Water Authority-Cayman

EFFLUENT DISPOSAL WELL SPECIFICATIONS

EFFECTIVE DATE 1 AUGUST 2015

1 GENERAL

1.1 Purpose

Effluent disposal wells need to be constructed in such a manner that treated effluent does not affect public health and minimizes the impact of effluent on the environment.

Effluent may contain pathogens; therefore effluent disposal wells are designed and constructed to protect the public from direct contact with effluent.

Effluent contains suspended solids, organics and nutrients which may impact the quality of groundwater, surface water and the marine environment. Effluent disposal wells are designed and constructed to minimize impacts on the quality of fresh water lenses, surface water and the marine environment.

1.2 Minimum Requirements

These specifications provide the Water Authority's minimum requirements for the installation of effluent disposal wells. Alternative methods or variation from these specifications shall be submitted in writing and approved in writing by the Water Authority prior to well construction.

1.3 Licensed Well Driller

The construction and installation of effluent disposal wells shall be carried out by a well driller holding a current well driller's licence issued under Part VIII of the Water Authority Law (2011 Revision).

1.4 Filing of Well Construction Returns

The licensed well driller shall submit records of well construction details to the Water Authority on a monthly basis in accordance with section 51 (1) (b) of the Water Authority Law (2011 Revision) and Regulation 39 (1) of the Water Authority Regulations (2007 Revision). The Water Authority shall provide the format including information required for the well construction returns. The Water Authority may modify, as it deems fit, the format and information required for the well construction returns.

1.5 Updates and modifications of effluent well specifications

The Water Authority may modify and update, as it deems fit, the effluent disposal well specifications. In the event the Water Authority modifies or updates the effluent disposal well specifications, the well

drillers shall be provided with reasonable notice before the modified or updated effluent disposal well specifications are implemented.

1.6 Notification of scheduled well installation

To provide the Water Authority with an opportunity to carry out inspections, the well driller shall notify the Water Authority, no later than one (1) business day prior to the installation of a well, of the date and time that a well is installed, The notification may be sent to the Water Authority via email at drillerinfo@waterauthority.ky.

2 DEFINITIONS

2.1 D1 and D2

D1 is the total depth of the borehole from ground level.

D2 is the depth of grouted casing from ground level.

The Water Authority determines site specific minimum depths for D1 and D2 based on site elevation and proximity to water features such as fresh water lenses, excavations and the coastal zone. Prior to the installation of an effluent disposal well, the well driller shall contact the Water Authority via email at drillerinfo@waterauthority.ky to obtain the minimum site specific requirements for D1 and D2.

Based on specific site conditions encountered during the installation of the well, the well driller may install a well that exceeds the minimum total well depth (D1) as specified by the Water Authority.

2.2 OPEN ZONE

The open, or injection, zone is the uncased portion at the base of the well where effluent discharges into the groundwater.

The open zone is the total borehole depth (D1) less the depth of grouted casing (D2).

The minimum length of the open, or injection, zone is ten (10) feet, however this may be larger depending on the permeability of the formation. This shall be accomplished by increasing the total depth of the borehole (D1).

3 MATERIALS

3.1 Well Casing

All well casing shall be new and shall be made of PVC and conform to, or exceed, one of the following standards:

a. ASTM F480-14 Schedule 40 or SDR 26
b. ASTM D1785-12 Schedule 40
c. ASTM D2241-15 SDR 26

The nominal diameter of well casing shall be at least four (4) inches.

3.2 Annular Grout

The following grout mixtures shall be used:

a. Neat cement grout

   A mixture of Portland cement (ASTM C150) mixed with no more than six (6) US gallon of fresh potable water per bag of cement (94 pounds).

b. Sand-cement grout
   A mixture of Portland cement (ASTM C150) and dry sand in the proportion of no more than two parts by weight of dry sand to one part of cement mixed with no more than six (6) US gallon of fresh potable water per bag of cement (94 pounds).

Grout mixtures may contain up to five percent (5%) powdered bentonite to reduce shrinkage of the grout mixture and reduce the heat of curing. The cement-bentonite-water ratios shall be in accordance with the table below.

Mixing ratios of cement, bentonite and water						
Percentage Bentonite	0	1	2	3	4	5
Volume of water per bag cement (US gallon)	6.0	6.0	6.5	7.2	7.8	8.5
Weight of bentonite per bag cement (lbs)	0	1	2	3	4	5
Volume of grout per bag cement (ft^3)	1.28	1.28	1.36	1.45	1.55	1.64
Volume of grout per bag cement (US gallon)	9.6	9.6	10.2	10.9	11.6	12.3

Admixtures, such as a high range water reducing agent or a temperature control agent, to modify the performance of the grout, may be used, provided that the Water Authority has given permission in writing and the admixtures are used in accordance with the specifications of the manufacturer.

3.3 Formation Packer (Shale Trap)

The size of the formation packer, if used, shall be compatible with the diameter of the well casing and the diameter of the borehole located directly above the open zone of the well. The formation packer shall be made of rubber material and be installed with a stainless steel adjustable clamp at the end of the well casing. The casing shall be installed in competent rock to ensure a proper seal between the well casing and the borehole. If necessary, additional formation packers may be installed at the bottom of the casing at approximately two (2) foot intervals.

The use of bentonite pellets or chips to seal the packer at the bottom of the casing is prohibited.

3.4 Materials other than Grout to Fill Annular Space

All materials shall be free of organic materials and maximum particle size shall be 3/8 inch. Clean sand, 3/8 inch gravel, crusher-run or drill cuttings may be placed in the annular space from the top of the well to a maximum of two (2) foot directly above the formation packer to obtain a seal between the formation packer and the grout. The sand, gravel, crusher-run or drill cuttings shall be placed slowly and uniformly from the surface into the annular space. The volume of sand, gravel, crusher-run or drill cuttings shall be in accordance with the table below.

Maximum volume of sand, crusher run, gravel or drill cuttings to obtain two (2) foot seal above formation packer				
Casing diameter (inches)	4	6	8	10
Borehole size (inches)	8	10	12	14
Sand, crusher run or gravel (ft^3)	0.7	0.9	1.1	1.3
Sand or crusher run (US gallon)	4.9	6.5	8.2	9.8
Note: these volumes include an allowance of 25% to fill additional space created by the drilling of the borehole				

4 WELL CONSTRUCTION

4.1 Well Construction

Surface casing may be installed into the upper portion of bedrock to stabilize unconsolidated surface material. The diameter of the borehole for the upper, cased section of the well (D2), shall be at least four (4) inches larger than the nominal size of the casing and provide sufficient space to accommodate the use of a tremie pipe extended to the bottom of the cased portion of the well.

During well construction all precautions shall be taken and best management practices shall be followed to limit the disposal of excess water from the drilling operation on the surface and on adjacent properties, this may include but not be limited to discontinue drilling until excess water has settled, diversion of excess water to a nearby stormwater drainage well, use of sandbags or berms to protect sensitive areas and landscaping and the removal of excess water with a vacuum truck.

The well may be constructed by drilling the cased portion and the open zone of the well prior to placing well casing and grout, if this method is used all precautions shall be taken to avoid the introduction of grout in the open zone.

Alternatively the well may be constructed by drilling the cased portion of the well, installing the well casing and grout, observe a minimum twenty-four (24) hours for the grout to cure before drilling the open zone of the well.

The completed well shall be sufficiently plumb and straight to facilitate, if so required, the re-drilling or deepening of the open zone without damaging the installed well casing or grout seal.

4.2 Installation of Well Casing

Casing lengths shall be joined watertight by an appropriate method, so that the resulting joint shall have the same structural integrity as the casing itself. Solvent welding shall be carried out in accordance with the manufacturer's recommendations. Curing time for solvent cemented joints shall not be less than five (5) minutes.

The jointed casing string shall be lowered in the borehole with the drilling rig, utilizing clamps, elevators or other mechanical devices.

Centralizers shall be installed on the well casing and shall be spaced at a minimum of fifteen (15) feet intervals, but not exceeding thirty (30) feet intervals. Centralizers shall be aligned vertically to facilitate the use of the tremie pipe.

The completed well casing shall terminate at least one (1) foot above ground level and be capped with a suitable PVC cap. In the event the drilling operation is not completed at the end of the working day, the well shall be capped with a suitable PVC cap.

4.3 Annular Grout Seal

The annular space between the casing and the borehole shall be grouted under pressure to provide an annular seal, from the base of the casing to approximately eighteen (18) inches below ground level. The upper eighteen (18) inches of the well casing shall not be grouted to facilitate the installation of the "tee" fitting to connect the drainage pipe from the wastewater treatment system to the well.

Grout shall be pumped through a tremie pipe in the annular space between the casing and the borehole. The tremie pipe shall extend from the surface to the bottom of the zone to be grouted. Grout shall be placed, from bottom to top, in one continuous operation. The grout pipe may be slowly raised as the grout is placed, but the discharge end of the grout pipe must remain submerged in the emplaced grout until the grouting process is completed. The grout pipe shall be maintained full with mixed grout, to the surface, at all times until the grouting process is completed.

In the event of interruption of the grouting operation, the bottom of the tremie pipe shall be raised above the grout level in the annular space and shall not be re-submerged below the emplaced grout until all air and water have been displaced from the tremie pipe and the tremie pipe has been filled with grout.

In the event the cased portion of the well has sections where the annular space being grouted cannot be filled in one continuous operation due to the presence of large cavities or fractures, the tremie pipe shall

be raised to a point above the open section or removed from the well. The annulus of the open section shall be bridged by clean sand, 3/8 inch clean gravel, crusher-run or drill cuttings. When cavities are bridged, the fill material shall extend no more than three (3) foot above the open section and the fill material shall be placed slowly and uniformly from the surface into the annular space to avoid "bridging" of the annular space. Upon completion of bridging the open section, the tremie shall be reinserted to a point just above the bridge fill, and grouting of the annular space with neat cement or sand-cement grout shall resume.

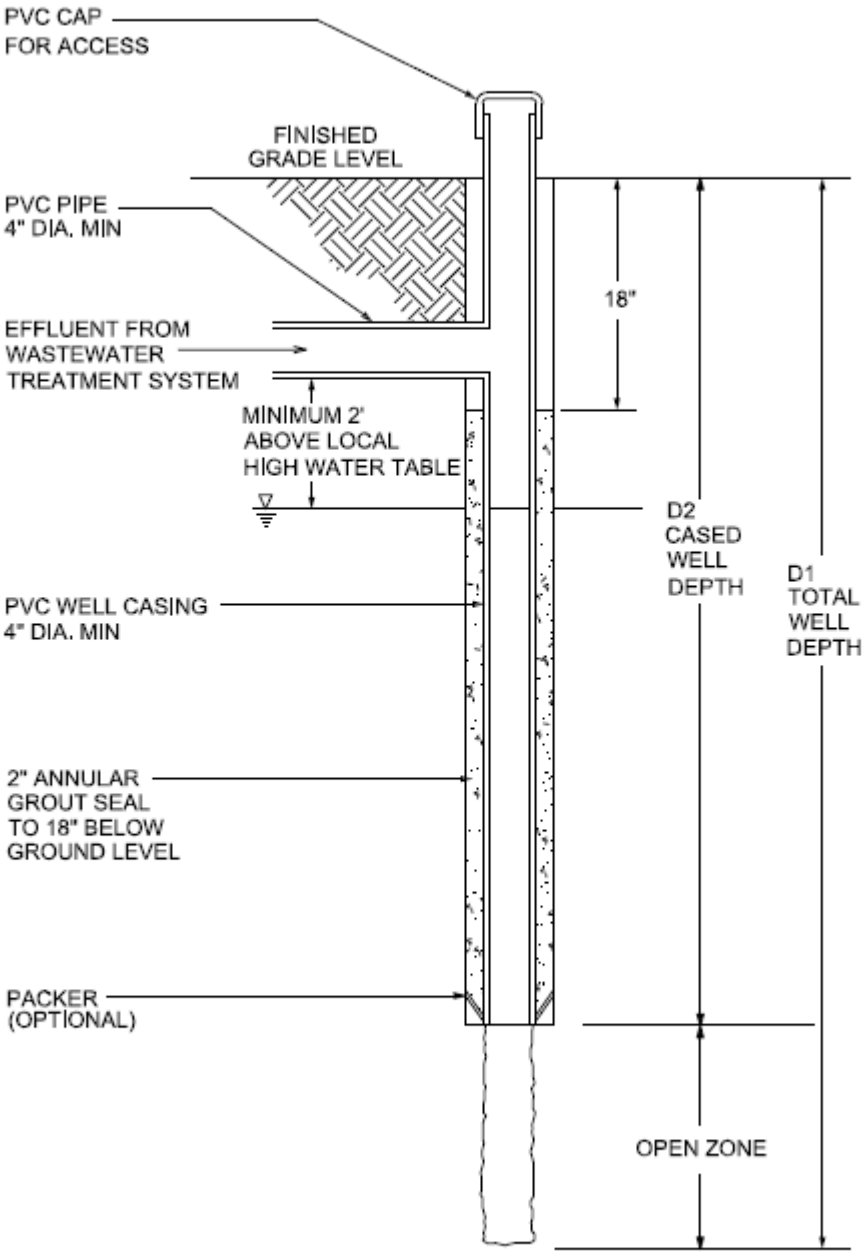
Grouting shall continue until the consistency of the grout in the annular space at eighteen (18) inches below ground level is the same as the mix that is pumped into the tremie pipe.

The nominal volume of grout to fill the annular space is provided in the table below, due to the porous nature of the rock and presence of cavities, the actual volume of grout will exceed the nominal volume. It is a sound practice to have 20% to 50% additional grout material at the job site.

Nominal volume of grout to fill one (1) foot of annular space				
Casing diameter (inches)	4	6	8	10
Borehole size (inches)	8	10	12	14
Grout (ft^3)	0.26	0.36	0.44	0.50
Grout (US gallon)	2.0	2.6	3.3	3.9

Nominal number of bags of cement to grout annular space (based on neat cement, 1 bag of 94 lbs cement yields 1.27 cubic feet)				
Casing diameter (inches)	4	6	8	10
Borehole size (inches)	8	10	12	14
Casing length (ft)				
10	2.0	2.8	3.5	4.0
20	4.0	5.6	7.0	7.9
30	5.9	8.4	10.5	11.9
40	7.9	11.3	14.0	15.8
50	9.9	14.1	17.4	19.8
60	11.9	16.9	20.9	23.7
70	13.8	19.7	24.4	27.7
80	15.8	22.5	27.9	31.6
90	17.8	25.3	31.4	35.6
100	19.8	28.2	34.9	39.6
110	21.8	31.0	38.4	43.5
120	23.7	33.8	41.9	47.5
130	25.7	36.6	45.4	51.4
140	27.7	39.4	48.8	55.4
150	29.7	42.2	52.3	59.3

EFFLUENT DISPOSAL WELL
(DRAWING IS NOT TO SCALE)



WAC PROJECT NO.		DATE: FEB 2013	
DRAWING NO.		DRAWN BY: SD	
SCALE: NTS	VIEW	CHECKED: HvG	
SHEET	REV 1		

EFFLUENT DISPOSAL WELL

WATER AUTHORITY – CAYMAN
P.O. BOX 1104, GRAND CAYMAN KY1–1102
CAYMAN ISLANDS
345–949–2837

REV	DATE	BY	DESCRIPTION
1	May '15	HvG	GROUT SEAL MODIFIED
0	Feb '13	HvG	ORIGINAL RELEASE