

Initial Dilution for the Tafuna and Utulei Wastewater Treatment Plants

Prepared For: American Samoa Power Authority Utulei WWTP
(NPDES Permit No. AS0020001)

Prepared By: **gdc**, PO. Box 1238, Trinidad, CA 95570
707-677-0123 – glatzeldacosta@suddenlink.net

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Distribution: Michael Wolfram
United States Environmental Protection Agency, Region 9
Christianera Tuitele
American Samoa Environmental Protection Agency

Purpose

The purpose of this Technical Memorandum (TM) is to summarize the initial dilution studies done for the reconfiguration of the Utulei And Tafuna diffusers. The studies were done in support of an Administrative order (AO)¹ required by the United States Environmental Protection Agency (USEPA).

Background: Modeling Approach for Diffuser Reconfiguration

The approach to modeling for the reconfigured diffusers at Tafuna and Utulei was updated from the previous modeling presented in the Permit Renewal Application as follows:.

- [1] More representative critical vertical density profiles were used².
- [2] A more representative critical ambient ocean current was used.³
- [3] A more realistic port configuration was used⁴

¹ Administrative Orders (Docket No. CWA 309(a)-11- 016 and -017). Issued July 27, 2011. Modified February 17, 2012. Terminated April 10, 2018.

² *Tafuna WWTP and Utulei WWTP Background Density Gradients for Dilution Model Input*. Technical Memorandum prepared for the American Samoa Power Authority, Submitted to the United States environmental protection Agency and the American Samoa Environmental Protection Agency. Prepared by gdc, August 9, 2013.

³ *Amended Section 301(h) Technical Support Document* (EPA 842-B-94-007). United States Environmental Protection Agency, Office of Water. September 1994. (See p. A-3)

⁴ *Recommended Modifications to Tafuna WWTP and Utulei WWTP Diffuser Configurations*. Technical Memorandum prepared for the American Samoa Power Authority, Submitted to the United States Environmental protection Agency and the American Samoa Environmental Protection Agency. Prepared by gdc, September 16, 2013.

[4] Diffusers were reconfigured to substantially increase initial dilution⁵.

Final Recommended Modifications to the Tafuna WWTP and Utulei WWTP Diffuser Configurations

As a part of the Administrative Orders gdc prepared a final report describing the final recommend diffuser configurations for the ASPA outfall diffusers based on the previous studies. The results of the final investigations the results for each facility are presented below.

Final Tafuna Diffuser Configuration and Zone of Initial Dilution

The final Tafuna configuration was a diffuser with six 6-inch ports and one 11-inch port. The six-inch ports discharge perpendicular to the diffuser barrel in alternating directions and the final 11-inch port on the end gate discharging seaward parallel to the diffuser barrel. The original diffuser configuration was six 8-inch ports along the diffuser barrel and no end gate port. The results of the modeling for the reconfigured diffuser are shown in Figure 1 and Table 1.

The initial dilution model was run for flows from 2 mgd to 10 mgd. The proposed permit limitation in the draft (pre-public) permit is 6 mgd as maximum daily flow. If dilutions at the trapping level (the CID) for flows other than those shown in the Table 1 are required they can be calculated using the polynomial trend line equation below which has an R² value of 0.9994:

$$y = 1.1774x^3 + 28.91x^2 - 250.63x + 1001.9$$

This equation is valid for flows from 2 mgd to 10 mgd.

Flow (mgd)	Densimetric Froude Number		Trapping Level ¹ (m)		Maximum Rise Level ² (m)		Flux Average Dilution at:	
	11" port	6" ports	11" port	6" ports	11" port	6" ports	Trapping Level (m)	Maximum Rise (m)
1	0.76	1.43	RD ³					
2	1.52	2.82	RD ⁴	3.7	RD ⁴	25.99	607.74 ⁴	695.58 ⁴
4	3.02	5.67	3.3	3.3	26.85	27.26	383.02	443.06
6	4.54	8.47	2.9	3.0	26.85	27.00	290.14	326.75
8	6.03	11.32	2.8	2.8	26.98	27.15	240.97	269.22
10	7.55	14.18	2.6	2.6	27.26	26.95	210.61	232.86
¹ Trapping level is the distance below the surface of the plume centerline ² Maximum rise is the distance above the discharge point of the plume centerline ³ RD indicates the model run was discontinued because the Froude number was below a critical value and calculations may not be reliable. ⁴ The dilution through the end port (11-inch port) was estimated by trend line analysis.								

⁵ Amended Section 301(h) Technical Support Document (EPA 842-B-94-007). United States Environmental Protection Agency, Office of Water. September 1994. (See p. 55)

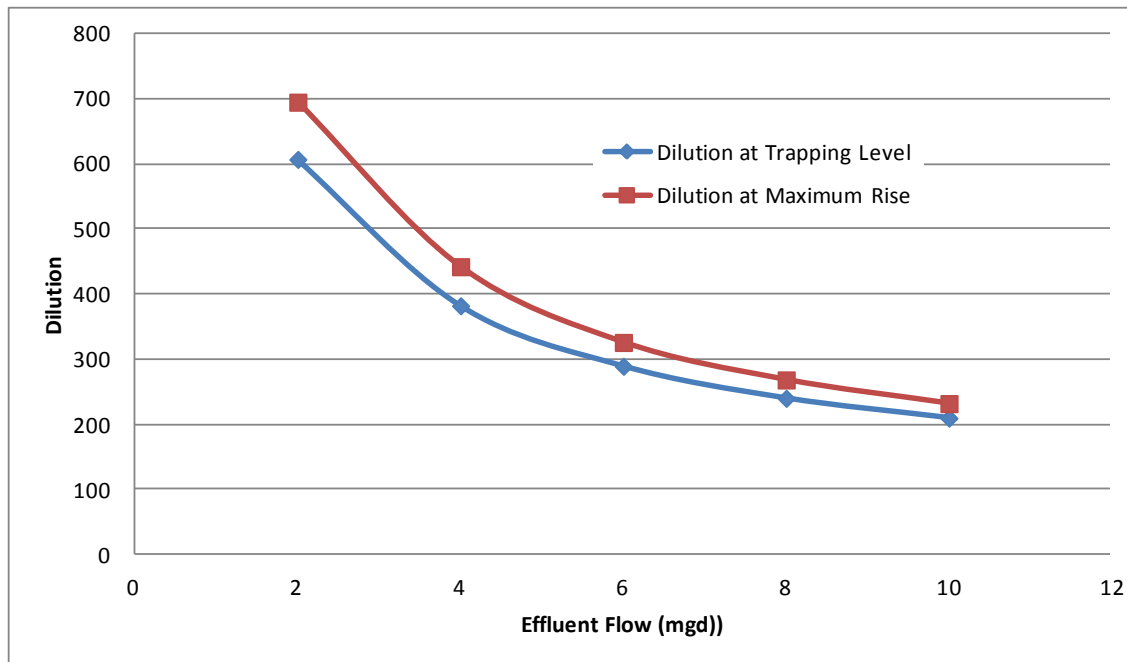


Figure 2-4. Dilution for Reconfigured Tafuna Diffuser

Final Utulei Diffuser Configuration and Zone of Initial Dilution

The final Utulei configuration was a diffuser with six 5.5-inch ports and one 11-inch port. The 5.5-inch ports discharging perpendicular to the diffuser barrel in alternating directions and the final 11-inch port on the end gate discharging seaward parallel to the diffuser barrel. The original diffuser configuration was six 6-inch ports along the diffuser barrel and no end gate port. The results of the modeling for the reconfigured diffuser are shown in Figure 2 and Table 3.

The initial dilution model was run for flows from 2 mgd to 10 mgd. The proposed permit limitation in the draft (pre-public) permit is 6 mgd as maximum daily flow. If dilutions at the trapping level (the CID) for flows other than those shown in the Table 1 are required they can be calculated using the polynomial trend line equation below which has an R² value of 0.9838:

$$y = -0.1335x^3 + 2.0543x^2 - 23.939x + 481.41$$

This equation is valid for flows from 2 mgd to 10 mgd.

Flow (mgd)	Densimetric Froude Number		Trapping Level ¹ (m)		Maximum Rise Level ² (m)		Flux Average Dilution at:		
	11" port	5.5" ports	11" port	5.5" ports	11" port	5.5" ports	Trapping Level	Maximum Rise	
							(m)	(m)	
1	0.92	1.63	RD ³						
2	1.81	3.23	RD ⁴	30.3	RD ⁴	22.78	376.68 ⁴	570.87 ⁴	
4	3.64	6.47	19.0	22.0	35.4	34.08	335.64	496.01	
6	5.45	9.68	14.6	16.7	40.08	40.78	313.19	439.06	
8	7.25	12.91	13.3	14.0	41.72	43.29	274.44	379.21	
10	9.06	16.15	12.4	12.6	42.84	44.46	246.46	335.43	

Note: Shaded cells are revised from original report. The original report included only the dilution from the end port and not the flux averaged dilution from all ports.

¹ Trapping level is the distance below the surface of the plume centerline

² Maximum rise is the distance above the discharge point of the plume centerline

³ RD indicates the model run was discontinued because the Froude number was below a critical value and calculations may not be reliable.

⁴ The dilution through the end port (11-inch port) was estimated by trendline analysis.

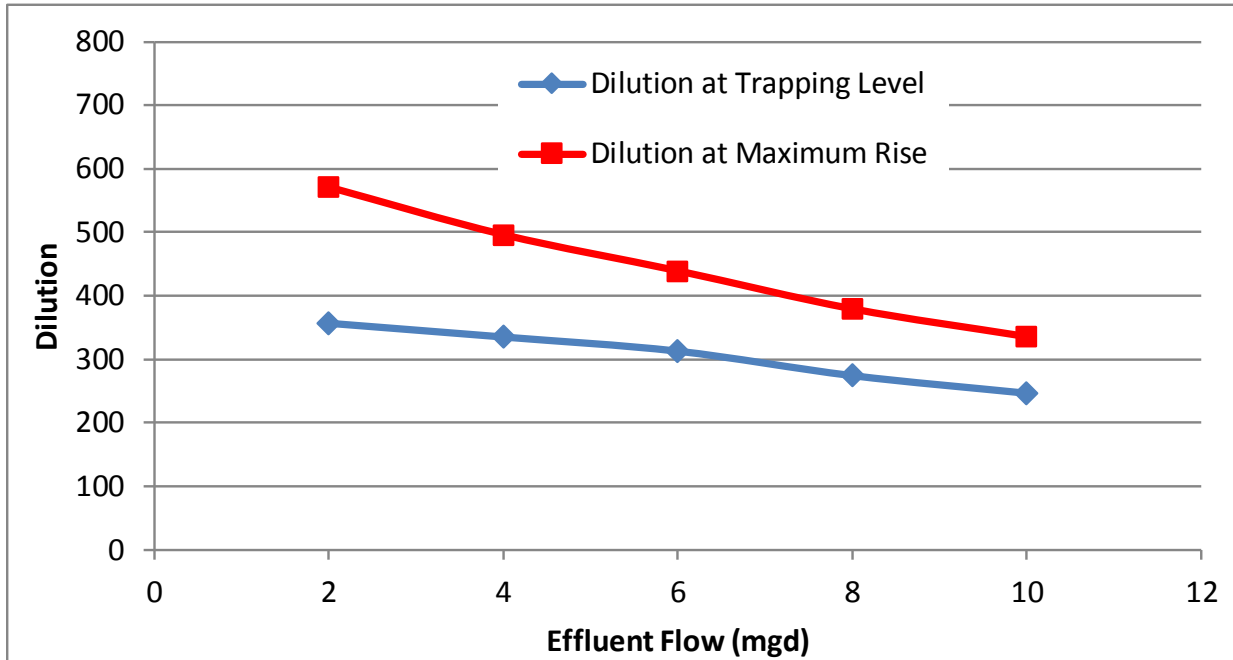


Figure 2. Dilution for Reconfigured Utulei Diffuser