Incline (e.g. water extraction from a river)

WORLDWIDE SALES, SERVICE AND SUPPORT

THE RELIABILITY EXPERTS

PLEUGER designs, manufactures and services submersible motors, pumps, thrusters and plunger pumps. Renowned worldwide for absolute reliability and outstanding longevity throughout the energy, mining, water, industrial processing and oil & gas industries.

Our products perform in some of the most challenging and harshest of environments. PLEUGER engineers find solutions to some of the toughest challenges and are trusted across the globe as the reliability experts.

HEADQUARTERS: PLEUGER Industries GmbH
Friedrich-Ebert-Damm 105, 22047 Hamburg, Germany
Tel: +49 (0) 40 69 689 0   hamburg@pleugerindustries.com

GENERAL ENQUIRIES
Tel. +49 (0) 40 69 689 770

SPARE PARTS
Tel. 49 (0) 40 69 689 200
spareparts@pleugerindustries.com

PLEUGER INDUSTRIES FRANCE
21, Rue de la Mouchetière Parc d’activités d’Ingré,
F – 45140 Saint-Jean de la Ruelle
France

Tel: +33 (0) 2 38 70 84 00
orleans@pleugerindustries.com

PLEUGER INDUSTRIES USA
1450 Brickell Ave Suite 1900 Miami,
Florida 33131
United States of America

Tel: +1 786 280 3471
miami@pleugerindustries.com

PLEUGER INDUSTRIES SINGAPORE
84 Toh Guan Road East,
Singapore Water Exchange
Singapore 608501

Tel: +65 8822 2413
singapore@pleugerindustries.com

PLEUGER

www.pleugerindustries.com

Made in Germany

ATTACHMENT #3

MW-PW2 AQUIFER TESTING FIELD DATA SHEETS

STEP-DRAWDOWN TEST - PRODUCTION WELL # MJ-PW2

FIELD DATA FORM

Test date: 4-1-25

Well Information

Date drilled: ___ Borehole diameter: ___ (inches) Borehole depth: ___ ft BLS
Casing ID diameter: ___ (inches) Casing material & thickness: ___ Casing length: ___ ft BLS
Screen ID diameter: ___ (inches) Screen material & slot size: ___ Screen length: ___ ft BLS
Screen Type: ___ Screen fittings: ___ Total well depth: ___ ft BLS

Pump Information

Pump type: ___ Pump diameter: ___ Pump stages: ___
Pump column -type/diameter: ___ Check valve-type/material: ___
Pump intake level: ___ ft BLS
Motor type: ___ Motor horsepower: ___ Motor length: ___
Motor voltage: ___ Phase: ___ Service factor: ___ Full-load amps: ___

Step-Test Setup

Water discharged to: ___ Discharge distance from PW: ___ (feet)
Orifice size: 10 x 7 (inches) Discharge pipe diameter: 8 (inches)
Static water level from top of access port: 18.00 (feet) Date/time: 4/1/25 @ 0958
Contractor performing test: NWS & TEIRIZAN
Measurements made by: ___

STEP #1						
Notes	Time (hr:min)	Elapse Time (minutes)	Depth to Water (feet)	Line Pressure (psi)	Orifice Reading (inches)	Pumping Rate (gpm)
Static Water Level	0958	-5	18.00			
Pump On - Shut In HD	1000	0	20.90		"	
Valve Open	1001	1	20.31		13.5	753
	1002	2	19.91			
	1003	3	20.12			
	1004	4	20.12			
Step #1 Motor	1005	5	20.09			
Amp Readings	1011	10	20.23			
L_1 =	1015	15	20.24			
L_2 =	1020	20	20.32			
L_3 =	1025	25	20.28			
	1030	30	20.27		13.5	753
	1040	40	20.32			
	1050	50	20.35			
	1100	60	20.35			
	1120	80	20.38			
	1140	100	20.47			
	12:00	120	20.40			

STEP-DRAWDOWN TEST - PRODUCTION WELL MJ-PW2

Test date: 4/1/25

STEP #2						
Notes	Time (hr:min)	Elapse Time (minutes)	Depth to Water (feet)	Line Pressure (psi)	Orifice Reading (inches)	Pumping Rate (gpm)
Change Pump Rate	12:00	0	20.46		31	1133
	12:01	1	21.85			
	12:02	2	21.89			
	12:03	3	21.87			
	12:04	4	21.90		31	1133
Step #2 Motor	12:05	5	21.90			
Amp Readings	12:10	10	21.94			
L1 =	12:15	15	21.94			
L2 =	12:20	20	21.95			
L3 =	12:25	25	21.98		31	1133
	12:30	30	21.97			
	12:40	40	21.99			
	12:50	50	22.01			
	13:00	60	22.03			
	13:20	80	22.10			
	13:40	100	22.13			
	14:00	120	22.16			
STEP #3						
Change Pump Rate	14:00	0	22.16		49	1435
	14:01	1				
	14:02	2	23.33			
	14:03	3	23.35		49	1435
	14:04	4	23.35			
Step # 3 Motor	14:05	5	23.35			
Amp Readings	14:10	10	23.37			
L1 =	14:15	15	23.34			
L2 =	14:20	20	23.40			
L3 =	14:25	25	23.43			
	14:30	30	23.44			
	14:40	40	23.46			
	14:50	50	23.48			
	15:00	60	23.51			
	15:20	80	23.53			
	15:40	100	23.57		49	1435
	16:00	120	23.63			

STEP-DRAWDOWN TEST - PRODUCTION WELL ______

Test date:__________

STEP #4						
Notes	Time (hr:min)	Elapse Time (minutes)	Depth to Water (feet)	Line Pressure (psi)	Orifice Reading (inches)	Pumping Rate (gpm)
Change Pump Rate	16:00	0	23.63		65	1660
	16:01	1	24.60			
	16:02	2	24.63			
	16:03	3	24.62			
	16:04	4	24.63			
Step #4 Motor	16:05	5	24.63			
Amp Readings	16:10	10	24.68			
L_1 =	16:15	15	24.70		65	1660
L_2 =	16:20	20	24.69			
L_3 =	16:25	25	24.71			
	16:30	30	24.73			
	16:40	40	24.75			
	16:50	50	24.75			
	17:00	60	24.79			
	17:20	80	24.84		65	1660
	17:40	100	24.86			
	18:00	120	24.93			
Recovery						
Pump Off	18:00	0	24.93			
	18:01	1	19.22			
	18:02	2	19.06			
	18:03	3	19.05			
	18:04	4	19.04			
	18:05	5	19.01			
	18:06	6	19.00			
	18:07	7	19.02			
	18:08	8	19.00			
	18:09	9	19.00			
	18:10	10	18.99			
		20				
		30				
		40				
		50				
		60				

Comments & Additional Notes:

PASS 1

~~STEP DRAWDOWN~~ TEST - PRODUCTION WELL # MJ-PW2 (TW-2)

Constant Rate

FIELD DATA FORM

Test date: 4-2-25

Well Information

Date drilled:____ Borehole diameter:____(inches) Borehole depth:____ft BLS

Casing ID diameter:____(inches) Casing material & thickness:____ Casing length:____ ft BLS

Screen ID diameter:____(inches) Screen material & slot size:____ Screen length:____ ft BLS

Screen Type:____ Screen fittings:____ Total well depth:____ ft BLS

Pump Information

Pump type:____ Pump diameter:____ Pump stages:____

Pump column -type/diameter:____ Check valve-type/material:____

Pump intake level:____ft BLS

Motor type:____ Motor horsepower:____ Motor length:____

Motor voltage:____ Phase:____ Service factor:____ Full-load amps:____

Step-Test Setup

Water discharged to:____ Discharge distance from PW:____ (feet)

Orifice size: 10 X 7 (inches) Discharge pipe diameter: 7 (inches)

Static water level from top of access port: 18.41 (feet) Date/time: 0846

Contractor performing test:____

Measurements made by:____

STEP #1						
Notes	Time (hr:min)	Elapse Time (minutes)	Depth to Water (feet)	Line Pressure (psi)	Orifice Reading (inches)	Pumping Rate (gpm)
Static Water Level	0846	-5	18.41			
Pump On - Shut In HD	0900	0	23.25			
Valve Open	0901	1	23.81			
	0902	2	24.04			
	0903	3	24.17			
	0904	4	24.17			
Step #1 Motor	0905	5	24.19			
Amp Readings	0910	10	24.21			
L_1 =	0915	15	24.26			
L_2 =	0920	20	24.29		65	1660
L_3 =	0925	25	24.31			
	0930	30	24.36			
	0940	40	24.40			
	0950	50	24.41			
	1000	60	24.48			
	1020	80	24.58		65	1660
	1040	100	24.56			
	1100	120	24.63			

Owner____________ Well ID MJ-PW2 Date 4/2/25 Page No. 2

Date	Clock Time (Use Military Time)	Time Since Pumping Started (In Minutes)	Depth to Water (S)	Change in Water Level (S - S$_0$)	Discharge Rate (GPM)	Comments (Include Weather Conditions)
4-2-25	1200		24.81			
	100 am		24.95			
	200					Missed Reading
	300					Tearing down Rig
	400		25.43			
	500		25.61			
	600		25.75			
	7:00		25.75			
	8:00		25.75			
	9:00		25.78			Checked at office
	10:00		25.92			65" Part fuel in generator
	11:00		26.03			Warm Windy
4/3	12		26.18			
	1		26.24			
	2		26.35			Checked at office
	3		26.43			Small increase Backup to 65
	4		26.48			
	5		26.57			
	6		26.66			
	7:		26.71			
	8		26.76			
	9:00		26.80			Pump Off
	9:01		21.14			
	9:02		21.03			
	9:03		21.02			
	9:04		20.98			
	9:05		20.96			
	9:06		20.95			
	9:07		20.95			
	9:08		20.97			
	9:10		20.92			
	9:11		20.90			
	9:12		20.91			
	9:13		20.88			
	9:14		20.90			
	9:15		20.88			

ATTACHMENT #4

GROUNDWATER LAB RESULTS

MASI LABORATORIES

7940 Memorial Drive Plain City, Ohio 43064 (614) 873-4654

Date: April 07, 2025

National Water Services LLC (1384)
Attn: Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

RE: Certificate of Analysis for Project - Private Drinking Water

The following report contains analytical results for samples submitted on the chain of custody dated April 03, 2025.

I have reviewed the validity of the analytical data generated. All data is reported in accordance to our laboratory QA/QC plan. Any exceptions are noted in the Case Narrative or with qualifiers in the report.

If you have any questions or need additional documentation, please contact our Office.

Sincerely,

Cheryl Rex

Cheryl Rex
MASI Laboratories
QA/QC Officer
cheryl@masilabs.com
(614) 873-4654

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number:
Date Received: 4/3/25 15:29
Ohio EPA Analyzed Date: 4/7/25 08:51

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 08:30
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warrne County Middletown Junction Well Field TW-2

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sample ID: 285707-01

Lab Sample # : 5D00751-01 (Potable)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Microbiology									
Total Coliform	Absence	/ 100 ml		N/A	N/A	04/03/25 16:23	04/04/25 10:32	JAC	SM 9223 B

The contents of this report apply to the sample(s) analyzed in accordance with the chain of custody document.
No duplication of this report is allowed, except in its entirety.

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number:
Date Received: 4/3/25 15:29
Ohio EPA Analyzed Date: 4/7/25 08:51

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 09:00
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warrne County Middletown Junction Well Field TW-2

Sample ID: 285707-02

Lab Sample # : 5D00751-02 (Potable)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Microbiology									
Total Coliform	Absence	/ 100 ml		N/A	N/A	04/03/25 16:23	04/04/25 10:32	JAC	SM 9223 B

The contents of this report apply to the sample(s) analyzed in accordance with the chain of custody document.
No duplication of this report is allowed, except in its entirety.

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number:
Date Received: 4/3/25 15:29
Ohio EPA Analyzed Date: 4/7/25 08:51

Notes and Definitions

Item	Definition
mg/kg Dry	Sample results reported on a dry weight basis
ug/L	ppb/Part per Billion
mg/L	ppm/Part per Million
ng/L	ppt/Part per Trillion
ND	Analyte NOT DETECTED at or above the method detection limit (MDL)
!	Analyte is at or above the Maximum Contaminate Level
MDL	Method Detection Limit
CFU	Colony Forming Units
MPN	Most Probable Number
NTU	Nephelometric Turbidity Unit
pCi/L	Picocuries per liter
SVI	Sludge Volume Index
%	Percent
GPD	Gallons per Day
su	Standard Units

Notes:
1. Calculated analytes are based on raw data and may not reflect the rounding of the individual compounds.
2. Samples are analyzed using the information received on the request sheet and may not be analyzed when the parameters fall outside required guidelines.

MASI ®
ENVIRONMENTAL
LABORATORIES
7940 Memorial Drive
Plain City, OH 43064
614-873-4654

New 5D00747-01/2/3 st Sheet
Analysis R
AR # 285707
Received: 4/3/2025
Matrix: Potable
on Bottle: 285707

** See re[illegible] information *:

Client #: 1384 Client Name: National Water Services County: ______ P.O.# 082652

Sampler Name: Josh Gavin SMP ID : ______ Sample Type/Class: ( ) New Well/Special

Sample Tap: Spigot Date Collected: 04/03/25 (MM/DD/YY) Time Collected: 9:00 am (hh:mm am/pm)

Tap Address: Warren County, Middletown Junction Well Field TW-2

( ) Public Sample ( ) PWS ID #: ______ ( ) Facility ID #: ______

( ) (New Well Trans) Transient Noncommunity

Private

( ) (New Well Nontrans) Nontransient-Noncommunity + PFAS

(X) (New Well Comm) Community Water Systems + PFAS

Work Order

Microbiological Tests

5D00751-01/02
(Office Use Only)

	Time Collected
( ) 140 Total Coliform #1	0830 hh:mm [✓ am]/pm
( ) 140 Total Coliform #2	0900 hh:mm [✓ am]/pm

Office Use Only:
9 items
12°
FD
1510

Route
Office/Lab

COOLER:

REVISED 2-15-23 DN

MASI LABORATORIES

7940 Memorial Drive   Plain City, Ohio 43064   (614) 873-4654

Date: May 12, 2025

National Water Services LLC (1384)
Attn: Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

RE: Certificate of Analysis for Project - Private Drinking Water

The following report contains analytical results for samples submitted on the chain of custody dated April 03, 2025.

I have reviewed the validity of the analytical data generated. All data is reported in accordance to our laboratory QA/QC plan. Any exceptions are noted in the Case Narrative or with qualifiers in the report.

If you have any questions or need additional documentation, please contact our Office.

Sincerely,

Cheryl Rex

Cheryl Rex
MASI Laboratories
QA/QC Officer
cheryl@masilabs.com
(614) 873-4654

MASI LABORATORIES

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number: 082652
Date Received: 4/3/25 15:23
Ohio EPA Analyzed Date: 5/12/25 12:32

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 09:00
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warren County Middletown Junction Well Field TW-2

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sample ID: 285707

Lab Sample # : 5D00747-01 (Potable)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
EPA 200.8 Rev. 5.4									
Antimony, Total	<3.0	ug/L		3.0	3.0	04/03/25 09:00	04/08/25 13:47	SLB	EPA 200.8 Rev. 5.4
Thallium, Total	<1.0	ug/L		1.0	1.0	04/03/25 09:00	04/08/25 13:47	SLB	EPA 200.8 Rev. 5.4

MASI
LABORATORIES

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number: 082652
Date Received: 4/3/25 15:23
Ohio EPA Analyzed Date: 5/12/25 12:32

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 09:00
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warren County Middletown Junction Well Field TW-2

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sample ID: 285707

Lab Sample # : 5D00747-01 (Potable)

Wet Chemistry Analysis

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Alkalinity, Total	**287**	mg/L CaCO3		4.00		04/10/25 09:44	04/10/25 09:44	JOL	SM 2320 B 2011
Chloride	**59.2**	mg/L		10.0	10.0	04/08/25 16:58	04/08/25 16:58	CPP	SM 4500Cl B 2011
Cyanide, Free	ND	ug/L (as free CN)		3.00	0.682	04/08/25 12:25	04/08/25 12:25	CDM	OIA-1677DW
Fluoride	**0.20**	mg/L		0.20	0.05	04/08/25 13:19	04/08/25 13:19	CPP	SM 4500 F C 2011
Nitrate-Nitrite	**0.55**	mg/L		0.50	0.19	04/04/25 09:15	04/04/25 14:28	CDM	EPA 353.2 Rev 2.0
Nitrate as Nitrate-Nitrite	**0.553**	mg/L		0.500	0.185	04/04/25 09:15	04/04/25 14:28	CDM	EPA 353.2 Rev 2.0
Nitrite	**0.02**	mg/L	**J**	0.10	0.01	04/03/25 17:00	04/03/25 17:41	JOL	EPA 353.2 Rev 2.0
pH (su)	**7.3**	su	**HOLD**			04/03/25 15:00	04/03/25 15:00	MMM	SM 4500H B 2011
Temperature (Centigrade)	**19.6**	su	**HOLD**			04/03/25 15:00	04/03/25 15:00	MMM	SM 4500H B 2011
Total Dissolved Solids/Total Filterable Residue	**456**	mg/L		10.0	4.0	04/07/25 17:05	04/07/25 17:05	JAC	SM 2540 C 2015
Sulfate	**50.3**	mg/L		20.0	4.1	04/08/25 00:00	04/08/25 00:00	JAC	SM 4500 SO42 E 2011

Metals Analysis

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Arsenic, Total	ND	ug/L		3	0.5	04/08/25 13:48	04/08/25 18:48	CJS	SM 3113 B 2010
Barium, Total	**123**	ug/L		25.0	0.5	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994
Beryllium, Total	ND	ug/L		1.0	0.06	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994
Cadmium, Total	ND	ug/L		1.0	0.2	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994
Calcium, Total	**108**	mg/L		2.0	0.09	04/10/25 09:45	04/10/25 09:45	KRM	EPA 200.7 1994
Chromium, Total	ND	ug/L		5.0	0.8	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994
Copper, Total	**5**	ug/L	**J**	50	1	04/08/25 11:08	04/08/25 11:08	KRM	EPA 200.7 1994
Iron, Total	**29**	ug/L	**J**	80	0.8	04/08/25 18:00	04/08/25 18:00	KRM	EPA 200.7 1994
Lead, Total	ND	ug/L		5.0	0.4	04/11/25 14:07	04/11/25 15:35	CJS	SM 3113 B 2010

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number: 082652
Date Received: 4/3/25 15:23
Ohio EPA Analyzed Date: 5/12/25 12:32

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 09:00
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warren County Middletown Junction Well Field TW-2

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sample ID: 285707 (Continued)

Lab Sample # : 5D00747-01 (Potable)

Metals Analysis (Continued)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Magnesium, Total	**26.1**	mg/L		5.0	0.04	04/10/25 09:45	04/10/25 09:45	KRM	EPA 200.7 1994
Manganese, Total	**5**	ug/L	**J**	20	0.6	04/08/25 18:00	04/08/25 18:00	KRM	EPA 200.7 1994
Mercury, Total	ND	ug/L		0.5	0.07	04/09/25 12:31	04/10/25 16:39	CJS	EPA 245.1 1994
Nickel, Total	ND	ug/L		10.0	1.2	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994
Selenium, Total	ND	ug/L		5.0	0.5	04/08/25 09:47	04/08/25 13:45	CJS	SM 3113 B 2010
Silver, Total	ND	ug/L		10.0	0.6	04/07/25 15:17	04/07/25 15:17	KRM	EPA 200.7 1994
Sodium, Total	**30.7**	mg/L		5.0	0.2	04/10/25 09:45	04/10/25 09:45	KRM	EPA 200.7 1994
Zinc, Total	**16.0**	ug/L		10.0	0.9	04/09/25 12:38	04/09/25 12:38	KRM	EPA 200.7 1994

Volatile Organic Chemicals (VOC)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
1,1,1-Trichloroethane	ND	ug/L		0.5	0.09	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,1,2-Trichloroethane	ND	ug/L		0.5	0.07	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,1-Dichloroethene	ND	ug/L		0.5	0.09	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,2,4-Trichlorobenzene	ND	ug/L		0.5	0.1	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,2-Dichlorobenzene	ND	ug/L		0.5	0.03	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,2-Dichloroethane	ND	ug/L		0.5	0.05	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,2-Dichloropropane	ND	ug/L		0.5	0.08	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
1,4-Dichlorobenzene	ND	ug/L		0.5	0.07	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Benzene	ND	ug/L		0.5	0.06	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Carbon Tetrachloride	ND	ug/L		0.5	0.08	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Chlorobenzene	ND	ug/L		0.5	0.04	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
cis-1,2-Dichloroethene	ND	ug/L		0.5	0.04	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Ethylbenzene	ND	ug/L		0.5	0.05	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Methylene Chloride	ND	ug/L		0.5	0.05	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Styrene	ND	ug/L		0.5	0.07	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877
Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number: 082652
Date Received: 4/3/25 15:23
Ohio EPA Analyzed Date: 5/12/25 12:32

PWSID: Facility ID:
Repeat Sample #:
Total Chlorine (mg/L):
Free Chlorine (mg/L):
Combined Chlorine (mg/L):

Sampler Name: Josh Gavin
Sample Date/Time: 4/3/25 09:00
Sample Monitoring Point:
Sample Type:
Sample Tap/Address: Spigot Warren County Middletown Junction Well Field TW-2

Sample ID: 285707 (Continued)

Lab Sample # : 5D00747-01 (Potable)

Analyte	Result	Units	Qual	Reporting Limit	MDL	Date/Time Prepared	Date/Time Analyzed	Analyst	Method
Volatile Organic Chemicals (VOC) (Continued)									
Tetrachloroethene	ND	ug/L		0.5	0.07	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Toluene	ND	ug/L		0.5	0.05	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
trans-1,2-Dichloroethene	ND	ug/L		0.5	0.1	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Trichloroethene	ND	ug/L		0.5	0.08	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Vinyl Chloride	ND	ug/L		0.5	0.1	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Total Xylenes	ND	ug/L		1.5	0.2	04/08/25 21:46	04/08/25 21:46	DTS	EPA Method 524.2
Surrogate: 4-Bromofluorobenzene			*93%*			*70-130*			*EPA Method 524.2*
Surrogate: 1,2-Dichlorobenzene-d4			*82%*			*70-130*			*EPA Method 524.2*
Synthetic Organic Compounds (SOC) Group 1									
Alachlor	ND	ug/L		0.20	0.07	04/11/25 11:37	04/18/25 02:50	MEM	EPA Method 525.2
Atrazine	ND	ug/L		0.30	0.07	04/11/25 11:37	04/18/25 02:50	MEM	EPA Method 525.2
Simazine	ND	ug/L		0.35	0.06	04/11/25 11:37	04/18/25 02:50	MEM	EPA Method 525.2
Surrogate: 1,3-Dimethyl-2-nitrobenzene			*95%*			*70-130*			*EPA Method 525.2*
Surrogate: Triphenylphosphate			*73%*			*70-130*			*EPA Method 525.2*
Surrogate: Perylene-d12			*71%*			*70-130*			*EPA Method 525.2*

CERTIFICATE of ANALYSIS

Microbiological/Inorganic Certification - 877

Organic Certification - 4100

National Water Services LLC
Josh Gavin
281 Hamburg Rd SW
Lancaster, OH 43130

Client #: 1384
PO Number: 082652
Date Received: 4/3/25 15:23
Ohio EPA Analyzed Date: 5/12/25 12:32

Notes and Definitions

Item	**Definition**
HOLD	Exceeds Recommended Holding Time
J	Analyte was positively identified, the associated numerical value is estimated.
mg/kg Dry	Sample results reported on a dry weight basis
ug/L	ppb/Part per Billion
mg/L	ppm/Part per Million
ng/L	ppt/Part per Trillion
ND	Analyte NOT DETECTED at or above the method detection limit (MDL)
!	Analyte is at or above the Maximum Contaminate Level
MDL	Method Detection Limit
CFU	Colony Forming Units
MPN	Most Probable Number
NTU	Nephelometric Turbidity Unit
pCi/L	Picocuries per liter
SVI	Sludge Volume Index
%	Percent
GPD	Gallons per Day
su	Standard Units
RPD	Relative Percent Difference
%REC	Percent Recovery
Source	Sample that was matrix spiked or duplicated.

Notes:
1. Calculated analytes are based on raw data and may not reflect the rounding of the individual compounds.
2. Samples are analyzed using the information received on the request sheet and may not be analyzed when the parameters fall outside required guidelines.

MASI ®
ENVIRONMENTAL
LABORATORIES
7940 Memorial Drive
Plain City, OH 43064
614-873-4654

New 5D00747-01/2/3st Sheet
AR # 285707
Received: 4/3/2025
Matrix: Potable
Analysis R on Bottle: 285707
** See reverse for important SDS information **

Client #: 1384 Client Name: National Water Services County: ______ P.O.# 082652

Sampler Name: Josh Gavin SMP ID : ______ Sample Type/Class: ( ) New Well/Special

Sample Tap: Spigot Date Collected: 04/03/25 (MM/DD/YY) Time Collected: 9:00 am (hh:mm am/pm)

Tap Address: Warren County, Middletown Junction Well Field TW-2

( ) Public Sample ( ) PWS ID #: ______ ( ) Facility ID #: ______

( ) (New Well Trans) Transient Noncommunity

Private

( ) (New Well Nontrans) Nontransient-Noncommunity + PFAS

(X) (New Well Comm) Community Water Systems + PFAS

Work Order

5D00751-01/02
(Office Use Only)

Microbiological Tests

	Time Collected
( ) 140 Total Coliform #1	0830 hh:mm [✓ am]/pm
( ) 140 Total Coliform #2	0900 hh:mm [✓ am]/pm

Office Use Only:
9 items
12°
FD
1510

Route
Office/Lab

COOLER:

REVISED 2-15-23 DN

Alliance Technical Group - Akron
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

May 09, 2025

Audrey Cooper
MASI Environmental Services
7940 Memorial Dr.
Plain City, OH 43064
TEL: (614) 873-4654
FAX: (614) 873-3809

RE: 5D00747

Order No.: 25040461

Dear Audrey Cooper:

Alliance Technical Group - Akron received 2 sample(s) on 4/4/2025 for the analyses presented in the following report.

There were no problems with the analytical events associated with this report unless noted in the Case Narrative.

Quality control data is within laboratory defined or method specified acceptance limits except where noted.

If you have any questions regarding these tests results, please feel free to call the laboratory.

Sincerely,

Brian J. Fackelman
Project Manager, LIMS Administrator

3310 Win St.
Cuyahoga Falls, Ohio 44223

Arkansas 88-0735, California 2943, Colorado, Connecticut PH-0108, Florida NELAC E87688, Idaho OH00923, Illinois 200061, Indiana C-OH-13, ISO/IEC 17025:2017 119125 L22-544, Kansas E-10347, Kentucky (Underground Storage Tank) 3, Kentucky 90146, Maryland 339, Michigan 9988, Minnesota 1780279, Nevada OH009232020-1, New Hampshire 2996, New Jersey OH006, New York 11777, North Carolina 39705 and 631, North Dakota R-201, Ohio DW, Ohio VAP CL0052, Oklahoma 2019-155, Oregon OH200001, Pennsylvania 68-01335, Rhode Island LA000317, South Carolina 92016001, Texas T104704466-19-16, Utah OH009232020-12, Virginia VELAP 10381, West Virginia 9957C

Alliance Technical Group - Akron
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Case Narrative

WO#: **25040461**
Date: **5/9/2025**

CLIENT: MASI Environmental Services
Project: 5D00747

WorkOrder Narrative:
25040461: This report in its entirety consists of the following documents: Cover Letter, Case Narrative, Analytical Results, QC Summary Report, Applicable Accreditation Information, Chain-of-Custody, Cooler Receipt Form, and other applicable forms as necessary. All documents contain the Alliance Technical Group Work Order Number assigned to this report.

Alliance Technical Group holds the accreditations/certifications listed at the bottom of the cover letter that may or may not pertain to this report. Please refer to the "Accreditation Program Analytes Report" for accredited analytes list.

The information contained in this analytical report is the sole property of Alliance Technical Group and that of the customer. It cannot be reproduced in any form without the consent of Alliance Technical Group or the customer for which this report was issued. The results contained in this report are only representative of the samples received. Conditions can vary at different times and at different sampling conditions. Alliance Technical Group is not responsible for use or interpretation of the data included herein.

All results for solid samples are reported on an "as received" or "wet weight" basis unless indicated as "dry weight" using the "-dry" designation on the reporting units.

This report is believed to meet all of the requirements of the accrediting agency, where applicable. Any comments or problems with the analytical events associated with this report are noted below.

WorkOrder Comments:
25040461: State required accreditation not specified; results may not be reported as certified data. Data is not for compliance per the chain of custody; data is for private use.

Analytical Sequence Sample Notes:
25040461-002A SVOC-EPA537_DW(537): Potential low bias due to LCS results, process in control with passing LCSD. Results confirmed via re-analysis. Unable to re-extract due to no remaining volume.
25040461-002A SVOC-EPA537_DW(537): Potential low bias due to low 13C3-HFPO-DA recovery, result confirmed via re-analysis.

Alliance Technical Group - Akron
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Workorder Sample Summary

WO#: **25040461**
09-May-25

CLIENT: MASI Environmental Services
Project: 5D00747

Lab SampleID	Client Sample ID	Tag No	Date Collected	Date Received	Matrix
25040461-001	5D00747-01		4/3/2025 9:00:00 AM	4/4/2025 3:30:00 PM	Drinking Water
25040461-001	5D00747-01		4/3/2025 9:00:00 AM	4/4/2025 3:30:00 PM	Drinking Water
25040461-002	5D00747-02 FRB		4/3/2025 9:00:00 AM	4/4/2025 3:30:00 PM	Drinking Water

CLIENT: MASI Environmental Services

Collection Date: 4/3/2025 9:00:00 AM

Project: 5D00747

Lab ID: 25040461-001

Matrix: DRINKING WATER

Client Sample ID: 5D00747-01

Analyses	Result	RL	Qual	Units	Uncertainty	DF	Date Analyzed
GROSS ALPHA / GROSS BETA RADIOACTIVITY (EPA 900.0)					**E900.0**	**E900**	Analyst: **HDJ**
ALPHA, Gross	ND	3.00		pCi/L	± 1.79	1	4/17/2025 10:30:00 A
BETA, Gross	ND	4.00		pCi/L	± 1.79	1	4/17/2025 10:30:00 A
RADIUM-228 (904.0)					**E904.0**	**E903-904**	Analyst: **HDJ**
Radium-228	ND	1.00		pCi/L	± 0.250	1	5/7/2025 2:45:00 PM
Yield	1.00					1	5/7/2025 2:45:00 PM

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
ND	Not Detected	PL	Permit Limit
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
W	Sample container temperature is out of limit as specified at testcode		

Original

Analytical Report

(consolidated)

WO#: **25040461**

Date Reported: **5/9/2025**

CLIENT: MASI Environmental Services

Collection Date: 4/3/2025 9:00:00 AM

Project: 5D00747

Lab ID: 25040461-001

Matrix: DRINKING WATER

Client Sample ID: 5D00747-01

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PFAS BY EPA 537.1 **PERFLUORINATED ALKYL ACIDS (EPA 537.1)**				**E537.1**	**E537.1**	Analyst: **JJF**
PFBS	2.26	1.88		ng/L	1	4/17/2025 12:28:00 PM
PFHxS	ND	1.88		ng/L	1	4/17/2025 12:28:00 PM
PFOA	2.40	1.88		ng/L	1	4/17/2025 12:28:00 PM
PFOS	16.4	1.88		ng/L	1	4/17/2025 12:28:00 PM
PFNA	ND	1.88		ng/L	1	4/17/2025 12:28:00 PM
HFPO-DA	ND	1.88		ng/L	1	4/17/2025 12:28:00 PM
Surr: 13C2-PFDA	108	70 - 130		%Rec	1	4/17/2025 12:28:00 PM
Surr: 13C2-PFHxA	102	70 - 130		%Rec	1	4/17/2025 12:28:00 PM
Surr: 13C3-HFPO-DA	88.6	70 - 130		%Rec	1	4/17/2025 12:28:00 PM

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
ND	Not Detected	PL	Permit Limit
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
W	Sample container temperature is out of limit as specified at testcode		

Original

Analytical Report

(consolidated)

WO#: **25040461**
Date Reported: **5/9/2025**

CLIENT: MASI Environmental Services
Collection Date: 4/3/2025 9:00:00 AM
Project: 5D00747
Lab ID: 25040461-002
Matrix: DRINKING WATER
Client Sample ID: 5D00747-02 FRB

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PFAS BY EPA 537.1 **PERFLUORINATED ALKYL ACIDS (EPA 537.1)**				**E537.1**	**E537.1**	Analyst: **JJF**
PFBS	ND	1.76	QL-	ng/L	1	4/10/2025 3:49:00 PM
PFHxS	ND	1.76		ng/L	1	4/10/2025 3:49:00 PM
PFOA	ND	1.76	QL-	ng/L	1	4/10/2025 3:49:00 PM
PFOS	ND	1.76		ng/L	1	4/10/2025 3:49:00 PM
PFNA	ND	1.76		ng/L	1	4/10/2025 3:49:00 PM
HFPO-DA	ND	1.76		ng/L	1	4/10/2025 3:49:00 PM
Surr: 13C2-PFDA	89.3	70 - 130		%Rec	1	4/10/2025 3:49:00 PM
Surr: 13C2-PFHxA	71.8	70 - 130		%Rec	1	4/10/2025 3:49:00 PM
Surr: 13C3-HFPO-DA	63.4	70 - 130	S	%Rec	1	4/10/2025 3:49:00 PM

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747
BatchID: **83496**

Sample ID: **MB-83496** SampType: **MBLK** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/8/2025** RunNo: **206757**
Client ID: **BatchQC** Batch ID: **83496** TestNo: **E537.1** **E537.1** Analysis Date: **4/10/2025** SeqNo: **5534222**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	ND	2.00									
PFHxS	ND	2.00									
PFOA	ND	2.00									
PFOS	ND	2.00									
PFNA	ND	2.00									
HFPO-DA	ND	2.00									
Surr: 13C2-PFDA	0.0400		0.04000		99.9	70	130				
Surr: 13C2-PFHxA	0.0315		0.04000		78.8	70	130				
Surr: 13C3-HFPO-DA	0.0287		0.04000		71.7	70	130				
Surr: NETFOSAA-d5	0.155		0.1600		96.9	70	130				

Sample ID: **LCS-83496** SampType: **LCS** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/8/2025** RunNo: **206757**
Client ID: **BatchQC** Batch ID: **83496** TestNo: **E537.1** **E537.1** Analysis Date: **4/10/2025** SeqNo: **5534227**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	23.1	2.00	35.4	0	65.3	70	130				SQLR
PFHxS	32.8	2.00	36.5	0	90.0	70	130				
PFOA	27.1	2.00	40.0	0	67.8	70	130				S
PFOS	33.8	2.00	37.0	0	91.2	70	130				
PFNA	29.6	2.00	40.0	0	74.0	70	130				
HFPO-DA	28.7	2.00	40.0	0	71.7	70	130				
Surr: 13C2-PFDA	0.0358		0.04000		89.5	70	130				

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747 **BatchID:** **83496**

Sample ID: **LCS-83496** SampType: **LCS** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/8/2025** RunNo: **206757**
Client ID: **BatchQC** Batch ID: **83496** TestNo: **E537.1** **E537.1** Analysis Date: **4/10/2025** SeqNo: **5534227**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 13C2-PFHxA	0.0313		0.04000		78.2	70	130				
Surr: 13C3-HFPO-DA	0.0281		0.04000		70.2	70	130				
Surr: NETFOSAA-d5	0.143		0.1600		89.5	70	130				

Sample ID: **LCSD-83496** SampType: **LCSD** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/8/2025** RunNo: **206757**
Client ID: **BatchQC** Batch ID: **83496** TestNo: **E537.1** **E537.1** Analysis Date: **4/10/2025** SeqNo: **5534232**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	29.1	2.00	35.4	0	82.3	70	130	23.1	23.0	20	R
PFHxS	35.7	2.00	36.5	0	97.8	70	130	32.8	8.39	20	
PFOA	29.0	2.00	40.0	0	72.5	70	130	27.1	6.77	20	
PFOS	36.4	2.00	37.0	0	98.1	70	130	33.8	7.35	20	
PFNA	31.8	2.00	40.0	0	79.5	70	130	29.6	7.17	20	
HFPO-DA	33.8	2.00	40.0	0	84.6	70	130	28.7	16.5	20	
Surr: 13C2-PFDA	0.0372		0.04000		92.9	70	130		0	20	
Surr: 13C2-PFHxA	0.0337		0.04000		84.2	70	130		0	20	
Surr: 13C3-HFPO-DA	0.0301		0.04000		75.2	70	130		0	20	
Surr: NETFOSAA-d5	0.144		0.1600		90.1	70	130		0	20	

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747 **BatchID:** **83622**

Sample ID:	**MB-83622**	SampType:	**MBLK**	TestCode:	**SVOC-EPA53**	Units:	**ng/L**	Prep Date:	**4/14/2025**
Client ID:	**BatchQC**	Batch ID:	**83622**	TestNo:	**E537.1**		**E537.1**	Analysis Date:	**4/17/2025**

RunNo: **207261**
SeqNo: **5546660**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	ND	2.00									
PFHxS	ND	2.00									
PFOA	ND	2.00									
PFOS	ND	2.00									
PFNA	ND	2.00									
HFPO-DA	ND	2.00									
Surr: 13C2-PFDA	0.0438		0.04000		109	70	130				
Surr: 13C2-PFHxA	0.0396		0.04000		99.0	70	130				
Surr: 13C3-HFPO-DA	0.0353		0.04000		88.3	70	130				
Surr: NETFOSAA-d5	0.181		0.1600		113	70	130				

Sample ID:	**LCS-83622**	SampType:	**LCS**	TestCode:	**SVOC-EPA53**	Units:	**ng/L**	Prep Date:	**4/14/2025**
Client ID:	**BatchQC**	Batch ID:	**83622**	TestNo:	**E537.1**		**E537.1**	Analysis Date:	**4/17/2025**

RunNo: **207261**
SeqNo: **5546661**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	27.8	2.00	35.4	0	78.6	70	130				
PFHxS	33.9	2.00	36.5	0	92.9	70	130				
PFOA	28.6	2.00	40.0	0	71.4	70	130				
PFOS	36.2	2.00	37.0	0	97.8	70	130				
PFNA	34.0	2.00	40.0	0	85.0	70	130				
HFPO-DA	32.8	2.00	40.0	0	81.9	70	130				
Surr: 13C2-PFDA	0.0355		0.04000		88.7	70	130				

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

Client: MASI Environmental Services
Project: 5D00747 **BatchID:** **83622**

Sample ID: **LCS-83622** SampType: **LCS** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/14/2025** RunNo: **207261**
Client ID: **BatchQC** Batch ID: **83622** TestNo: **E537.1** **E537.1** Analysis Date: **4/17/2025** SeqNo: **5546661**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: 13C2-PFHxA	0.0336		0.04000		84.1	70	130				
Surr: 13C3-HFPO-DA	0.0299		0.04000		74.6	70	130				
Surr: NETFOSAA-d5	0.160		0.1600		99.9	70	130				

Sample ID: **LCSD-83622** SampType: **LCSD** TestCode: **SVOC-EPA53** Units: **ng/L** Prep Date: **4/14/2025** RunNo: **207261**
Client ID: **BatchQC** Batch ID: **83622** TestNo: **E537.1** **E537.1** Analysis Date: **4/17/2025** SeqNo: **5546662**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
PFBS	29.6	2.00	35.4	0	83.5	70	130	27.8	6.02	20	
PFHxS	34.3	2.00	36.5	0	94.0	70	130	33.9	1.23	20	
PFOA	28.3	2.00	40.0	0	70.8	70	130	28.6	0.829	20	
PFOS	36.1	2.00	37.0	0	97.4	70	130	36.2	0.409	20	
PFNA	32.3	2.00	40.0	0	80.8	70	130	34.0	4.99	20	
HFPO-DA	32.3	2.00	40.0	0	80.8	70	130	32.8	1.41	20	
Surr: 13C2-PFDA	0.0365		0.04000		91.2	70	130		0	20	
Surr: 13C2-PFHxA	0.0351		0.04000		87.8	70	130		0	20	
Surr: 13C3-HFPO-DA	0.0309		0.04000		77.3	70	130		0	20	
Surr: NETFOSAA-d5	0.163		0.1600		102	70	130		0	20	

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747 **BatchID:** **83705**

Sample ID: **MB-83705** SampType: **MBLK** TestCode: **AlphaBeta_D** Units: **pCi/L** Prep Date: **4/15/2025** RunNo: **207667**
Client ID: **BatchQC** Batch ID: **83705** TestNo: **E900.0** **E900** Analysis Date: **4/17/2025** SeqNo: **5555686**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ALPHA, Gross	ND	3.00									
BETA, Gross	ND	4.00									

Sample ID: **LCS-83705** SampType: **LCS** TestCode: **AlphaBeta_D** Units: **pCi/L** Prep Date: **4/15/2025** RunNo: **207667**
Client ID: **BatchQC** Batch ID: **83705** TestNo: **E900.0** **E900** Analysis Date: **4/17/2025** SeqNo: **5555687**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ALPHA, Gross	12.0	3.00	15.00	0	79.8	70	130				
BETA, Gross	15.6	4.00	20.00	0	78.2	70	130				

Sample ID: **RLC-83705** SampType: **RLC** TestCode: **AlphaBeta_D** Units: **pCi/L** Prep Date: **4/15/2025** RunNo: **207667**
Client ID: **BatchQC** Batch ID: **83705** TestNo: **E900.0** **E900** Analysis Date: **4/17/2025** SeqNo: **5555689**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ALPHA, Gross	ND	3.00	3.000	0	51.1	50	150				
BETA, Gross	4.99	4.00	4.000	0	125	50	150				

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747 **BatchID:** **84183**

Sample ID: **MB-84183** SampType: **MBLK** TestCode: **Radium-228_** Units: **pCi/L** Prep Date: **5/1/2025** RunNo: **208450**
Client ID: **BatchQC** Batch ID: **84183** TestNo: **E904.0** **E903-904** Analysis Date: **5/7/2025** SeqNo: **5574285**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	ND	1.00		0	0						
Yield	1.00			0	0						

Sample ID: **LCS-84183** SampType: **LCS** TestCode: **Radium-228_** Units: **pCi/L** Prep Date: **5/1/2025** RunNo: **208450**
Client ID: **BatchQC** Batch ID: **84183** TestNo: **E904.0** **E903-904** Analysis Date: **5/7/2025** SeqNo: **5574286**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	3.58	1.00	5.000	0	71.6	50	130				
Yield	1.00			0	0						

Sample ID: **LCSD-84183** SampType: **LCSD** TestCode: **Radium-228_** Units: **pCi/L** Prep Date: **5/1/2025** RunNo: **208450**
Client ID: **BatchQC** Batch ID: **84183** TestNo: **E904.0** **E903-904** Analysis Date: **5/7/2025** SeqNo: **5574287**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	4.07	1.00	5.000	0	81.4	50	130	3.580	12.8	20	
Yield	1.00			0	0			1.000	0		

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

QC SUMMARY REPORT

WO#: **25040461**
09-May-25

Client: MASI Environmental Services
Project: 5D00747
BatchID: **84183**

Sample ID: **RLC-84183**	SampType: **RLC**	TestCode: **Radium-228_**	Units: **pCi/L**	Prep Date: **5/1/2025**	RunNo: **208450**						
Client ID: **BatchQC**	Batch ID: **84183**	TestNo: **E904.0**	**E903-904**	Analysis Date: **5/7/2025**	SeqNo: **5574289**						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	ND	1.00	1.000	0	79.0	50	150				
Yield	1.00			0	0						

Sample ID: **RLCD-84183**	SampType: **RLC**	TestCode: **Radium-228_**	Units: **pCi/L**	Prep Date: **5/1/2025**	RunNo: **208450**						
Client ID: **BatchQC**	Batch ID: **84183**	TestNo: **E904.0**	**E903-904**	Analysis Date: **5/7/2025**	SeqNo: **5574290**						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	ND	1.00	1.000	0	59.0	50	150				
Yield	1.00			0	0						

Qualifiers:

H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response	ND	Not Detected
PL	Permit Limit	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	Spike Recovery outside accepted recovery limits	W	Sample container temperature is out of limit as specified at testcode		

Qualifiers and Acronyms

WO#: **25040461**
Date: **5/9/2025**

These commonly used Qualifiers and Acronyms may or may not be present in this report.

Qualifiers

U	The compound was analyzed for but was not detected above the MDL.
J	The reported value is greater than the Method Detection Limit but less than the Reporting Limit.
H	The hold time for sample preparation and/or analysis was exceeded. Not Clean Water Act compliant.
D	The result is reported from a dilution.
E	The result exceeded the linear range of the calibration or is estimated due to interference.
MC	The result is below the Minimum Compound Limit.
*****	The result exceeds the Regulatory Limit or Maximum Contamination Limit.
m	Manual integration was used to determine the area response.
d	Manual integration in which peak was deleted
N	The result is presumptive based on a Mass Spectral library search assuming a 1:1 response.
P	The second column confirmation exceeded 25% difference.
C	The result has been confirmed by GC/MS.
X	The result was not confirmed when GC/MS Analysis was performed.
B	The analyte was detected in the Method Blank at a concentration greater than the RL.
MB+	The analyte was detected in the Method Blank at a concentration greater than the MDL.
G	The ICB or CCB contained reportable amounts of analyte.
QC-/+	The CCV recovery failed low (-) or high (+).
R/QDR	The RPD was outside of accepted recovery limits.
QL-/+	The LCS or LCSD recovery failed low (-) or high (+).
QLR	The LCS/LCSD RPD was outside of accepted recovery limits.
QM-/+	The MS or MSD recovery failed low (-) or high (+).
QMR	The MS/MSD RPD was outside of accepted recovery limits.
QV-/+	The ICV recovery failed low (-) or high (+).
S	The spike result was outside of accepted recovery limits.
W	Samples were received outside temperature limits (0° – 6° C). Not Clean Water Act compliant.
Z	Deviation; A deviation from the method was performed; Please refer to the Case Narrative for additional information

Acronyms

ND	Not Detected	**RL**	Reporting Limit
QC	Quality Control	**MDL**	Method Detection Limit
MB	Method Blank	**LOD**	Level of Detection
LCS	Laboratory Control Sample	**LOQ**	Level of Quantitation
LCSD	Laboratory Control Sample Duplicate	**PQL**	Practical Quantitation Limit
QCS	Quality Control Sample	**CRQL**	Contract Required Quantitation Limit
DUP	Duplicate	**PL**	Permit Limit
MS	Matrix Spike	**RegLvl**	Regulatory Limit
MSD	Matrix Spike Duplicate	**MCL**	Maximum Contamination Limit
RPD	Relative Percent Different	**MinCL**	Minimum Compound Limit
ICV	Initial Calibration Verification	**RA**	Reanalysis
ICB	Initial Calibration Blank	**RE**	Reextraction
CCV	Continuing Calibration Verification	**TIC**	Tentatively Identified Compound
CCB	Continuing Calibration Blank	**RT**	Retention Time
RLC	Reporting Limit Check	**CF**	Calibration Factor

This list of Qualifiers and Acronyms reflects the most commonly utilized Qualifiers and Acronyms for reporting. Please refer to the Analytical Notes in the Case Narrative for any Qualifiers or Acronyms that do not appear in this list or for additional information regarding the use of these Qualifiers on reported data.

MASI LABORATORIES ©

SUBCONTRACT ORDER

25040461

Sending Laboratory:

Mobile Analytical Services, Inc.
7940 Memorial Dr
Plain City, OH 43064
Phone: 614-873-4654

Project Manager: Audrey Cooper

Subcontracted Laboratory:

Summit Environmental Technologies (5626)
3310 Win Street
Cuyahoga Falls, OH 44223
Phone: (330) 253-8211

Work Order: 5D00747

Analysis	**Expires**	**Method**	**Comments** Private
Sample ID: 5D00747-01 ***Potable*** ***Sampled: 04/03/2025 09:00***			
PFOA/PFOS M537 Regulated List	04/17/2025 09:00		
Radium-228	09/30/2025 09:00		
Gross Beta	09/30/2025 09:00	Rec 2 PFAS containers	
Gross Alpha	09/30/2025 09:00		
Containers Supplied:		CPM10	pH 1
Sample ID: 5D00747-02 ***Potable*** ***Sampled: 04/03/2025 09:00***			
PFOA/PFOS M537 Regulated List Field Blanl	04/17/2025 09:00		
Containers Supplied:			

1.8-0.0: 1.8°C; ATG, cooler, ice

HM — Released By

4/4/25 — Date

T. Lund 11:00 — Received By

4-4-25 — Date

Reling. T. Lund 4-4-25 1530

Rec'd 4/4/25 1830

Alliance Technical Group - Akron
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Sample Log-In Check List

Client Name: MAS-OH-43017 Work Order Number: 25040461 RcptNo: 1

Logged by:	Tegan A. Richards	4/4/2025 3:30:00 PM	Tegan Richards
Completed By:	Tegan A. Richards	4/5/2025 1:06:15 PM	Tegan Richards
Reviewed By:	Brian J. Fackelman	4/7/2025 2:35:41 PM	

Chain of Custody

1. Is Chain of Custody complete? Yes ☐ No ☑ Not Present ☐
2. How was the sample delivered? Alliance

Log In

3. Coolers are present? Yes ☑ No ☐ NA ☐
4. Shipping container/cooler in good condition? Yes ☑ No ☐
   Custody seals intact on shipping container/cooler? Yes ☐ No ☐ Not Present ☑
   No. Seal Date: Signed By:
5. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
6. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
7. Sample(s) in proper container(s)? Yes ☑ No ☐
8. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
9. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
10. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
11. Is the headspace in the VOA vials less than 1/4 inch or 6 mm? Yes ☐ No ☐ No VOA Vials ☑
12. Were any sample containers received broken? Yes ☐ No ☑
13. Does paperwork match bottle labels? Yes ☑ No ☐
    (Note discrepancies on chain of custody)
14. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
15. Is it clear what analyses were requested? Yes ☑ No ☐
16. Were all holding times able to be met? Yes ☑ No ☐
    (If no, notify customer for authorization.)

Special Handling (if applicable)

17. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date:
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

18. Additional remarks:

Project information (address/state), preservation, and number of containers not recorded on COC.

Cooler Information

Cooler No	Temp ºC	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.8	Good	Not Present			