SSO Response

Standard Operating Procedures

SOP-CS103 / OCTOBER 2007

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ADMINISTRATIVE

A. Introduction

1. This SOP is a set of instructions or steps Operators follow to respond to an SSO. It shall be done safely, with no adverse impact on the environment, meets compliance standards, and in a way that maximizes operational and production requirements.

B. Cancellation

1. This SOP Cancels:
    a. "Sanitary Sewer Stoppage/Overflow Procedure 22,007" dated 8/15/03
    b. "Estimating Sanitary Sewer Overflows" dated 04/01/05
    c. "Wastewater Spill Procedure 22, 501" dated 11/25/02

C. References

1. Union Sanitary District Collection Services Staff
2. SOP-CS100-5 Wash Down Street and Manholes
3. Ken Kerry. *Operation and Maintenance of Wastewater Collection System*. Office of Wastewater Programs Volume 1. CSU Sacramento. 2004. p. 554

D. Objectives

1. Upon Completion the operator will be able to:
    a. Respond to an Sanitary Sewer Overflow (SSO)
    b. Estimate an SSO
    c. Sample an SSO
    d. Clean up an SSO

E. Equipment/Personnel Required

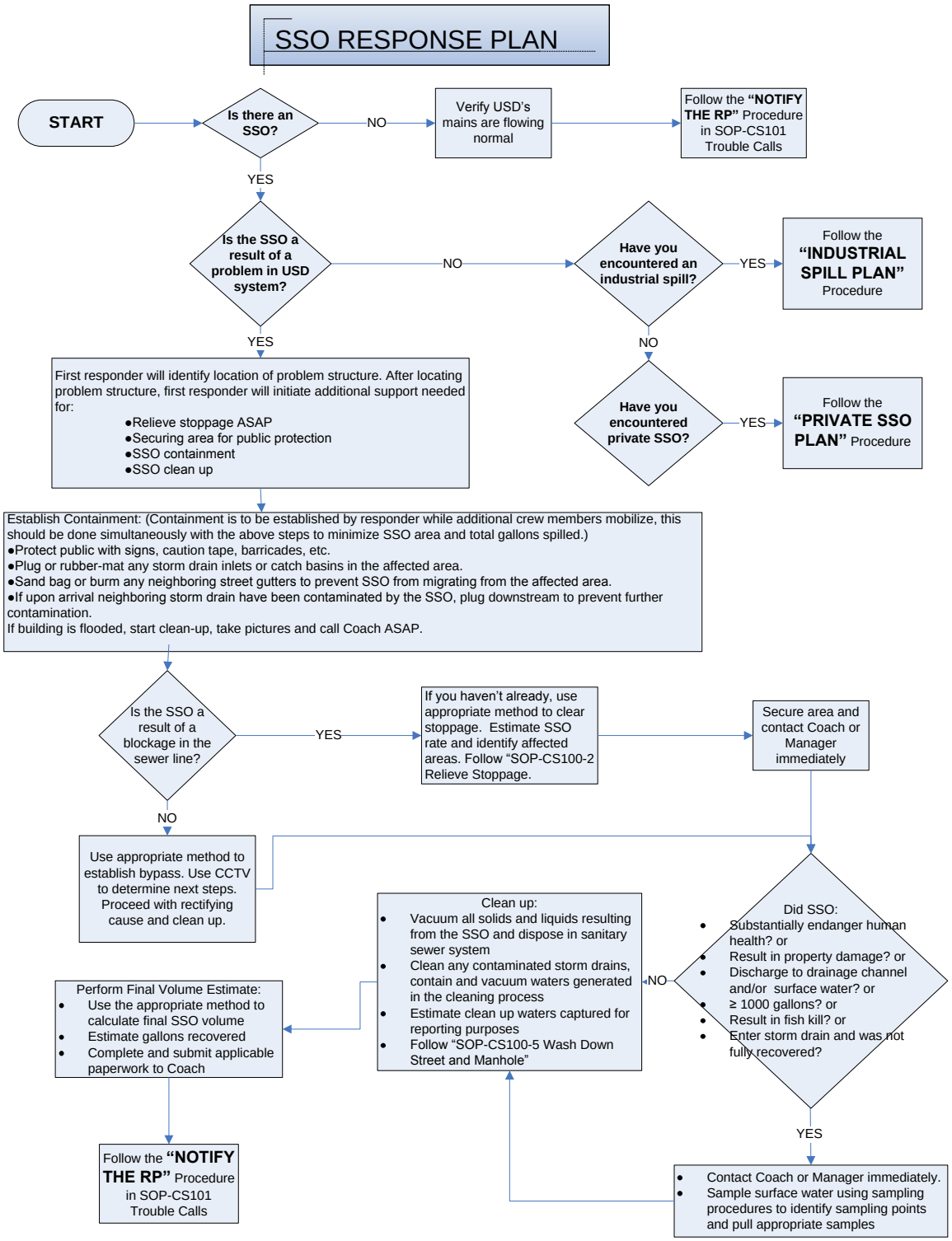
1. Personnel – Two Collection Services Workers (minimum)
2. PPE – Hard hat, gloves, steel-toe safety shoes, respiratory protection, eye protection, face shield, hearing protection, safety vest
3. Equipment – Emergency Response Trailer

F. Terminology

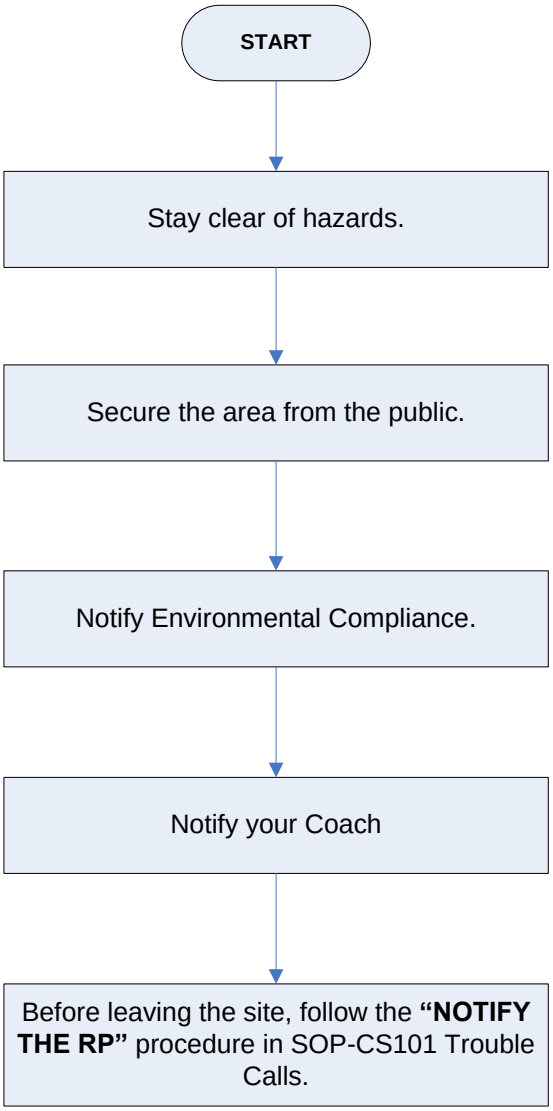
1. NOTE is used when information is available that can assist the Operator in accomplishing his or her task. Information is advisory in nature.
2. CAUTION is used when special cautions must be taken by the Operator. Failure to following prescribed steps may cause serious bodily injury and damage equipment.
3. WARNING is used when special cautions must be taken by the Operator. Failure to follow prescribed steps will cause loss of life or limb and severely damage equipment.

PROCEDURES

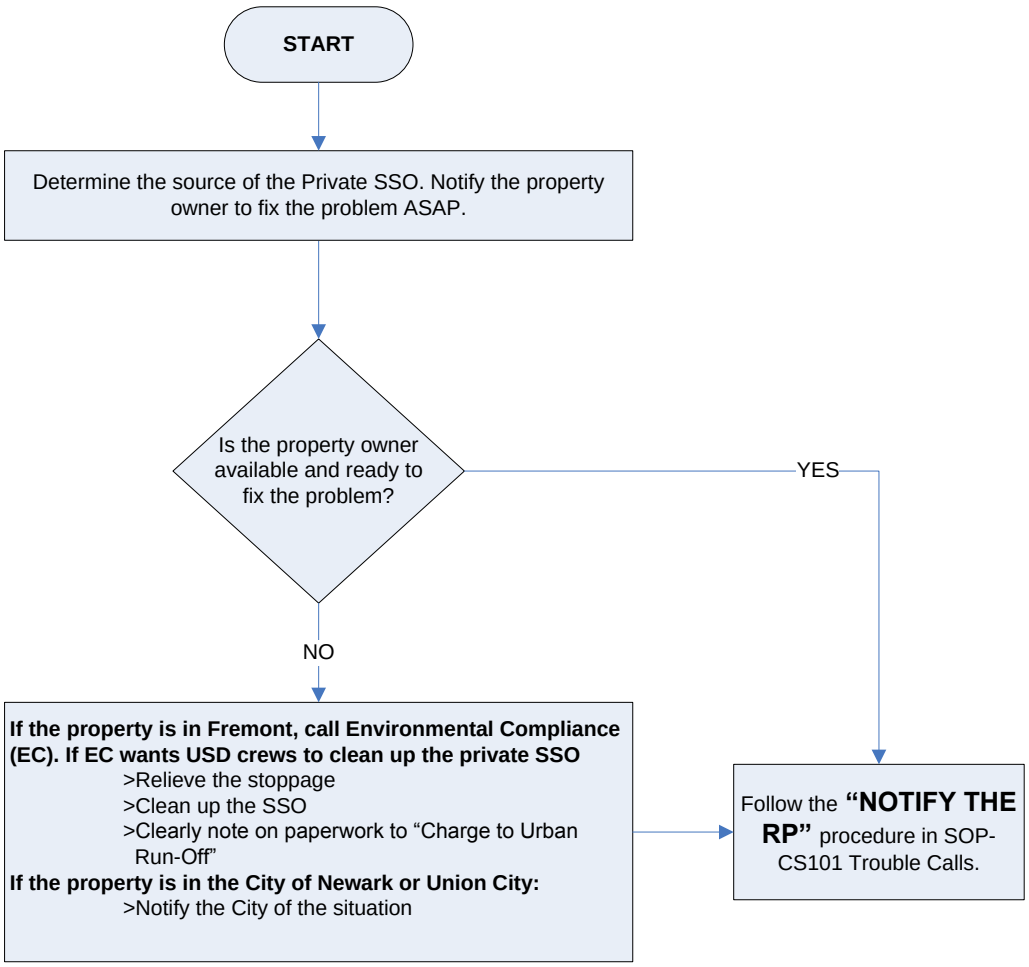
1. SSO Response



INDUSTRIAL SPILL PLAN



PRIVATE SSO PLAN



2. SSO Estimation

2.1 Eyeball Estimate Method

NOTE

This method is useful for contained SSOs up to approximately 200 gallons.

Step 1: Imagine the amount of water that would spill from a bucket or a barrel.

- A bucket contains 5 gallons and a barrel contains 55 gallons.

Step 2: If the SSO is larger than 55 gallons, try to break the standing water into barrels

- Multiply this barrel estimation by 55 gallons

Step 3: Proceed to use other estimation methods if the SSO looks to be more than four (4) barrels

2.2 Measured Volume Method

NOTE

The volume of most small SSOs that have been contained can be estimated using this method. The shape, dimensions, and the depth of the contained wastewater are needed. The shape and dimensions are used to calculate the area of the SSOs and the depths is used to calculate volume.

Step 1: Sketch the shape of the contained sewage

Step 2: Measure or pace off the dimensions

Step 3: Measure the depth at several locations and select an average

Step 4: Convert the dimensions, including depth, to feet

Step 5: Calculate the area in square feet using the following formulas

NOTE

Rectangle: Area = length (feet) x width (feet)
Circle: Area = radius (feet) x radius (feet) x 3.14
Triangle: Area = base (feet) x height (feet) x 0.5

Step 6: Multiply the area (square feet) times the average depth (in feet) to obtain the volume in cubic feet

Step 7: Multiply the volume in cubic feet by 7.48 to convert it to gallons

2.3 Duration and Flow rate Method

NOTE

Calculating the volume of larger SSOs, where it is difficult or impossible to measure the area and depth, requires a different approach. In this method, the separate estimates are made of the duration of the SSO and the flow rate.

☐ **Duration**

- The duration is the elapsed time from the time the SSOs started to the time that the flow was restored.

☐ **Start Time**

Step 1: Establish start time; use any of the following approaches

Step 2: Inquire observations from local residents

- SSOs that occur in rights-of-way are usually observed and reported promptly.
- SSOs that occur out of the public view can go on longer.

Step 3: Sometimes observations like odors or sounds (e.g. water running in a normally dry creek bed) can be used to estimate the start time.

NOTE

Conditions at the SSO site change over time. Initially there will be limited deposits of toilet paper and other sewage solids. After a few days to a week, the sewage solids form a light-colored residue. After a few weeks to a month, the sewage solids turn dark. The quantity of toilet paper and other materials of sewage origin increase over time.

Step 4: The observations in above note can be used to estimate the start time in the absence of other information.

Step 5: Take photographs to document the observations

- They can be helpful if questions arise later in the process.

NOTE

It is important to remember that SSOs may not be continuous. Blockages are not usually complete (some flow continues). In this case the SSO would occur during the peak flow periods (typically 10:00 to 12:00 and 13:00 to 16:00 each day). SSO that occur due to peak flows in excess of capacity will occur only during, and for a short period after, heavy rainfall.

☐ **End time**

Step 1: Field crews on-site observe the "blow down" that occurs when the blockage has been removed.

- The "blow down" can also be observed in downstream flow meters, if installed

2.4 Flow Rate

Step 1: The flow rate is the average flow that left the sewer system during the time of the SSO.

Step 2: There are three ways to estimate the flow rate:

- **The San Diego Manhole Flow rate Chart:** This chart shows sewage flowing from the manhole covers at a variety of flow rates. The observation of the field crew can be used to select the appropriate flow rate from the chart. IF possible, photographs are useful in documenting basis for the flow rate estimate. (See Appendix A)
- **Pick & Vent Hole Wallet Card:** The wallet card has different vent and pick hole diameters with water height, GPM, and GPH calculations (See Appendix B & C)
- **Counting connections:** Once the location of the SSO is known, the number of upstream connections can be determined from the sewer maps. Multiply the number of connections by 200 to 250 gallons per day per connection or 8 to 10 gallons per hour per connection.

2.5 Example

☐ **SSO Volume**

NOTE

Once duration and flow rate have been estimated, the volume of the SSO is the product of the duration in hours or days and the flow rate in gallons per hour or gallons per day.

- SSO start time = 11:00
- SSO end time = 14:00
- SSO duration = 3 hours
- SSO duration in minutes = 3 hours x 60 minutes = 180 minutes

Step 2: 3.3 gallons per minute x 180 minutes = 594 gallons

3. SSO Sampling

> **NOTE**
>
> First determine whether the SSO has reached a waterway or not. If no, no sampling is required. However, if the SSO has come in contact with waterway, proceed further to perform sampling.

3.1 Pre-Sampling

Step 1: Determine point SSO entered waterway.

> **CAUTION**
>
> Use Personal Protective Equipment (PPE) while performing sampling

Step 2: Photograph, map and mark the location for future sampling.

Step 3: Follow the instructions inside the kit and sample for Ammonia and Dissolved Oxygen.

Step 4: Record the testing results.

3.2 Upstream Sampling

> **NOTE**
>
> Upstream samples should be taken next.

Step 1: Move 50'-200' upstream of point where SSO entered waterway.

Step 2: Photograph, map and mark the location for future sampling

Step 3: Follow the instructions inside the kit and sample for Ammonia and Dissolved Oxygen.

Step 4: Record the testing results.

3.3 Downstream Sampling

Step 1: Move to 50’ and 200’ downstream of point where SSO entered waterway

Step 2: Follow the directions mentioned in “3.2 Upstream Sampling” to grab sample (Step 2 – Step 4)

3.4 Coliform Sampling

Step 1: Using the specific coliform sampling bottles, take a coliform sample upstream and downstream of the SSO area well away from the bank, preferably where water is visibly flowing

- Follow the sampling points detailed in “3.2 Upstream Sampling” and “3.3 Downstream Sampling” of this SOP.
- There are two sets (each of six) of sampling bottles stored in the collection system crew room and another set is stored in the service van.
- The bottles are sealed and contain hydrochloric acid (white powder)

Step 2: Label the sample as a Coliform sample with the date, time, location and initials

Step 3: Place coliform grab sample in cooler, to be transported to USD Laboratory.

Step 4: Take the samples to USD's lab and refrigerate as soon as possible.

- The coliform test must be performed within six hours after the samples have been taken.

Step 5: You or your supervisor must notify the lab that a coliform sample test needs to be performed.

- Use the USD Emergency Procedure Call List to notify lab personnel.

3.5 Deliver Samples to Lab

Step 1: Transport the cooler containing the samples and the completed form the Alvarado Treatment Plant

NOTE

Laboratory Service hours are:
Monday through Friday: 6:00 a. m. to 5:00 p.m.
Saturday, Sunday, and Holidays: 7:30 a. m. to 4:00 p.m.

Step 2: Give samples to the lab personnel or operator on duty for placement into the lab refrigerator for analysis.

NOTE

Depending on the magnitude of the SSO, continue sampling the downstream location until lab has declared the downstream results are consistent with the upstream results.

Step 3: Lab personnel will notify you or you supervisor if a coliform violation is found.

Step 4: If a violation is found your supervisor or other district management personnel will contact the regional board for advice.

4. SSO Clean Up

NOTE

To minimize health hazards to the public and to protect the environment, start cleaning the SSO area as soon as possible or immediately after the overflow stops.

Step 1: Install air plugs on storm lines whenever possible to contain the SSO.

Step 2: Remove all debris found in the SSO surface area

- Place back into the collection system or dispose of properly.

Step 3: Wash SSO area with fresh water

- Do NOT add chlorine solution.

Step 4: If plugs are used in the storm lines to contain SSO, pump wastewater back into the collection system and remove plugs from storm lines.

- If plugs are not used, visually inspect the storm drain system and determine if additional cleaning is needed.
- If additional cleaning is needed, use the hydro flush vacuum to flush and vacuum all water generated during cleaning. Return water to sanitary system. See "SOP-CS100-5 Wash Down Street and Manholes" for details.

Step 5: Inspect the collections system and SSO areas before you leave.

Step 6: Immediately notify management in the following events:

- Human health endangerment
- Property damage
- If there is a discharge to drainage channel and/or surface water
- There is a discharge to a storm that was not fully captured and returned to the sanitary sewer system
- SSO volume is ≥ 1000 gallons.
- Fish kill

Step 7: If SSO has come in contact with creek, pond, body of water or flood control channel, see "Section 3 SSO Sampling" of this SOP to conduct sampling.

Step 8: Task Complete

Appendix A: San Diego Manhole Flow Rate and Chart

City of San Diego
Metropolitan Wastewater Department

Reference Sheet for Estimating Sewer Spills from Overflowing Sewer Manholes

All estimates are calculated in gallons per minute (gpm)

Wastewater Collection Division
(619) 654-4160


5 gpm


25 gpm


50 gpm


100 gpm


150 gpm


200 gpm


225 gpm


250 gpm


275 gpm

All photos were taken during a demonstration using metered water from a hydrant in cooperation with the City of San Diego's Water Department.

rev. 4/99

Appendix B: **Pick and Vent Hole Wallet Card**

Hole Dia. inches	Water Ht inches	Q cfs	Q gpm	Q gph
Vent Hole				
0.50	1/16 th	0.0005	0.23	14
0.50	1/8 th	0.0007	0.33	20
0.50	1/4 th	0.0010	0.47	28
0.50	one half	0.0015	0.66	40
0.50	3/4 ths	0.0018	0.81	49
0.50	1 inch	0.0021	0.94	56
Vent Hole				
0.75	1/16 th	0.0011	0.51	31
0.75	1/8 th	0.0016	0.72	43
0.75	1/4 th	0.0023	1.02	61
0.75	one half	0.0032	1.44	87
0.75	3/4 ths	0.0039	1.77	106
0.75	1 inch	0.0045	2.04	122
Vent Hole				
1.00	1/16 th	0.0020	0.88	53
1.00	1/8 th	0.0028	1.25	75
1.00	1/4 th	0.0039	1.77	106
1.00	one half	0.0056	2.50	150
1.00	3/4 ths	0.0068	3.06	184
1.00	1 inch	0.0079	3.54	212
Pick Hole semicircular area				
1.00	1/16 th	0.0010	0.44	27
1.00	1/8 th	0.0014	0.63	38
1.00	1/4 th	0.0020	0.89	53
1.00	one half	0.0028	1.25	75
1.00	3/4 ths	0.0034	1.53	92
1.00	1 inch	0.0039	1.77	106
1.00	1-1/2 inc	0.0048	2.17	130
1.00	2 inches	0.0056	2.51	150

Appendix C: Sample Templates for SSO Volume Estimation

TABLE 'A'

ESTIMATED SSO FLOW OUT OF M/H WITH COVER IN PLACE

24" COVER

Height of spout above M/H rim **H** in inches	S S O FLOW **Q** in gpm	in MGD	Min. Sewer size in which these flows are possible
1/4	1	0.001	
1/2	3	0.004	
3/4	6	0.008	
1	9	0.013	
1 1/4	12	0.018	
1 1/2	16	0.024	
1 3/4	21	0.030	
2	25	0.037	
2 1/4	31	0.045	
2 1/2	38	0.054	
2 3/4	45	0.065	
3	54	0.077	
3 1/4	64	0.092	
3 1/2	75	0.107	
3 3/4	87	0.125	
4	100	0.145	
4 1/4	115	0.166	
4 1/2	131	0.189	
4 3/4	148	0.214	
5	166	0.240	
5 1/4	185	0.266	
5 1/2	204	0.294	
5 3/4	224	0.322	6"
6	244	0.352	
6 1/4	265	0.382	
6 1/2	286	0.412	
6 3/4	308	0.444	
7	331	0.476	
7 1/4	354	0.509	
7 1/2	377	0.543	
7 3/4	401	0.578	8"
8	426	0.613	
8 1/4	451	0.649	
8 1/2	476	0.686	
8 3/4	502	0.723	
9	529	0.761	

36" COVER

Height of spout above M/H rim **H** in inches	S S O FLOW **Q** in gpm	in MGD	Min. Sewer size in which these flows are possible
1/4	1	0.002	
1/2	4	0.006	
3/4	8	0.012	
1	13	0.019	
1 1/4	18	0.026	
1 1/2	24	0.035	
1 3/4	31	0.044	
2	37	0.054	
2 1/4	45	0.065	
2 1/2	55	0.079	
2 3/4	66	0.095	
3	78	0.113	
3 1/4	93	0.134	
3 1/2	109	0.157	
3 3/4	127	0.183	
4	147	0.211	
4 1/4	169	0.243	
4 1/2	192	0.276	
4 3/4	217	0.312	6"
5	243	0.350	
5 1/4	270	0.389	
5 1/2	299	0.430	
5 3/4	327	0.471	
6	357	0.514	
6 1/4	387	0.558	8"
6 1/2	419	0.603	
6 3/4	451	0.649	
7	483	0.696	
7 1/4	517	0.744	
7 1/2	551	0.794	
7 3/4	587	0.845	10"
8	622	0.896	
8 1/4	659	0.949	
8 1/2	697	1.003	
8 3/4	734	1.057	
9	773	1.113	

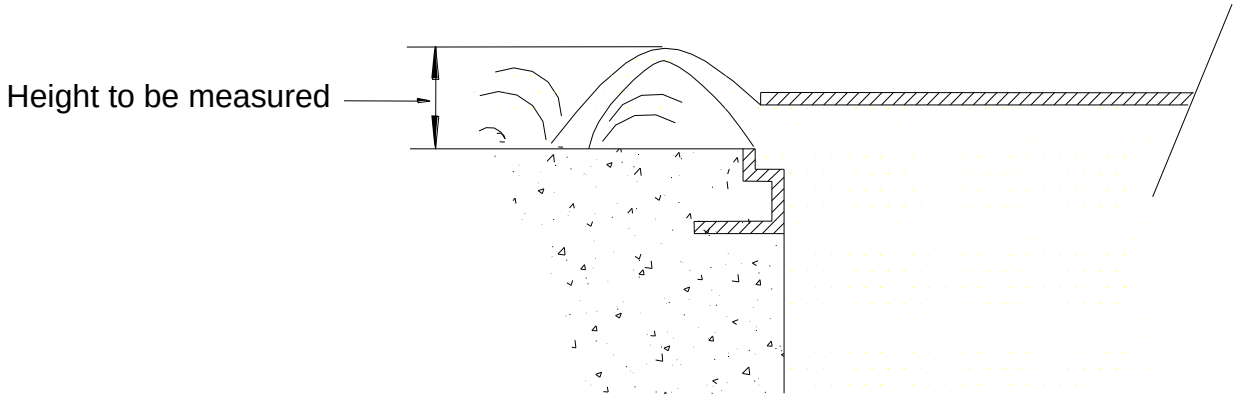
Disclaimer:
This sanitary sewer overflow table was developed by Ed Euyen, Civil Engineer, P.E. No. 33955, California, for County Sanitation District 1. This table is provided as an example.

The formula used to develop Table A measures the maximum height of the water coming out of the maintenance hole above the rim. The formula was taken from hydraulics and its application by A.H. Gibson (Constable & Co. Limited

Example Overflow Estimation:

The maintenance hole cover is unseated and slightly elevated on a 24" casting. The maximum height of the discharge above the rim is 5 ¼ inches. According to Table A, these conditions would yield an SSO of 185 gallons per minute

FLOW OUT OF M/H WITH COVER IN PLACE



This sanitary sewer overflow drawing was developed by Debbie Myers, Principal Engineering Technician, for Ed Euyen, Civil Engineer, P.E. No. 33955, California, of County Sanitation District 1.

TABLE 'B'

ESTIMATED SSO FLOW OUT OF M/H WITH COVER REMOVED

24" FRAME

Water Height above M/H frame **H** in inches	S S O FLOW **Q** in gpm	in MGD	Min. Sewer size in which these flows are possible
1/8	28	0.04	
1/4	62	0.09	
3/8	111	0.16	
1/2	160	0.23	
5/8	215	0.31	6"
3/4	354	0.51	8"
7/8	569	0.82	10"
1	799	1.15	12"
1 1/8	1,035	1.49	
1 1/4	1,340	1.93	15"
1 3/8	1,660	2.39	
1 1/2	1,986	2.86	
1 5/8	2,396	3.45	18"
1 3/4	2,799	4.03	
1 7/8	3,132	4.51	
2	3,444	4.96	21"
2 1/8	3,750	5.4	
2 1/4	3,986	5.74	
2 3/8	4,215	6.07	
2 1/2	4,437	6.39	
2 5/8	4,569	6.58	24"
2 3/4	4,687	6.75	
2 7/8	4,799	6.91	
3	4,910	7.07	

36" FRAME

Water Height above M/H frame **H** in inches	S S O FLOW **Q** in gpm	in MGD	Min. Sewer size in which these flows are possible
1/8	49	0.07	
1/4	111	0.16	
3/8	187	0.27	6"
1/2	271	0.39	
5/8	361	0.52	8"
3/4	458	0.66	
7/8	556	0.8	10"
1	660	0.95	12"
1 1/8	1,035	1.49	
1 1/4	1,486	2.14	15"
1 3/8	1,951	2.81	
1 1/2	2,424	3.49	18"
1 5/8	2,903	4.18	
1 3/4	3,382	4.87	
1 7/8	3,917	5.64	21"
2	4,458	6.42	
2 1/8	5,000	7.2	24"
2 1/4	5,556	8	
2 3/8	6,118	8.81	
2 1/2	6,764	9.74	
2 5/8	7,403	10.66	
2 3/4	7,972	11.48	30"
2 7/8	8,521	12.27	
3	9,062	13.05	
3 1/8	9,604	13.83	
3 1/4	10,139	14.6	
3 3/8	10,625	15.3	36"
3 1/2	11,097	15.98	
3 5/8	11,569	16.66	
3 3/4	12,035	17.33	
3 7/8	12,486	17.98	
4	12,861	18.52	
4 1/8	13,076	18.83	
4 1/4	13,285	19.13	
4 3/8	13,486	19.42	

Disclaimer:

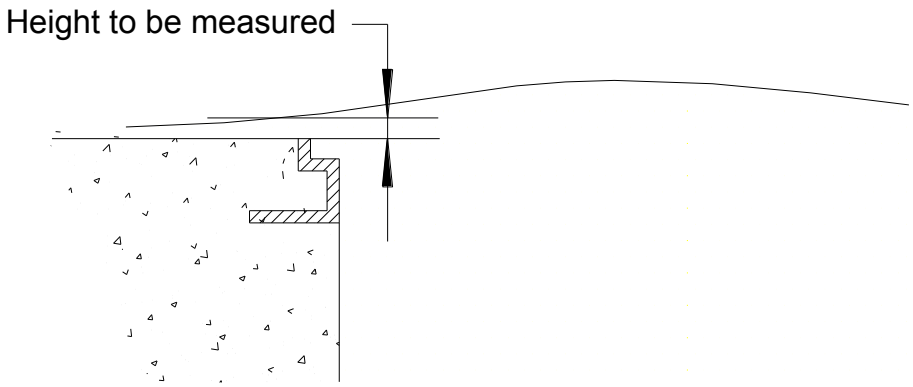
This sanitary sewer overflow table was developed by Ed Euyen, Civil Engineer, P.E. No. 33955, California, for County Sanitation District 1. This table is provided as an example.

The formula used to develop Table B for estimating SSO's out of maintenance holes without covers is based on discharge over curved weir -- bell mouth spillways for 2" to 12" diameter pipes. The formula was taken from hydraulics and its application by A.H. Gibson (Constable & Co. Limited)

Example Overflow Estimation:

The maintenance hole cover is off and the flow coming out of a 36" frame maintenance hole at one inch (1") height will be approximately 660 gallons per minute.

FLOW OUT OF M/H WITH COVER REMOVED (TABLE "B")



This sanitary sewer overflow drawing was developed by Debbie Myers, Principal Engineering Technician, for Ed Euyen, Civil Engineer, P.E. No. 33955, California, of County Sanitation District 1.

TABLE 'C'

ESTIMATED SSO FLOW OUT OF M/H PICK HOLE

Height of spout above M/H cover **H** in inches	SSO FLOW **Q** in gpm
1/8	1.0
1/4	1.4
3/8	1.7
1/2	1.9
5/8	2.2
3/4	2.4
7/8	2.6
1	2.7
1 1/8	2.9
1 1/4	3.1
1 3/8	3.2
1 1/2	3.4
1 5/8	3.5
1 3/4	3.6
1 7/8	3.7
2	3.9
2 1/8	4.0
2 1/4	4.1
2 3/8	4.2
2 1/2	4.3
2 5/8	4.4
2 3/4	4.5
2 7/8	4.6
3	4.7
3 1/8	4.8
3 1/4	4.9
3 3/8	5.0
3 1/2	5.1
3 5/8	5.2
3 3/4	5.3
3 7/8	5.4
4	5.5
4 1/8	5.6
4 1/4	5.6
4 3/8	5.7
4 1/2	5.8
4 5/8	5.9
4 3/4	6.0
4 7/8	6.0
5	6.1

Height of spout above M/H cover **H** in inches	SSO FLOW **Q** in gpm	
5 1/8	6.2	
5 1/4	6.3	
5 3/8	6.3	
5 1/2	6.4	
5 5/8	6.5	
5 3/4	6.6	
5 7/8	6.6	
6	6.7	
6 1/8	6.8	
6 1/4	6.8	
6 3/8	6.9	
6 1/2	7.0	← Unrestrained M/H cover will start to lift
6 5/8	7.0	
6 3/4	7.1	
6 7/8	7.2	
7	7.2	
7 1/8	7.3	
7 1/4	7.4	
7 3/8	7.4	
7 1/2	7.5	
7 5/8	7.6	
7 3/4	7.6	
7 7/8	7.7	
8	7.7	
8 1/8	7.8	
8 1/4	7.9	
8 3/8	7.9	
8 1/2	8.0	
8 5/8	8.0	
8 3/4	8.1	
8 7/8	8.1	
9	8.2	
9 1/8	8.3	
9 1/4	8.3	
9 3/8	8.4	
9 1/2	8.4	
9 5/8	8.5	
9 3/4	8.5	
9 7/8	8.6	
10	8.7	

Note: This chart is based on a 7/8 inch diameter pick hole

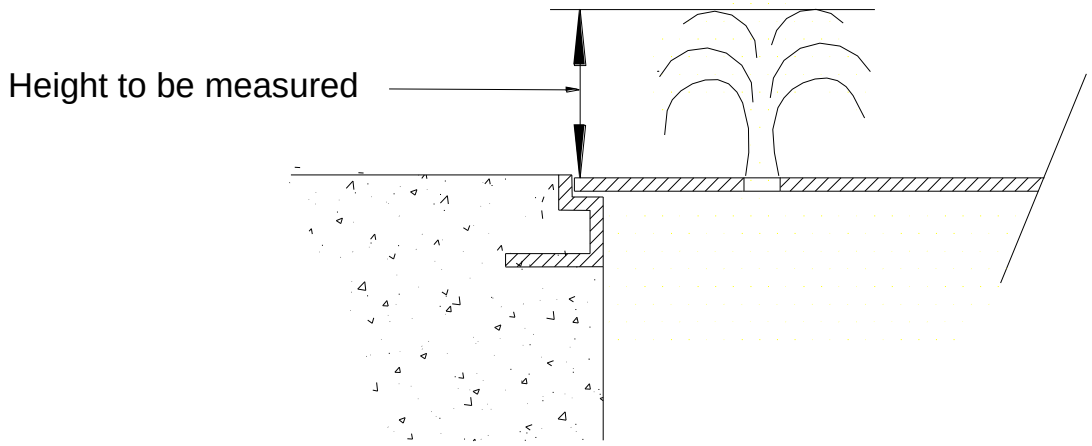
Disclaimer: This sanitary sewer overflow table was developed by Ed Euyen, Civil Engineer, P.E. No. 33955, California, for County Sanitation District 1. This table is provided as an example.
The formula used to develop Table C is Q=CcVA, where Q is equal to the quantity of the flow in gallons per minute, Cc is equal to the coefficient of contraction (.63), V is equal

to the velocity of the overflow, and A is equal to the area of the pick hole.[1] If all units are in feet, the quantity will be calculated in cubic feet per second, which when multiplied by 448.8 will give the answer in gallons per minute. (One cubic foot per second is equal to 448.8 gallons per minute, hence this conversion method).

Example Overflow Estimation:

The maintenance hole cover is in place and the height of water coming out of the pick hole seven-eighths of an inch in diameter (7/8") is 3 inches (3”). This will produce an SSO flow of approximately 4.7 gallons per minute.

FLOW OUT OF VENT OR PICK HOLE (TABLE "C")



This sanitary sewer overflow drawing was developed by Debbie Myers, Principal Engineering Technician, for Ed Euyen, Civil Engineer, P.E. No. 33955, California, of County Sanitation District 1.

[1] Velocity for the purposes of this formula is calculated by using the formula h = v squared / 2G, where h is equal to the height of the overflow, v is equal to velocity, and G is equal to the acceleration of gravity.