Appendix H: Outfall Prioritization Methodology for Unnatural Water Balance Management

APPENDIX H: OUTFALL PRIORITIZATION METHODOLOGY FOR UNNATURAL WATER BALANCE MANAGEMENT

H.1 Introduction

Outfall prioritization is identified as part of the overall strategy for meeting goals associated with unnatural water balance and flow regime HPWQC (See Section 2.3). Specifically, outfall prioritization consists of a scoring and weighting framework used to identify the outfalls where structural outfall controls will be evaluated as a primary strategy for plan implementation. Figure 1 provides an overview of the approach for screening and prioritizing outfalls for potential structural controls. The outcomes of this prioritization methodology primarily describe relative need. This framework does not consider opportunity or feasibility of projects. Therefore, it must be accompanied by a feasibility evaluation for high priority outfalls.

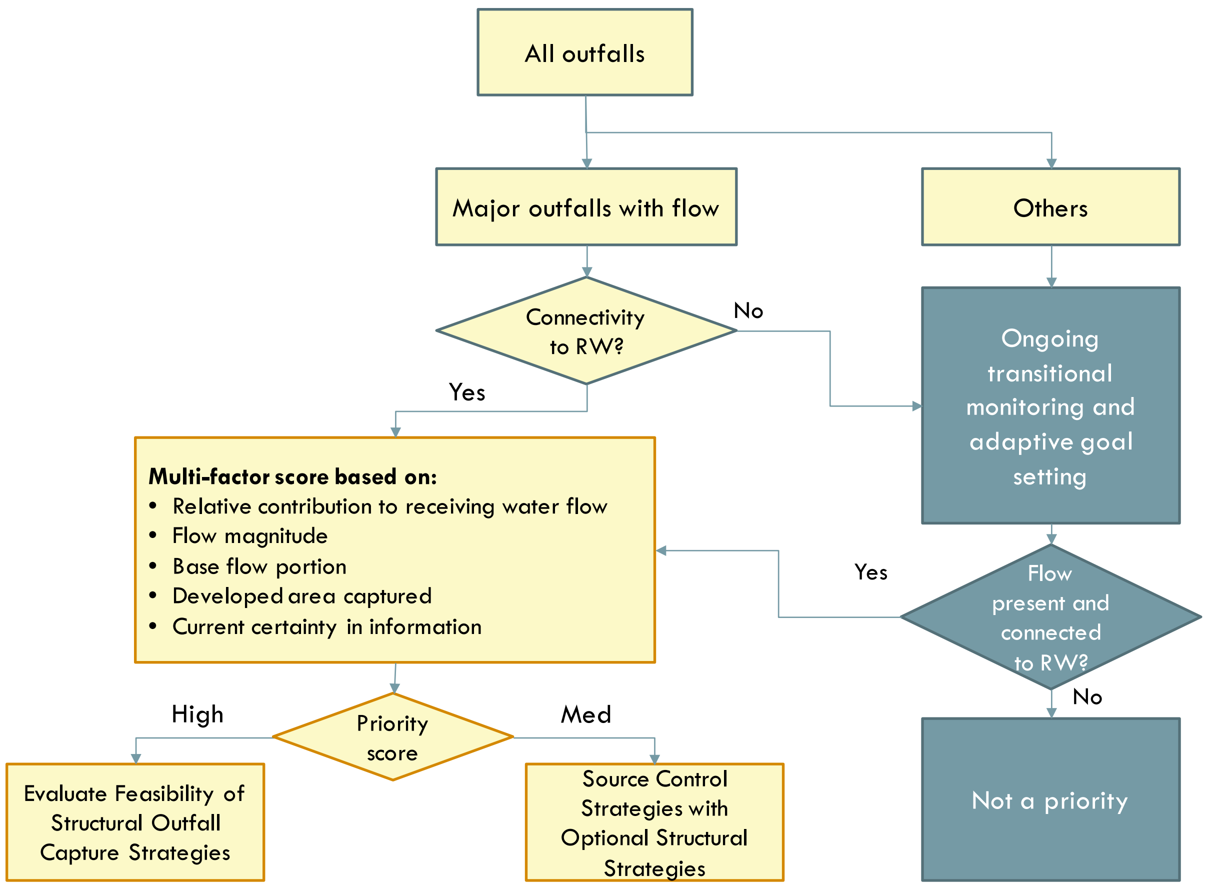

Figure 1: Schematic of Outfall Screening and Prioritization Framework

Appendix H: Outfall Prioritization Methodology for Unnatural Water Balance Management

The purpose of this appendix is to describe the methodology used to prioritize outfalls as part of the development of this plan. This appendix includes the following content:

- Data sources and inventory supporting outfall screening and prioritization
- Method for calculation of prioritization scores
- Summary of scoring results
- Limitations and additional factors to be considered in refinement to prioritization

The attachments to this appendix provide supporting detail about input data and results.

H.2 Data Sources and Inventory

Datasets were compiled from a number of sources, primarily associated with Orange County Stormwater Program monitoring datasets and GIS datasets. A description of the source datasets and intermediate analyses of these datasets are summarized below.

Transitional Monitoring Program:

The transitional monitoring program has yielded the following observations for most major outfalls (36-inch and larger) for one to three site visits:

- Visual observations flow condition: flow, ponded, or no flow
- Rough estimate of flowrate: width of flow, depth of flow, velocity of flow
- Various facility attributes

From this dataset, it is estimated that approximately 120 major outfalls discharging to inland receiving waters have consistently observed flow. The minimum, maximum, and average estimates of flowrate were calculated for each outfall to be used in the prioritization framework. The number of visits was also factored into scoring associated with the certainty of observations.

Expanded Transitional Monitoring Program:

In spring 2016, the transitional monitoring program was expanded to include additional observations as part of outfall visits:

- Flow connectivity: not connected, partially connected, fully connected
- Upstream and downstream condition: dry, ponded, flowing
- Contribution to in-stream flow: small (<10%), minor (10% to 50%), major (>50%)

Visits have been made to 56 outfalls to date to collect these parameters. Results are summarized in Attachment 2.

Detailed Flow Monitoring and Calculation of Flow Metrics:

Beginning in spring 2016, the County began to deploy HACH flow meters in major outfalls to measure flow at 5-minute intervals. These systems were typically deployed for two week periods during dry weather. To date, 58 records have been obtained. Of these, 48 records had been analyzed at the time of publication.

The resulting hydrographs were inspected and various metrics were calculated and inspected for meaningfulness and reliability. Selected metrics were found to be reliable for understanding flow magnitudes and flow regimes:

- *Median of all data points* – this metric provided a reliable estimate of the central tendency of the data. In sites without suspected outlier data, the median and average were very similar. The median is more resistant to bias from suspected outliers; therefore the median was used to characterize overall flow magnitude instead of the average.
- *Median of daily minimums* – this metric reliably describes the typical diurnal minimum. It was calculated by tabulating the minimum flow in each calendar day and calculating the median of these values. It is more resistant to sensor errors than an absolute minimum or average minimum
- *Median of daily maximums* - this metric reliably describes the typical diurnal maximum. It was calculated by tabulating the maximum flow in each calendar day and calculating the median of these values. It is more resistant to sensor errors than an absolute maximum or average maximum.
- *Ratio of median of the daily minimums to the median of all data points* – this ratio describes the relative contribution by base flows that did not vary through the day. This ratio various between 0 and 1. A higher value (closer to 1) represents a steadier hydrograph.
- *Ratio of median of the daily maximums to the median of all data points* – this ratio describes the relative diurnal fluctuation. This ratio is always higher than 1. A higher value represents more diurnal fluctuation.

Statistics were compared for weekday and weekend periods. Consistent trends were not readily observed between weekdays and weekends, except in a few datasets. These trends were not used in prioritization.

For those outfalls where detailed flow monitoring had been completed, the estimated average flowrate was compared to the average of flowrates for the same set of outfalls previously estimated as part of the transitional monitoring program. In general, it was found that the transitional monitoring program estimated higher flows than more detailed flow monitoring efforts by a ratio of approximately 2 to 1. This level of disagreement is not unexpected given the challenge of estimating and measuring small, shallow flows and the fact that the transitional monitoring estimates were based on discrete points in time, typically during daytime hours when flows tend to be somewhat higher on average. Transitional monitoring also tended to be done earlier, prior to the severe conservation mandates introduced in 2015. For the purpose of prioritization, the flows measured as part of detailed monitoring were considered to be more reliable and the ratio above was used to adjust the flow estimates from transitional monitoring for outfalls where detailed flow monitoring was not available. This formed a reasonably consistent estimate of flow magnitude across each of the set of approximately 120 outfalls considered.

Tributary Area Delineation and Characteristics:

The estimated tributary area to outfalls was delineated based on available subcatchment boundary data and storm drain networks. Delineations resulting from this effort are approximate and should be field-verified as part of more detailed investigation and project development. Acreage and land use distribution within each tributary area were tabulated. Additionally, the relative fraction of the tributary area within each jurisdiction was tabulated.

H.3 Prioritization Scoring Methodology

Scores were assigned to outfalls based on five scoring categories:

Contribution Score: The contribution score was assigned based on the degree to which the flow from the outfall was observed to contribute to the flow in the receiving water, as follows:

- Small contribution (<10%): 60
- Minor contribution (10 to 50%): 80
- Major contribution (>50%): 100

Where observations not available, the average score from available outfalls (a score of 70) was used.

Flow Magnitude Score: The flow magnitude score was assigned based on the measured or estimated median flow from the outfall relative to other outfalls. The score ranged from 30 to 100 based on the percentile range of the flow within the overall dataset, grouped into bins as summarized in Table H-1.

Table H-1: Scoring Basis for Flow Magnitude

Flow Rate Range, cfs	Score
< 0.005	30

0.005 - 0.016	50
0.016 - 0.043	70
0.043 - 0.197	90
0.197 – 0.685	100

Baseflow Score: The baseflow score was based on the ratio of the median of daily minimum flowrates divided by overall median flow (the ratio introduced above), expressed as a percent (0 to 100). This score is an indicator of the portion of the flow that is a consistent baseflow and may not be controllable through water conservation or irrigation management approaches. Where detailed flow records were not available to calculate this metric, the average of available records was used.

Developed Area Score: The developed area score was used as an indicator of the amount of developed area draining to the outfall. The score was based developed acreage as a percentile within overall dataset (0 to 100), grouped into bins as summarized in Table H-2.

Table H-2: Scoring Basis for Developed Area

Developed Area, acres	Score
< 50	30
50 - 120	50
120 - 220	70
220 - 480	90
480 - 1770	100

Certainty Score: A certainty score was assigned based on the certainty in the underlying data supporting other scores. This score was based on the types and numbers of observations or measurements obtained for the outfall as summarized in Table H-3.

Table H-3: Scoring Basis for Certainty Score

At least one site observation of flowing water	Two or more site observations of flowing water	Connectivity observations	Detailed flow measurement	Score
Y	Y	Y	Y	100
Y	Y		Y	80
Y	Y	Y		60

Y	Y			40
Y				20

After calculating scores for each factor, a modifier was applied to all scores based on the observed degree of connectivity of the outfall to the receiving water. Connectivity is an overriding factor in all scoring categories. If there is no connectivity, then the outfall is not a priority.

- Direct Connection: 1
- Partial: 0.5
- None - Flow Infiltrates: 0
- If observations were not available, a value of 0.7 was used based on the weighted average of outfalls with observations.

Individual component scores were then weighted based on their relative importance in deciding whether a structural capture solution should be investigated. Table H-4 shows the weights used initial prioritization. Alternative weighting could be used to highlight outfalls with specific combinations of attributes.

Table H-4: Weighting Factors Applied for Initial Prioritization

Factor	**Weight**
Relative Contribution to Downstream Flow in Stream	25%
Flow Magnitude Score	25%
Baseflow Score	25%
Developed Area Treated Score	10%
Certainty Score	15%
Sum	100%

The final composite score was calculated based on sum of each individual component score (with connectivity modifier) multiplied by the respective weighting factor for each component.

H.4 Results and Interpretation

Attachment H-2 shows the tabular scoring results for individual components and the overall composite score. Table H-5 reports the number of outfalls, total flow magnitude, and average flow per outfall for a range of scoring thresholds.

Table H-5: Initial Prioritization Results by Scoring Threshold

Priority Score Threshold	# of Outfalls Above Threshold	Total Cumulative Flow in Outfalls Above Threshold, CFS	Average Flow per Outfall, CFS
0	120	7.12	0.059
30	114	7.12	0.062
40	109	6.73	0.062
50	63	6.40	0.102
60	35	5.42	0.155
70	21	4.38	0.209
80	8	2.14	0.268
90	4	1.21	0.303

Based on Table H-5, approximately 75 percent of the known flow and one-quarter of major outfalls were associated with the scores above 60. This represents a reasonable cut-off point for primary consideration of structural outfall controls.

Table H-6 shows the breakdown of prioritized outfalls by score threshold and watershed. Pursuing structural outfall controls above a score of 60 will tend to accrue benefits distributed across most watersheds.

Table H-6: Initial Prioritization Results by Score Threshold and Watershed

Watershed	Score Threshold				
	30	**50**	**60**	**70**	**80**
Aliso Creek	37	18	13	7	2
Dana Point Coastal Streams	12	5	3	2	1
Laguna Coastal Streams	3	2	0	0	0
San Clemente Coastal Streams	7	7	5	4	1
San Juan Creek	55	31	14	8	4
Sum	114	63	35	21	8

To estimate the cumulative benefit associated with phased implementation, Figure 2 was developed. This assumes that outfalls are generally implemented in their order of priority, but is simplified to larger bins of outfalls (0-15, 15-35, 35-63), such that it does not require exact adherence to the prioritization order. Table H-7 summarized estimated total flowrates that would be reduced for each watershed through outfall controls targeting toward management of sites with a prioritization score of 60 and higher. Results are discounted somewhat, as noted, because of uncertainty about specifically which outfalls will be addressed. A linear estimate of the estimated benefit, spread over 30 years, would be a reasonable estimate of yearly milestones. Table H-8 reports the typical dry weather flow pollutant concentrations and estimated pollutant load reduction associated with flow capture or treatment based on the median of pooled monitoring data for 2010 to 2015 and the estimated volume of flow reduction.

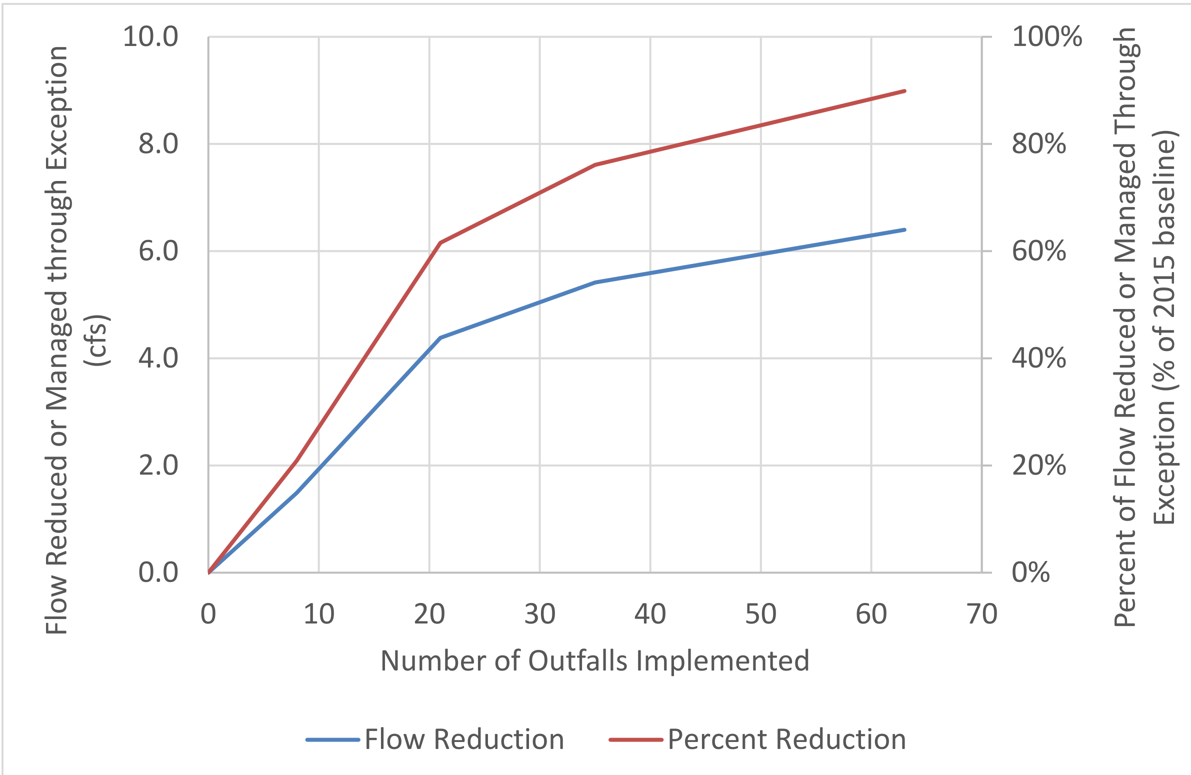

Figure 2: Estimated Relationship between Number of Outfall Projects and Volume of Flow Addressed

Table H-7: Estimate of Flow Magnitude Managed by Watershed Based on Management for Outfalls Score of 60 and Higher

Watershed	Flow Reduction or Management from Structural Outfall Controls, cfs (based on scoring threshold of approximately 60+)	Notes
Aliso	1.19	Based on average of Sites 50+, prorated based on ratio of total flow 60+/50+
Dana Point	0.45	Based on average of Sites 50+, prorated based on ratio of total flow 60+/50+
Laguna Coast	0.13	Based on average of Sites 50+, prorated based on ratio of total flow 60+/50+
San Clemente	1.26	Based on one third of flow from sites 50+ (one large outfall may be skewing results)
San Juan Creek	2.52	Based on average of Sites 50+, prorated based on ratio of total flow 60+/50+
Total	5.54	

Table H-8: Estimate of Pollutant Load Reduction via Outfall Capture Strategies for Outfalls with Score of 60 or Higher

Pollutant Category	Parameter	Units	Load Reductions by Watershed Through Removal or Treatment of Dry Weather Flows (Outfalls Scoring 60+)					
			Aliso	Dana Point	Laguna Coast	San Clemente	San Juan Creek	Total
Flow Removed	Flow	cfs	1.19	0.45	0.13	1.26	2.52	5.54
Bacteria	ENT	MPN/year	3.7E+13	1.4E+13	4.0E+12	3.9E+13	7.8E+13	1.7E+14
	FC	MPN/year	1.8E+13	6.7E+12	1.9E+12	1.9E+13	3.7E+13	8.2E+13
	TC	MPN/year	2.4E+14	9.1E+13	2.6E+13	2.6E+14	5.1E+14	1.1E+15
Metals	Cd	lbs/year	1.3	0.5	0.1	1.4	2.8	6.1
	Cr	lbs/year	1.0	0.4	0.1	1.1	2.2	4.8
	Cu	lbs/year	13.5	5.1	1.5	14.3	28.6	63.0
	Ni	lbs/year	16.3	6.2	1.8	17.4	34.7	76.3
	Pb	lbs/year	1.0	0.4	0.1	1.1	2.2	4.8
	Zn	lbs/year	34.7	13.2	3.8	36.9	73.6	162.2
Nutrients	Total N	tons/year	13.3	5.0	1.4	14.1	28.2	62.0
	Total P	tons/year	1.0	0.4	0.1	1.1	2.2	4.9
Solids	TDS	tons/year	1,530	580	167	1,628	3,249	7,154

H.5 Limitations and Recommendations for Refinements

The prioritization presented in this appendix is preliminary and is based on data that could be compiled on a consistent basis across the SOC WMA. Several limitations and opportunities for refinement should be noted.

- At this time, this prioritization only partly accounts for whether the receiving water would tend to be naturally perennially, intermittent, or ephemeral with urban flows entirely removed. This factor should be further considered in future refinements to the prioritization.
- The SCCWRP Flow Ecology research project and related tools could be considered in refinements to this prioritization approach.
- It is likely that after perennial, intermittent and ephemeral natural reference conditions are considered, a different basis for prioritization may be needed for Aliso Creek, and perhaps other stream reaches that are naturally perennial.

- At this time, each outfall has been prioritized individually. However, in developing plans for phasing of outfall capture projects, the spatial clustering of outfalls should be considered. There is potential for negative consequences to result during an interim period if some outfalls are eliminated and others are allowed to continue to flow, such that streamflows are reduced (i.e., more stagnation) but not entirely eliminated.
- This analysis does not definitively characterize groundwater contribution or provide an assessment of whether an outfall could be excepted on the basis of being primarily groundwater seepage.
- Proposed or plan projects that relate to the outfall should be considered. For example, water capture plans being considered in Lower San Juan Creek should be factored into the phasing of structural controls for outfalls that discharge to this reach. Plans for habitat restoration or species recovery (e.g., anadromous fish) must also be considered in selecting projects, but have not yet been factored into prioritization.

H.6 Attachments

The following attachments provide more information regarding the inputs and results of this prioritization:

- H-1: Table of Outfall Characteristics and Tributary Jurisdictions
- H-2: Table of Outfall Data, Calculated Data, and Prioritization Scores
- H-3: Bar Charts by Watershed Illustrating Components of Composite Score
- H-4: Raw Component Score Exhibits (WMA-Scale)
- H-5: Composite Score Exhibits (HSA Scale)