Newport Bay Fecal Coliform – SHEL Analysis

The Fecal Coliform Stakeholders have requested a presentation on a range of options and costs for complying with the SHEL targets in Newport Bay. The work to be conducted will be semi-quantitative with significant assumptions and simplifications employed in the planning level estimate. The overall approach and assumptions used for the analysis are outlined below.

Summary of Hydrological Analysis Approach and Assumptions

Theoretical planning level annual wet weather volumes and peak flow rates will be established using EPA’s Storm Water Management Model version 5 (SWMM5) for use in evaluating potential management strategies to achieve shellfish harvesting (SHEL) beneficial uses in Newport Bay.

The wet weather events that will be analyzed as a part of this effort include:

- 85th percentile storm, 24-hour storm event;
- 10-year storm event, 24-hour storm event; and
- 50-year storm event, 24-hour storm event.

The subwatersheds that will be analyzed as a part of this effort are shown in Figure 1 and include the following:

- Lower Newport Bay (LNB)
- Costa Mesa (CMC)
- Big Canyon and surrounding areas (BCW)
- Santa Ana Delhi (SAD)
- Bonita Canyon (BCF)
- San Diego Creek (SDM)

The stream gages that will be used as a part of this effort include:

- SADF01 (1/1/2007 – 7/1/2017);
- SDMF05 (1/1/2007 – 7/1/2017);
- BCF04 (7/2/2001 – 1/2/2018); and

Note – Big Canyon and surrounding areas and Lower Newport Bay do not have stream gages within the subwatersheds that will be used as a part of this analysis.

The precipitation gages that will be used as a part of this effort include:

- COSTAMESA_CMWD (6/23/2010 – 7/1/2017); and
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The SWMM5 modeling approach involves the following steps:

1. Calculate area-weighted imperviousness and soil parameters (i.e. saturated hydraulic conductivity ($K_{sat}$), initial moisture deficit, and suction head consistent with SWMM5’s Green-Ampt soil moisture accounting methodology\(^1\)) based on grouped subwatersheds (Figure 1). Imperviousness values are taken from the OC hydrology manual as follows:

<table>
<thead>
<tr>
<th>Land Use (1)</th>
<th>Range-Percent</th>
<th>Recommended Value For Average Conditions-Percent (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural or Agriculture</td>
<td>0 – 9</td>
<td>0</td>
</tr>
<tr>
<td>Public Park</td>
<td>10 – 25</td>
<td>15</td>
</tr>
<tr>
<td>School</td>
<td>30 – 50</td>
<td>40</td>
</tr>
<tr>
<td>Single Family Residential (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 acre lots</td>
<td>5 – 15</td>
<td>10</td>
</tr>
<tr>
<td>1 acre lots</td>
<td>10 – 25</td>
<td>20</td>
</tr>
<tr>
<td>2 dwellings/acre</td>
<td>20 – 30</td>
<td>30</td>
</tr>
<tr>
<td>3-4 dwellings/acre</td>
<td>30 – 50</td>
<td>50</td>
</tr>
<tr>
<td>5-7 dwellings/acre</td>
<td>35 – 55</td>
<td>55</td>
</tr>
<tr>
<td>8-10 dwellings/acre</td>
<td>50 – 70</td>
<td>60</td>
</tr>
<tr>
<td>More than 10 dwellings/acre</td>
<td>65 – 90</td>
<td>80</td>
</tr>
<tr>
<td>Multiple Family Residential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condominiums</td>
<td>45 – 70</td>
<td>65</td>
</tr>
<tr>
<td>Apartments</td>
<td>65 – 90</td>
<td>80</td>
</tr>
<tr>
<td>Mobile Home Park</td>
<td>60 – 80</td>
<td>75</td>
</tr>
<tr>
<td>Commercial, Downtown Business</td>
<td>80 – 100</td>
<td>90</td>
</tr>
<tr>
<td>or Industrial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravelly materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

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\(^1\) Soil parameter values will be established for hydrologic soil groups based on literature (Rawls, W.J., and D.L. Brakensiek. 1983. A procedure to predict Green-Ampt infiltration parameters. In Advances in infiltration. Proc. of the National Conference on Advances in Infiltration. Chicago, IL).

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2. Build a model network in SWMM5 using parameters extracted from spatial datasets and those developed in step 1. Hydrologic routing, accounting for factors such as time of concentration\(^2\) will be accounted for by using the actual length of major storm drains in each subwatershed. Stream gage locations will be incorporated into the model to be able to make meaningful comparisons between simulated flow and volume and measured numbers at each gage.

3. Introduce precipitation to the model using observed 15-minute rainfall records from two gages, one for the lower portions of the watershed (e.g. Costa Mesa-COSTAMESA_CMWD for LNB, CMC, BCW, SAD, and BCF subwatersheds) and one for the headwaters (e.g. Irvine Ranch – TUSTIN for SDM subwatershed).

4. Extract average annual runoff volumes and compare them to observed conditions for two stream gages (the gages used for this will be determined as a part of the analysis). Ensure that runoff volumes are within ten percent of observed conditions to validate performance. Adjust parameters developed in step 1 as needed to achieve the model performance standard of producing volumes that are within ten percent of observed conditions.

5. Introduce synthetic storm hyetographs to the model for the three storm events extracted directly from the hydrology manual.

6. Extract volumes and peak flow rates for use in the economic analysis (see below).

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\(^2\) The time needed for water to flow from the most remote point in a watershed to the watershed outlet.
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Based on the provided delineation shapefile, the following subwatersheds will be used for the analysis:

Figure 1: Grouped Subwatersheds for Runoff Calculations
Summary of Economic Analysis Approach and Assumptions

The structural engineering solutions will be evaluated for the three types of wet weather events outlined above and will assume implementation to the extent that wet weather discharges no longer cause exceedances of SHEL targets within the discharge to Newport Bay (flows for each design storm will be captured/treated/retained, etc.). To the extent possible and available, the cost estimates will include capital as well as operations and maintenance costs.

The volumes and peak flow rates derived using the SWMM5 modeling approach outlined above, will be used to evaluate the structural engineering solutions/implementation scenarios listed below:

- **Treatment BMPs** - Evaluation of planning level cost estimates and reduction in bacteria loads for structural engineered control measures to attain SHEL TMDL targets at the major freshwater inputs to Newport Bay (San Diego Creek, Bonita Canyon, Santa Ana Delhi, Costa Mesa Channel, Big Canyon Wash, Lower Newport Bay area, etc.) during three wet weather conditions.

  1) Distributed and/or regional BMPs to capture and retain, through infiltration and evapotranspiration, or capture and reuse stormwater in the watershed. In order to present a range of potential costs corresponding to implementation of stormwater BMPs, the costs corresponding to addressing bacteria water quality issues through two simplified scenarios will be presented:

    a. **Distributed BMPs**: this scenario will evaluate the costs of implementing distributed BMPs (lot and right-of-way scale BMPs) to address runoff volumes for the three wet weather conditions identified above. The costs per volume captured by distributed BMPs will be calculated by sizing a one (1) acre bioretention cell to represent a distributed project and area weighted soil parameters for the subwatershed. The costs per volume will be extrapolated to determine the total cost to treat the required runoff volume.

    b. **Regional BMPs at major inputs to Newport Bay and distributed BMPs in the Lower Newport Bay subwatershed**: this scenario will consist of sizing five (5) regional basins at the major inputs to Newport Bay at the following locations:

        - Santa Ana Delhi at SADF01;
        - San Diego Creek at SDMF05;
        - Bonita Canyon at BCF04;
        - Costa Mesa Channel at CMCG02; and
        - Big Canyon Wash (BCWG04).

    Since Lower Newport Bay consists of multiple smaller drainage systems, distributed BMPs, will be used in this implementation scenario.

  2) Disinfection of the theoretical planning level target wet weather volumes and bacteria loads. This scenario will evaluate the costs of implementing five (5) disinfection treatment plants which will capture, disinfect and release flows from
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each subwatershed to Newport Bay for the three wet weather conditions described above at the following locations:

- Santa Ana Delhi at SADF01;
- San Diego Creek at SDMF05;
- Bonita Canyon at BCF04;
- Costa Mesa Channel at CMCG02; and
- Big Canyon Wash (BCWG04).

Conveyance of stormwater originating in the Lower Newport Bay subwatershed to a disinfection facility if a complete spatial data base of the storm drain system is received from the City of Newport Beach.

- **Diversions** - Planning level cost estimates for diversion of stormwater to the sanitary sewer or the ocean to attain shellfish harvesting TMDL targets at the major freshwater inputs to Newport Bay (San Diego Creek, Bonita Canyon, Santa Ana Delhi, Costa Mesa Channel, Big Canyon Wash, Lower Newport Bay area, etc.) during wet weather conditions. For these solutions, improvements to water quality will be assumed and broadly estimated since the diversions will inherently improve water quality.

  1) Diversion of the theoretical planning level target wet weather volumes and bacteria loads to the sanitary sewer. Cost estimates for diversion structures at the (5) five major inputs to the sanitary sewer will be presented. Stormwater runoff will be diverted to the sanitary sewer collection system for Orange County Sanitation District (OCSD) at the following locations:

- Santa Ana Delhi at SADF01;
- San Diego Creek at SDMF05;
- Bonita Canyon at BCF04;
- Costa Mesa Channel at CMCG02; and
- Big Canyon Wash (BCWG04).

  If stormwater flow exceeds the design capacity of the OCSD facility, high-level planning estimates of the cost of expanding the capacity of the facility based cost per extra volume treated for the expanded treatment processes.

  2) Diversion of the theoretical planning level target wet weather volumes directly to the ocean or off-line/underground storage during wet weather.

    a. Diversion to ocean: A cost estimate of diverting the (5) five major inputs to Newport Bay to a new stormwater conveyance pipeline discharging at the Pacific Ocean shoreline between the entrance channel to Newport Bay and the Santa Ana River. The approximate route of the diversion pipeline will be optimized based on the cost of construction underwater and the cost of extra pipeline to avoid underwater construction.

    b. Diversion to off-line/underground storage: A cost estimate of diverting the (5) five major inputs to Newport Bay to an underground storage basin for infiltration or capture and reuse.
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Costs of diversion scenarios from outfalls directly entering Lower Newport Bay will be evaluated if a complete spatial data base of the storm drain system and information pertaining to existing diversion efforts is received from the City of Newport Beach.

- **Improved Circulation** – For this solution, which consists of improved circulation in Newport Bay, a literature review will be conducted to identify potential solutions, the effectiveness of the solutions, and the costs (to the extent that they are available). This will primarily address the western end of the LNB since that area has particularly poor circulation with some stations with chronically poor water quality. Therefore, this option involves opening an ocean outlet between 37th and 47th Street (see the figure below).

![Map of Newport Bay](image)

The approach to the evaluation of structural engineering solutions and cost estimate is as follows:

1. Conduct a literature review pertaining to stormwater best management practices (BMPs), disinfection treatment processes, stormwater diversions, and improved circulation options in Newport Bay to assess the availability of and gather information on the costs of proposed solutions.

2. Cost per unit volume of stormwater retained or diverted will be attained, if available, for treatment BMPs and diversion options. Information pertaining to the cost and effectiveness of improved circulation options in the western end of LNB will be compiled to the extent that it is available.

3. Develop implementation scenarios at a planning level with the specificity needed to approximate costs. Spatial data for existing storm drain and sanitary sewer infrastructure, subwatershed delineations, soil types and land uses will be utilized to develop conceptual scenarios. For specific locations for diversions, pipelines, BMPs, treatment facilities, etc., feasibility of construction and acquisition of property will be assumed.
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4. Evaluate efficacy and costs of implementation scenarios for treatment BMPs and diversions (using cost per unit volume information) designed according to the three wet weather conditions identified above. Costs of ancillary facilities (e.g. pipelines, pump stations) will be gathered and presented based on literature review, if significant. Cost estimates will include material and construction costs, and costs per year for operations and maintenance. The costs of design, land acquisition, permitting, and feasibility studies (e.g. soils testing) will not be included.

5. Based on the results of literature review, evaluate and present potential improved circulation solutions for Lower Newport Bay, along with available cost data.

It is anticipated that the resources that will be used to develop the planning level cost estimates include the following:

- Newport Bay Watershed Selenium TMDLs – Appendix R: BMP Strategic Plan for the Santa Ana-Delhi and San Diego Creek Sub-Watersheds (December 2013);
- Newport Bay Watershed Selenium TMDLs – Appendix T: Economic Analysis (January 2015);
- Costs of Maintaining Green Infrastructure, ASCE/EWRI, 2017;
- Pathogens in Urban Stormwater Systems, Urban Water Resources Research Council, ASCE (August 2014); and
CHARTING A PATH FOR APPLYING RESULTS FROM SHELLFISH STUDIES

Stephen B. Weisberg

Southern California Coastal Water Research Project Authority

January 25, 2018
BACKGROUND

• At our last meeting, we discussed potentially moving forward with shellfish studies
  – Jason Freshwater described a specific proposal that he had submitted for funding consideration

• Group supported the concept, but wanted a clear path for how results would guide TMDL development

• A small committee (Hope Smythe, Amanda Carr, myself) was charged with defining that path
  – This is our report-out
STUDY CONCEPT

• Fecal indicator bacteria in the water column sampled concomitantly with measurements in bivalves
  – Enterococcus and fecal coliform in the water
  – Enterococcus, fecal coliform, viruses and coliphage in bivalves

• Null hypothesis: There is a disconnect between water column measurements and the beneficial use they are intended to protect

• A disconnect would allow for implementation of a site specific objective
CHALLENGES

• We need to define what we mean by “disconnect”
  – Moreover we need to quantify how much disconnect is required to move toward an SSO

• We need to define appropriate SSO options

• We need to consider the time frame for making such decisions
  – The TMDL has a 2022 deadline and there is little sentiment for another extension
WHAT DO WE MEAN BY A DISCONNECT?

- **Philosophy:** There is an existing standard and a high burden of proof is needed to abandon that standard

- **One extreme:** Water column measures correlate with pathogens in shellfish
  - There is linkage to beneficial use
  - Existing standards are appropriate

- **Opposite extreme:** Water column correlates with none of the shellfish measures
  - That would be a basis for considering a site specific objective
  - However, lack of correlation is not at the 95% confidence interval
  - Would want to show there is less than a 60% chance of a correlation
MIDDLIN’ POSSIBILITIES

- **Water column measures correlate with shellfish coliphage or virus, but not bacteria**
  - That would NOT be a basis for an SSO
  - Viruses and coliphage are the key indicators for beneficial use

- **Water column measures correlate with bacteria in shellfish, but not with coliphage or virus**
  - That would be a basis for an SSO
  - Again, viruses and coliphage are the key indicators for beneficial use

- **Water column measures correlate with shellfish coliphage, but not virus**
  - That would NOT be a basis for an SSO
  - Burden of proof is to show lack of relationship, which means showing it with both of the virus measurements
WHAT WOULD OUR SSO OPTIONS BE?

- **Coliphage in shellfish**
  - Preferred option because a (European) standard already exists
  - Want to avoid developing a new standard

- **Coliphage in water column**
  - Might be useful since water measurements are easier than in tissue
  - EPA is likely to offer a new coliphage standard for water, though it will be to protect recreation rather than shellfish
  - We could amend the study to include water column coliphage to determine a correlation with the shellfish tissue standard

- **Viruses in either shellfish or water column**
  - There are no standards
  - Even the methods are not standardized
TIMING

• **Decisions need to be made by December 2020**
  - To achieve the 2022 implementation requirement
  - Will be tight if you go the SSO route, but potentially doable

• **Study would be initiated in summer 2018**
  - Completed in summer 2019
  - Results/report completed in December 2019

• **Provides a year for discussion about TMDL direction**
  - Assuming you obtain funding/initiate study by February