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EJECTOR PUMP DESIGN

Prepared for:

HILLSIDE COMMERCIAL PARK

Town of Orangetown
Rockland County, New York

November 6, 2014



Stuart Strow, P.E.
N.Y. Lic. No. 66876

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SANITARY PUMP STATION DESIGN

Estimate Design Flow

A new ejector pump station will be designed to serve the watchman's residence and small office on the southerly side of the site. The ejector pump will discharge to a new sanitary manhole to be installed in the driveway between the two self-storage buildings. Sewage will then flow by gravity from the new manhole to the larger pump station that is to be installed on the northerly side of the site.

The watchmen's residence includes two bedrooms; the office space is 1,000 square feet and will be occupied by 2 employees.

$$\begin{aligned}\text{Water usage} &= [(2 \text{ BR}) \times (110 \text{ gal/BR/day})] + [(2 \text{ employees}) \times (15 \text{ gal/emp/day})] \\ &= 250 \text{ gpd}\end{aligned}$$

$$\text{Average Flow} = Q_{\text{AVG}} = (250 \text{ gpd}) / (1440 \text{ min/day}) = 0.174 \text{ gpm}$$

Use peaking factor = 4

$$\text{Peak Flow} = Q_{\text{PEAK}} = (4) \times (0.174 \text{ gpm}) = 0.70 \text{ gpm}$$

Force Main Characteristics

Static Head

Invert elevation of destination manhole = 228.0

Low Level in proposed pump station = 220.0

$$\text{Static Head} = 8.0 \text{ feet}$$

Dynamic Head

Provide new 1.25" diameter force main

Straight length of force main = 450 feet

Equivalent length of valves and fittings (see attached table)

$$\begin{aligned}(4) - 90^\circ \text{ bends} & \quad \times 4.0 = 16.0 \text{ feet} \\ (1) - \text{Check valve} & \quad \times 13.0 = \underline{13.0 \text{ feet}}\end{aligned}$$

$$\text{Equivalent length} = 29.0 \text{ feet}$$

$$\text{Total equivalent length} = 450 \text{ feet} + 29.0 \text{ feet} = 479 \text{ feet}$$

Total Dynamic Head Calculations

Flow (GPM)	*Friction Loss Factor (ft/100 ft)	System Dynamic Head (ft)**	Static Head (ft)	Total Dynamic Head (ft)
7	0.81	3.88	8.0	11.88
10	1.55	7.42	8.0	15.42
15	3.28	15.71	8.0	23.71
20	5.59	26.78	8.0	34.78
25	8.45	40.48	8.0	48.48

*refer to attached chart

**system dynamic head = (friction loss factor) X (total equivalent length/100)

Pump Station Operating Characteristics

Select E/ONE Packaged Grinder Sewer Pump System, Model DH071-61, 1.0 HP, 1.25" diameter discharge, 1725 RPM

From plotted system curve, minimum operating discharge = **13 GPM @ 20 feet TDH**

Check velocity in 1.25" diameter force main (Area = 0.0085 sq. ft.)

$$V = \frac{13 \text{ GPM}}{(0.0085 \text{ sq. ft.})(450 \text{ GPM/cfs})} = 3.66 \text{ ft/s}$$

OK – velocity exceeds minimum requirement of 2 ft/s

Selected Elevations

Invert of wet well:	220.0
Lead pump on:	221.50
Pump off:	221.17
High level alarm:	222.0

Wet Well Volume

Use 24" diameter (internal) wet well

Area = 3.14 sq. ft.

Volume = (3.14 sq ft) x (7.48 gallons/cu ft) = 23.5 gallons / ft

Volume pumped = (0.33 ft) x (23.5 gallons / ft) = **7.8 gallons**

Check Cycling Times

At Peak Flow:

$$\text{Pump OFF time} = (7.8 \text{ Gallons}) / (0.70 \text{ GPM}) = 11.1 \text{ minutes}$$

$$\text{Pump RUN time (zero inflow)} = (7.8 \text{ Gallons}) / (13 \text{ GPM}) = 0.60 \text{ minutes}$$

$$\begin{aligned} \text{Pump RUN time (peak inflow):} \quad & 13(T) = 0.70(T) + 7.8 \\ & 12.30(T) = 7.8 \\ & T = 0.63 \text{ minutes} \end{aligned}$$

At Average Flow:

$$\text{Pump OFF time} = (7.8 \text{ Gallons}) / (0.174 \text{ GPM}) = 44.8 \text{ minutes}$$

$$\text{Pump RUN time (zero inflow)} = (7.8 \text{ Gallons}) / (13 \text{ GPM}) = 0.60 \text{ minutes}$$

$$\begin{aligned} \text{Pump RUN time (avg. inflow):} \quad & 13(T) = 0.174(T) + 7.8 \\ & 12.83(T) = 7.8 \\ & T = 0.61 \text{ minutes} \end{aligned}$$

FRICTION LOSS CHART

FRICTION LOSS PER 100 FEET OF PIPE OF PLASTIC PIPE

GPM	PIPE DIAMETER																			
	1/2 in.		3/4 in.		1 in.		1 1/4 in.		1 1/2 in.		2 in.		2 1/2 in.		3 in.		4 in.		5 in.	
	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80	SCH 40	SCH 80
1	2.08	4.02	0.51	0.88	0.55	0.88	0.14	0.21	0.07	0.10										
2	4.16	8.03	1.02	1.72	1.10	1.72	0.44	0.66	0.22	0.30	0.056	0.10	0.038	0.05	0.015	0.02				
5	23.44	45.23	5.73	9.67	1.72	2.75	0.81	1.21	0.38	0.55	0.11	0.15	0.051	0.07	0.021	0.028				
7	43.06	83.07	10.52	17.76	3.17	5.04	1.55	2.30	0.72	1.04	0.21	0.29	0.09	0.12	0.03	0.04				
10	82.02	-	20.04	33.84	6.02	9.61	3.28	4.87	1.53	2.20	0.45	0.62	0.19	0.26	0.07	0.09				
15	-	-	42.46	71.70	12.77	20.36	5.59	8.30	2.61	3.75	0.76	1.06	0.32	0.44	0.11	0.15	0.03	0.04		
20	-	-	72.34	-	21.75	34.68	8.45	12.55	3.95	5.67	1.15	1.60	0.49	0.67	0.17	0.22	0.04	0.06	0.08	0.03
25	-	-	-	-	32.88	52.43	11.85	17.59	5.53	7.95	1.62	2.25	0.68	0.94	0.23	0.31	0.06	0.08	0.11	0.04
30	-	-	-	-	46.08	73.48	-	-	7.76	10.80	2.15	2.99	0.91	1.25	0.31	0.42	0.06	0.11	0.14	0.04
35	-	-	-	-	-	-	15.78	23.40	9.43	13.55	2.75	3.83	1.16	1.60	0.40	0.54	0.11	0.14	0.17	0.06
40	-	-	-	-	-	-	20.18	29.97	11.73	16.85	3.43	4.76	1.44	1.99	0.50	0.67	0.13	0.17	0.21	0.07
45	-	-	-	-	-	-	25.10	37.27	14.25	20.48	4.16	5.79	1.75	2.42	0.60	0.81	0.16	0.21	0.25	0.10
50	-	-	-	-	-	-	30.51	45.30	19.98	28.70	5.84	8.12	2.46	3.39	0.85	1.14	0.22	0.30	0.37	0.10
60	-	-	-	-	-	-	-	-	-	-	7.76	10.80	3.27	4.51	1.13	1.51	0.30	0.39	0.50	0.13
75	-	-	-	-	-	-	-	-	-	-	8.82	12.27	3.71	5.12	1.28	1.72	0.34	0.45	0.58	0.14
80	-	-	-	-	-	-	-	-	-	-	9.94	13.83	4.19	5.77	1.44	1.94	0.38	0.50	0.63	0.15
90	-	-	-	-	-	-	-	-	-	-	12.37	17.20	5.21	7.18	1.80	2.41	0.47	0.58	0.76	0.16
100	-	-	-	-	-	-	-	-	-	-	15.03	20.90	6.33	8.72	2.18	2.93	0.58	0.76	0.91	0.24
125	-	-	-	-	-	-	-	-	-	-	-	-	9.58	13.21	3.31	4.43	0.88	1.19	1.46	0.37
150	-	-	-	-	-	-	-	-	-	-	-	-	13.41	18.48	4.63	6.20	1.22	1.61	2.15	0.52
175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.16	8.26	1.63	2.15	2.75	0.69
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.88	10.57	2.08	2.75	3.76	0.88
250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.93	16.00	3.15	4.16	5.87	1.34
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.87	7.76	9.93	2.49
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.19
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.97
450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.82
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

THIS CHART GIVES FRICTION LOSSES FOR YOUR GIVEN FLOW RATE PER 100 FEET OF PIPE. EXAMPLE: IF YOU HAVE 80 GALLONS PER MINUTE AND YOU'RE USING 2 INCH SCHEDULE 80 PIPE AND YOU HAVE A 160 FEET OF PIPE, YOUR FRICTION LOSS IS 8.12 x 1.6 = 12.99 FEET.

NOTE: IT IS BEST TO KEEP YOUR FRICTION LOSS (PER 100 FEET OF PIPE) TO LESS THAN 5 FEET.

FRICTION LOSS IN PVC FITTINGS IN EQUIVALENT FEET OF STRAIGHT PIPE

NORMAL PIPE SIZE (IN)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
90° ELBOW, STANDARD	1.5	2.0	2.25	4.0	4.0	6.0	8.0	8.0	12.0
45° ELBOW, STANDARD	0.75	1.0	1.4	1.75	2.0	2.5	3.0	4.0	5.0
INSERT COUPLING	0.5	0.75	1.0	1.25	1.5	2.0	3.0	3.0	4.0
GATE VALVE	3	4	6	8	10	15	18	20	30
MALE-FEMALE ADAPTERS	1.0	1.5	2.0	2.75	3.5	4.5	5.5	6.5	9.0
TEE - FLOW THROUGH RUN	1.0	1.4	1.7	2.3	2.7	4.3	5.1	6.3	8.3
TEE - FLOW THROUGH BRANCH	4.0	5.0	6.0	7.0	8.0	12.0	15.0	16.0	22.0

EJECTOR PUMP DESIGN

BBE #57007

Total Equivalent Length:

479 LF

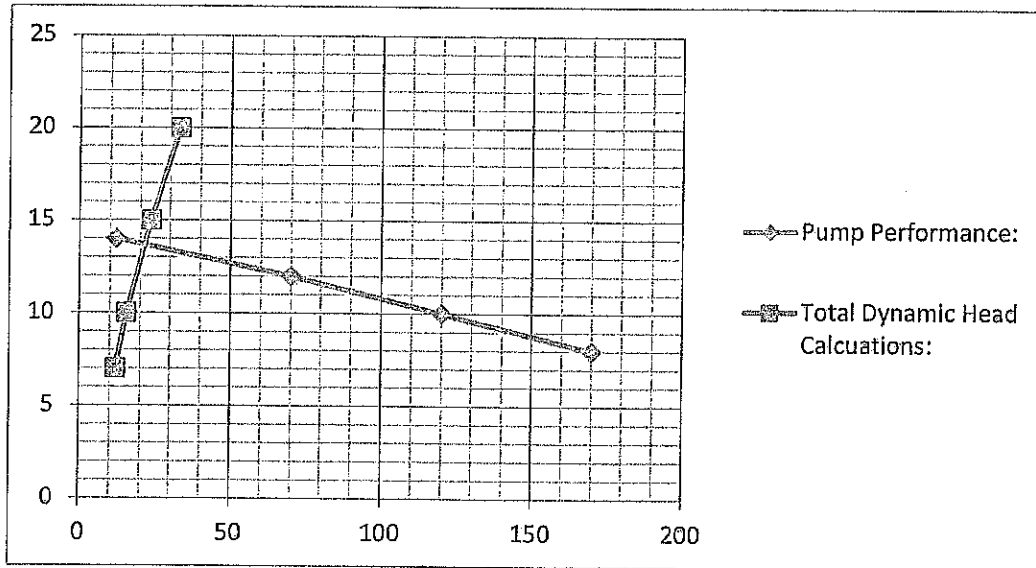
Total Dynamic Head Calculations:

Flow (GPM)	Flow (GPH)	Friction Loss Factor (ft/100ft)	System Dynamic Head (ft)	Static Head (ft)	Total Dynamic Head (ft)
7.0	420	0.81	3.8799	8.0	11.88
10.0	600	1.55	7.4245	8.0	15.42
15.0	900	3.28	15.7112	8.0	23.71
20.0	1200	5.59	26.7761	6.5	33.28

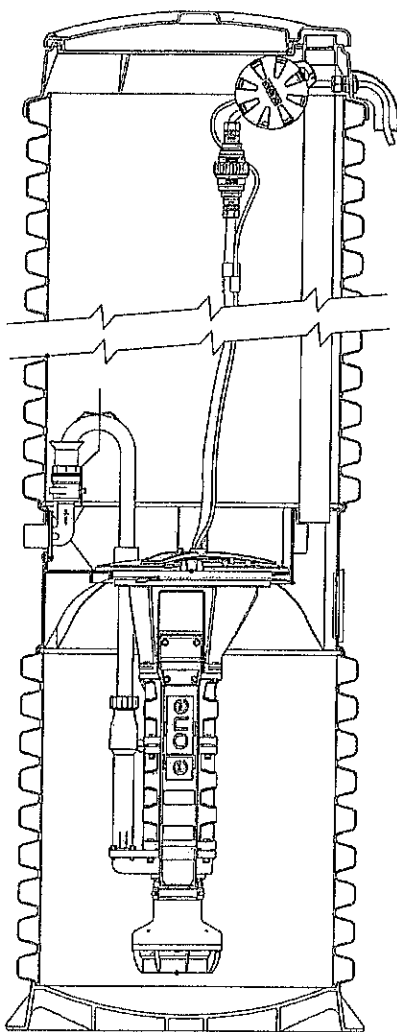
Pump Performance:

Flow (GPM)	Total Dynamic Head (ft)
8	170
10	120
12	70
14	12

Per E/ONE Packaged Grinder Sewer Pump System, Model DH071-61, 1hp, 1725rpm



DH071/DR071



General Features

The model DH071 or DR071 grinder pump station is a complete unit that includes: the grinder pump, check valve, HDPE (high density polyethylene) tank, controls, and alarm panel. A single DH071 or DR071 is a popular choice for one, average single-family home and can also be used for up to two average single-family homes where codes allow and with consent of the factory.

- Rated for flows of 700 gpd (2650 lpd)
- 70 gallons (265 liters) of capacity
- Indoor or outdoor installation
- Standard outdoor heights range from 61 inches to 160 inches

The DH071 is the "hardwired," or "wired," model where a cable connects the motor controls to the level controls through watertight penetrations.

The DR071 is the "radio frequency identification" (RFID), or "wireless," model that uses wireless technology to communicate between the level controls and the motor controls.

Operational Information

Motor

1 hp, 1,725 rpm, high torque, capacitor start, thermally protected, 120/240V, 60 Hz, 1 phase

Inlet Connections

4-inch inlet grommet standard for DWV pipe. Other inlet configurations available from the factory.

Discharge Connections

Pump discharge terminates in 1.25-inch NPT female thread. Can easily be adapted to 1.25-inch PVC pipe or any other material required by local codes.

Discharge

15 gpm at 0 psig (0.95 lps at 0 m)
11 gpm at 40 psig (0.69 lps at 28 m)
7.8 gpm at 80 psig (0.49 lps at 56 m)

Accessories

E/One recommends that the Uni-Lateral, E/One's own stainless steel check valve, be installed between the grinder pump station and the street main for added protection against backflow.

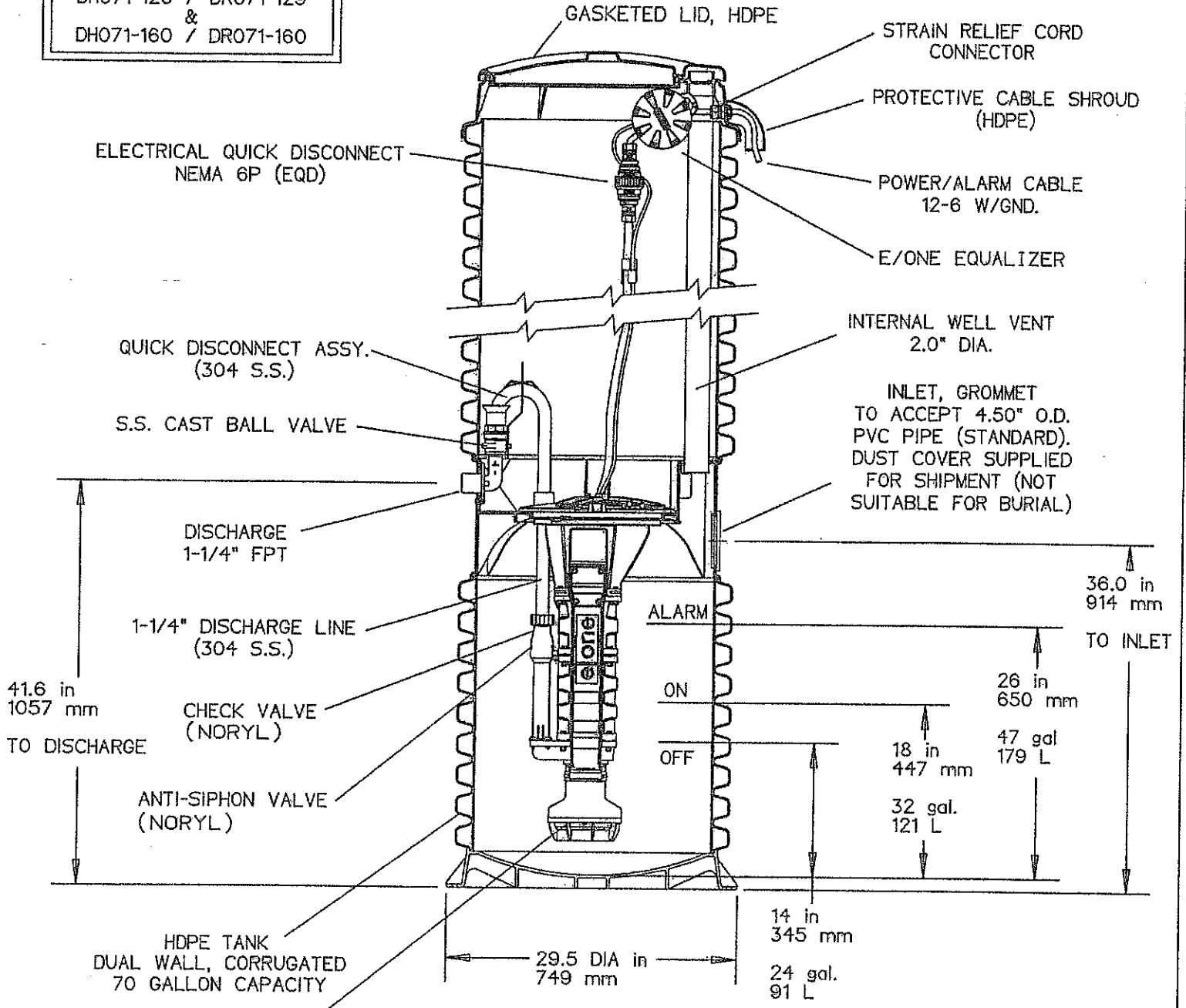
Alarm panels are available with a variety of options, from basic monitoring to advanced notice of service requirements.

The Remote Sentry is ideal for installations where the alarm panel may be hidden from view.

Patent Numbers: 5,752,315
5,562,254 5,439,180

OPTIONS : **DH071** (HARD WIRED LEVEL CONTROLS)
 DR071 (WIRELESS LEVEL CONTROLS)

FIELD JOINT REQUIRED FOR MODELS
 DH071-129 / DR071-129
 &
 DH071-160 / DR071-160



SEMI-POSITIVE DISPLACEMENT TYPE PUMP. EACH DIRECTLY DRIVEN BY A 1 HP MOTOR

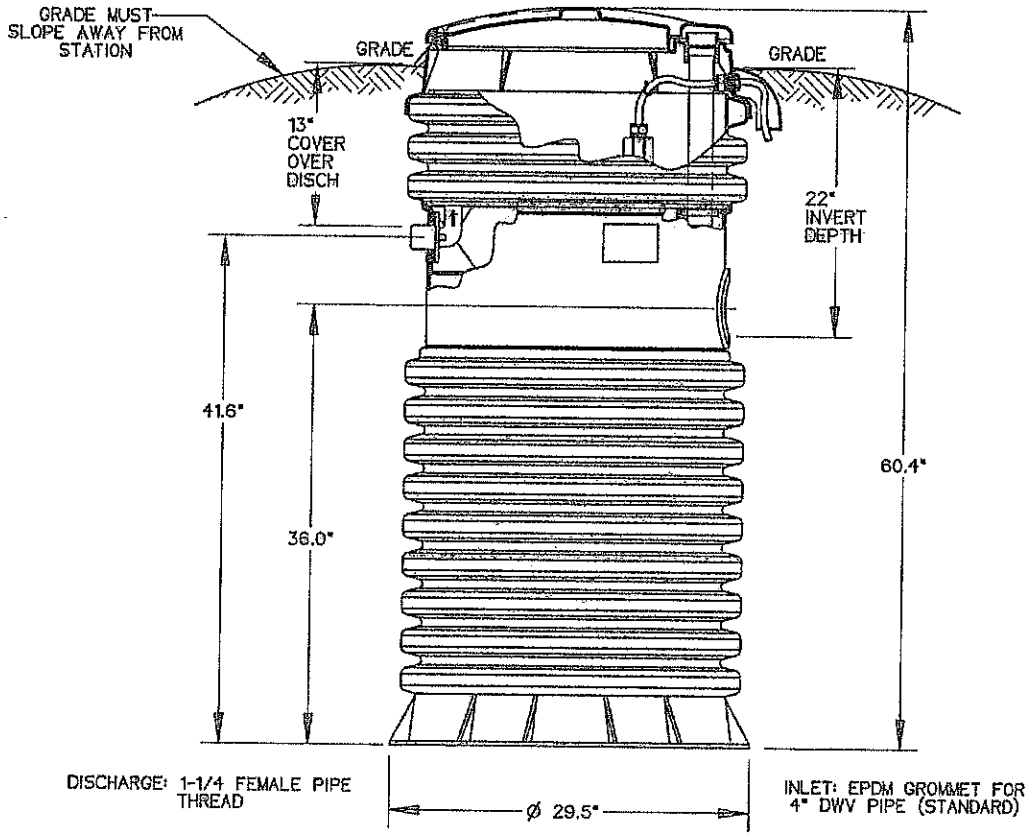


CONCRETE BALLAST MAY BE REQUIRED
 SEE INSTALLATION INSTRUCTION
 FOR DETAILS...

NOTE: DIMENSIONS ARE FOR REF ONLY

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MODEL DH071 / DR071 DETAIL SHEET				
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OPTIONS : DH071-61 (HARD WIRED LEVEL CONTROLS)
 DR071-61 (WIRELESS LEVEL CONTROLS)

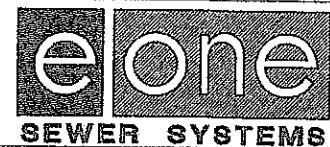


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DR BY	CHK'D	DATE	ISSUE	SCALE



MODEL DH071-61 / DR071-61

NA0050P04

EJONE SPD PUMP PERFORMANCE CURVE

GRINDER PUMP, 1HP, 1725 RPM

