

State of California
North Coast Regional Water Quality Control Board

PEER REVIEW COMMENTS &
RESPONSES TO PEER REVIEW
COMMENTS

FOR THE

PEER REVIEW DRAFT STAFF REPORT
FOR THE ACTION PLAN FOR THE
RUSSIAN RIVER WATERSHED
PATHOGEN INDICATOR BACTERIA
TOTAL MAXIMUM DAILY LOAD

August 28, 2015



State Water Resources Control Board
North Coast Region
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INTRODUCTION

Staff of the North Coast Regional Water Quality Control Board (Regional Water Board) prepared for external scientific peer review a Peer Review Draft Staff Report for the Action Plan for the Russian River Watershed Pathogen Indicator Bacteria Total Maximum Daily Load [dated January 16, 2015](Peer Review Draft Staff Report) related to the assessment and control of pathogen indicator bacteria discharges in the Russian River Watershed. A draft Action Plan will be proposed to the Regional Water Board for adoption as regulation and inclusion in the Water Quality Control Plan for the North Coast Region and is based on the TMDL analysis.

The statutory mandate for external scientific review (Health and Safety Code Section 57004) states that it is the reviewer's responsibility to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. Reviewers were asked to determine whether the scientific work product is "based upon sound scientific knowledge, methods, and practices." We requested that the scientific peer reviewers make this determination for each of the identified findings and conclusions that constitute the scientific portions of the Peer Review Draft Staff Report. Relevant sections of the references cited in the Peer Review Draft Staff Report were provided to reviewers electronically or in hard copy.

After a selection process for candidate peer reviewers, Gerald Bowes, the manager of the Cal/EPA Scientific Peer Review Program, State Water Resources Control Board, provided contact information for two reviewers approved to conduct the peer review:

Patricia A. Holden

Professor
Bren School of Environmental Science & Management
University of California, Santa Barbara

Expertise: Professor Holden oversees a research group in environmental science & management that includes backgrounds in engineering, microbiology, ecology, environmental science, chemistry, toxicology, geology and physics. The researchers conduct field and laboratory studies to understand chemical and microbiological pollutants, including origins and fates, in waters, sediments, and soils. The current research focus is the urban water environment and coastal microbiological water quality.

Nicholas J. Ashbolt

Professor
School of Public Health
University of Alberta, Edmonton

Expertise: Professor Ashbolt is a world renowned leader in the field of environmental pathogen fate and transport and in the application of quantitative microbial risk assessment to municipal water systems. Over the previous 15 years he has worked in joint Australian-Sweden and European programs developing methods to interpret pathogen data with the aid of quantitative microbial risk assessment and integrated that research within urban water sustainability frameworks. His research has been fundamental to the risk-based approach adopted in the most recent WHO recreational, drinking water and reuse guidelines and U.S. EPA recreational criteria (2012)

The Peer Review Draft Staff Report was the primary scientific document submitted for peer review. Additional monitoring reports and technical memoranda are secondary documents, which support the Peer Review Draft Staff Report, and were also made available for review.

Reviewers were asked to determine whether each of the identified findings and conclusions that constitute the scientific portions of the Peer Review Draft Staff Report were “based upon sound scientific knowledge, methods, and practices”. The following list of Peer Review Draft Staff Report findings and conclusion were provided for review:

1. Nature of the Water Quality Problem - Pathogenic indicator bacteria concentrations exceed the Bacteria Water Quality Objective throughout the mainstem Russian River and tributary creeks.
2. Desired Target Conditions - The instream desired target conditions represent conditions supportive of the Bacteria Water Quality Objective and beneficial uses including recreation, fisheries uses, and domestic and agricultural water supplies.
3. Source Analysis - The analysis reasonably and accurately identifies the probable sources of pathogen indicator bacteria.
4. Seasonal Variation and Critical Conditions - The seasonal variability of pathogen indicator bacteria are described and critical conditions occur throughout the year.
5. Linkage Analysis - The Peer Review Draft Staff Report provides a reasonable description of the relationship between the desired target conditions and impairment to beneficial uses of water.
6. TMDL, Loading Capacity, and Allocations - The concentration-based TMDLs are a reasonable loading capacity for Russian River watershed and will likely be supportive of the Bacteria Water Quality Objective.
7. Margin of Safety - The margin of safety will ensure beneficial uses are protected and it reasonably accounts for uncertainty in the source analysis, the loading capacity, and seasonal variation.
8. Implementation Plan - The implementation plan will reasonably ensure progress towards attaining water quality standards and supporting recreational beneficial uses.
9. Other Issues - Identify any additional scientific issues that should be part of the scientific portion of the Peer Review Draft Staff Report that are not described.

Comments were received from Patricia A. Holden on February 22, 2015.

Comments were received from Nicholas J. Ashbolt on March 6, 2015.

All written comments received are summarized in this document and responded to by Regional Water Board Staff, divided by each scientific peer reviewer. Comments are not necessarily duplicated here verbatim and may not follow the order of each of the comment letters. For each peer reviewer, where his/her comments address a single theme or issue, the comments have been combined for a single response.

SIGNIFICANT CHANGES

The following significant changes have been made to the Public Review Draft Staff Report (dated August 21, 2015) resulting from the peer review:

1. It will be proposed to the Regional Water Board that a TMDL for the protection of potential shellfish harvesting (SHELL) use in the Russian River be deferred. Further study is needed to determine whether the SHELL-related water quality objective needs revision and whether SHELL is still a potential use in the Russian River. Implementation of a TMDL for the protection of REC-1 will likely also be protective of SHELL. Monitoring data collected in association with implementation of a TMDL for the protection of water contact recreation (REC-1) use will be assessed to determine if additional implementation is required to protect SHELL, as well. If so, a future TMDL effort will be designed to address impairments to SHELL beneficial use, including the evaluation of updated water quality objectives as necessary. The assessment of SHELL beneficial use, loading capacity, the load and wasteload allocations, and required monitoring for fecal coliform bacteria has been removed from the Public Review Draft Staff Report.
2. It will be proposed to the Regional Water Board that a TMDL based on the Basin Plan narrative natural conditions water quality objective for bacteria in the Russian River be deferred. *Bacteroides* bacteria were used independently to assess natural background bacteriological quality in the Peer Review Draft Staff Report, using the analytical reporting limit of the *Bacteroides* genetic markers to define the natural background loading capacity and assign TMDL load and waste load allocations. Regional Board staff is currently conducting a natural background study of bacteria concentrations in relatively undisturbed subwatersheds within the Region that will inform future efforts to identify and address exceedances of the Basin Plan narrative water quality objective for bacteria. The loading capacity, load and wasteload allocations for *Bacteroides* bacteria have been removed from the Public Review Draft Staff Report. However, *Bacteroides* bacteria are still recommended in ‘Chapter 9 – Monitoring’ of the Peer Review Draft Staff Report (along with the other source tracking methods described) to assess possible sources causing exceedance of the numeric TMDL targets.
3. An assessment of REC-1 using enterococci bacteria concentration measurements and the U.S. EPA (2012) criteria has been added to ‘Chapter 3 – Evidence of Impairment’ of the Public Review Draft Staff Report. Language in the Peer Review Draft Staff Report incorrectly implied that U.S. EPA (2012) had found *E. coli* bacteria as a better indicator of health risk from water contact recreation than enterococci bacteria.

COMMENTS AND RESPONSES

COMMENTS FROM PATRICIA A. HOLDEN (PAH)

PAH Comment 1: The scientific basis is sound for establishing the conclusion that “the Bacteria Water Quality Objective is not being fully supported in the subject watershed”.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 2: It is scientifically valid and justified to use *E. coli* concentrations in place of fecal coliform in this context.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 3: The range of potential sources appears to be comprehensive and reasonably derived from studies to identify potential sources.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 4: It is scientifically valid to apply the same loading criteria throughout the year.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 5: The basis for linking *E. coli* concentrations to attaining beneficial uses as described is valid.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 6: There is scientific validity to base TMDLs on *E. coli* concentrations.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 7: The basis for selecting the Margin of Safety appears to be scientifically valid.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 8: The implementation plan would likely result in progress towards attaining water quality standards and supporting recreational beneficial uses.

Response: Comment noted. Regional Board Staff concur.

PAH Comment 9:

These comments address the assessment of impairment applying DNA-based markers in isolation.

- The diagnosis of non-attainment should not be made on the basis of a few select host-specific qPCR results.
- In the absence of epidemiological justification, source-specific DNA-based markers should not be used in isolation. However, it is scientifically valid and justified to use *Bacteroides*-based host specific markers, in tandem with fecal indicator bacterial data, to infer fecal sources that impinge on human health.
- A more holistic approach to watershed management is advocated. Where there are bacterial markers of human or bovine waste, there may also be compounds of emerging concern and nutrients.

Response:

The U.S. EPA (2012) REC-1 criteria for *E. coli* and enterococci bacteria concentrations are based on a distribution of samples collected over a 30-day period. Accordingly, single samples of *E. coli* and enterococci bacteria concentrations for this TMDL were not assessed individually to assess impairment of REC-1. The *Bacteroides* bacteria concentrations were used to assess the narrative objective of natural background conditions, not for REC-1 impairment. As such, *Bacteroides* bacteria concentrations were assessed independently of the *E. coli* data to assess compliance with the natural background objective. *Bacteroides* bacteria concentrations were also used to determine the likely sources of fecal waste associated with exceedances of *E. coli* or enterococcus targets. ‘Chapter 7 – TMDL Calculations and Allocations’ of the Public Review Draft Staff Report has been revised so that the TMDLs and allocations are based on the U.S. EPA (2012) REC-1 criteria for *E. coli* and enterococci bacteria concentrations. As a result of peer review, *Bacteroides* bacteria are recommended (along with the other source tracking methods described) only to assess whether the impairment is from natural, human, or domestic animal sources in ‘Chapter 9- Monitoring’ of the Public Review Draft Staff Report.

Regional Board Staff also agree that other measures of human pollution that may affect other beneficial uses could be addressed given additional resources. However, the implementation measures that are proposed to reduce bacteria loads will also likely result in reductions in other human-caused pollutants. Further, the Russian River Pathogen TMDL is but one of many actions the Regional Water Board is involved in in the Russian River Watershed. For example, with other partners, the Board is endeavoring to develop a regional monitoring program for the Russian River Watershed that would look comprehensively at the issues important to the watershed, possibly CECs.

PAH Comment 10:

These comments address the need to establish a standard method for the DNA-based markers proposed for use.

- It is crucial that the specific *Bacteroides* DNA-based marker and methods used to quantify be specified. If standardized methods are used for setting and monitoring natural background conditions, then the proposal as stated is valid and justified.
- Standardization in sampling, analysis, and data analysis methods should be required. Available DNA-based markers vary in their specificity and sensitivity, as described in the Report. The targets that are described, their basis, and protocols for measuring, should be selected and should be

consistent. It should be noted that the closest equivalent to a “Standard Methods (for the Examination of Water and Wastewater)” in DNA-based analysis in this context is Griffith et al., (2013).

- Section 2.2.1.1, Page 34: Ashbolt et al. (2010) specify use of the HF183 marker for..., This recommendation is based on personal communication internally at the U.S. EPA. The text in this section should be specific: if it is HF183, then this needs to be stated. Not all human markers have the same detection limits and not all are similarly specific to human waste. Further, Wade et al. (2010) did not test HF183, but rather the general *Bacteroides* marker. These are not interchangeable. In sum, the reporting limit is specific to the marker and likely the qPCR conditions. Reading on to Section 2.1.1.2, the Peer Review Draft Staff Report could address this if the numeric limits are set based on detection limits for the selected markers from Griffith et al. (2013), using the approaches specified in the latter reference.
- Section 6.1, Page 103: The need to be specific about *Bacteroides* numerical criteria, i.e. tethered to a specific qPCR marker and method, is reiterated here, as commented upon for Chapter 2 sections.
- Chapter 3, Page 39: in point “1.”, The numeric targets should be related specifically to a specific host-specific marker (e.g. HF183) and using specified qPCR analysis methods. While one can assume that fecal coliform will be measured according to “Standard Methods for the Examination of Water and Wastewater”, and that doing so is implied when one states that fecal coliform are being measured (for example), this is not yet the case for qPCR methods for host specific markers. A recommendation is that Griffith et al. (2013) be specified throughout, to standardize around a specific qPCR approach.
- Table 7.3: These percent reductions hinge on whether the methods for DNA-based analysis were exactly the same in the monitoring studies. That is, the exact same laboratory protocols, and primers for the DNA-based marker, would need to be used. The selection of “60 gene copies / 100 mL” hinges on a specific DNA-based protocol having been used exactly for the data that resulted in monitoring and the monitoring moving forward.
- The numbers of samples and frequency of exceedance should be specified for the *Bacteroides* numeric targets.
- Table 2.5: The numeric targets for *Bacteroides* gene markers do not specify the number of samples. Does this mean that if only one sample is acquired, the numeric target applies within a calendar year?
- Chapter 7, Sections 7.1 and 7.1.1, Page 108: The number of samples for *Bacteroides* monitoring is not specified.

Response: Thank you for this guidance. With the rapid improvements in the technology of microbial source tracking, Regional Board Staff want to remain flexible on protocols and markers for *Bacteroides* bacteria assessment. As such, staff prefers not to codify a single protocol or marker at this time, given the risk that they may quickly become outdated. For example, as described in Griffith et al. (2013), the qPCR assay markers used in the development of the TMDL (i.e., HuBac and BoBac) are no longer recommended due to cross sensitivity with other animal hosts. Further, the reporting limits for other markers recommended by Griffith et al. (2013) are unknown at this time, an issue the Sonoma County Public Health Laboratory is currently attempting to rectify by conducting validation studies on the genetic markers for *Bacteroides* bacteria in the Russian River.

As a result of the peer reviewer’s comments, the loading capacity, load and wasteload allocations for *Bacteroides* bacteria have been removed from the Public Review Draft Staff Report. *Bacteroides* bacteria concentrations are no longer proposed to be assessed independently of the *E. coli* data to determine compliance with the TMDL. *Bacteroides* bacteria are now recommended (along with the

other source tracking methods described) to assess natural, human, or domestic animal sources in ‘Chapter 9 - Monitoring’ of the Public Review Draft Staff Report.

Section 2.2.1 of the revised Peer Review Draft Staff Report continues to describe the specific genetic markers based on Griffith et al. (2013) and currently recommended by Regional Board Staff for human-specific and bovine-specific *Bacteroides* bacteria. However, additional source tracking methods also are described in ‘Chapter 9 - Monitoring’ of the Public Review Draft Staff Report that could be used to assess whether any identified exceedances of enterococcus or *E. coli* criteria are related to anthropogenic sources, including domestic animals. These additional source tracking methods include animal-specific host *Bacteroides* bacteria, bacteriophages, viruses, and wastewater chemicals. No gene markers or samples sizes are specified in the Public Review Draft Staff Report, at this time. This approach allows greater flexibility in helping identify human or domestic animal sources causing impairment of REC-1 criteria, at the time that a monitoring and reporting program is designed.

PAH Comment 11:

These comments relate to the time frame recommended for development and submission of BLRPs.

- The time allowed for source identification is not sufficiently long and thus it will be difficult to produce scientifically based BLRPs (e.g. in 1 year).
- BLRP, Page 134: The time frame of 1 year for BLRPs to identify sources of bacteria is short. This doesn’t allow for determining the influence of seasonality on patterns. A tiered approach is advocated by the Clean Beaches Initiative in the SWRCB, which is described in Griffith et al., 2013.
- Table 8.1: The time schedule for submitting plans for Load Allocations is short, particularly for the “homeless” sources, which were not identified in the Peer Review Draft Staff Report. The time frame is of concern as it may place a large financial burden on the Counties, particularly if they need to perform studies to determine sources, and need to identify funding for doing so.

Response: Staff is sensitive to this issue and agrees that the time frame for source identification and submission of BLRPs must be reasonable and appropriate. Staff also agrees that the counties should not be placed under an unreasonable financial burden, with respect to large-scale source assessment. Please keep in mind that the BLRP should be designed to be implemented in an adaptive management framework. The BLRP will describe how the BLRP will be updated based on monitoring and performance assessments. It is expected that the BLRP will be assessed and revised at least every 5 years. Subsequent revisions to the BLRP will, in some cases, require additional actions depending on future source identification monitoring. The implementation strategy has been revised to better address the obligation on the counties.

PAH Comment 12: It is unclear how source identification for developing the BLRPs will be funded.

Response: The Public Review Draft Staff Report includes an ‘Economic Considerations’ chapter that was not available at the time of the scientific peer review. It identifies several sources of possible funding for each of the recommended implementation actions. Further, staff has been working with the counties to identify potential sources of funding for their activities and the requirements of individual home owners.

PAH Comment 13: Where possible, it is best to increase the direct relevance to human, or ecological, health of information used in water quality management.

Response: The purpose of ‘Chapter 6-Linkage Analysis’ is to describe the relationship between pathogen indicator bacteria concentrations and attainment of beneficial uses in the Russian River Watershed. Certain concentrations of *E. coli* and enterococci bacteria indicate a potential health risk from exposure to pathogens in surface waters. For this TMDL, the linkage between concentrations of the pathogenic indicator bacteria *E. coli* and enterococci and the attainment of REC-1 and REC-2 beneficial uses is based on risk of gastrointestinal illness following water contact recreation.

PAH Comment 14: The funding for implementation should be identified. It is a concern that the environmental improvement objectives can be met without causing undue burden to the Counties and other jurisdictions or stakeholders. How source identification studies are to be funded is unknown (for individual BLRPs), as is how monitoring is to be funded, particularly for DNA-based markers of human or bovine waste.

Response: See response to PAH Comment 12.

PAH Comment 15: Where bacteria load reduction strategies (BLRPs) are ineffective, watershed management methods should be investigated that would promote better water quality, for example (related to the soil attenuation outcomes described in Chapter 2) increasing percolation through soils, increasing natural sunlight incidence so that solar radiation can generate free radicals to attenuate fecal pathogens, and similar.

Response: Thank you for your suggested additions to the tools available for pathogen reduction. The purpose of the Implementation Plan chapter is to describe the steps necessary to reduce pathogen concentrations and achieve the TMDLs. It is not intended to be a comprehensive list of all available strategies. Staff envisions that the BLRPs will describe the specific actions that are necessary to reduce bacteria loadings and attain load allocations, including those management methods that are within the authority of responsible party. The effectiveness of actions identified within the BLRP then will be monitored and assessed under an adaptive management framework. Staff anticipates that subsequent revisions to the BLRP will, in some cases, require the development of new or additional actions, depending on the results of future source identification monitoring and ongoing ambient water quality monitoring. It is expected that the BLRPs will be assessed and revised at least every 5 years, allowing for consideration of updated data and any newly developed or recognized watershed management tools.

PAH Comment 16: DNA-based marker persistence, or decay, in the environment relative to fecal indicator bacterial decay is uncertain. An internal report to this Peer Review Draft Staff Report has reviewed and summarized a good body of scientific literature, but published studies have been performed over varying conditions and there are few such studies. It is very difficult to generalize relationships between DNA-based marker decay relative to fecal indicator bacterial decay. Often, it is found that there is low correspondence between concentrations of these two types of indicators. The scientific literature does not support quantitative interchange of *Bacteroides* with fecal coliform. Even when a specific host appears to be the source of fecal pollution based on host specific markers, fecal coliform levels rarely correspond to *Bacteroides* levels in affected waters.

Response: The sampling and analysis of fecal indicator bacteria and DNA-based markers of *Bacteroides* bacteria confirm the comments. Generally, we found no significant relationship between concentrations of culturable fecal indicator bacteria and DNA-based markers. Staff expects the difference may be due to non-human or domestic animal sources of fecal indicator bacteria, like wildlife or benthic biofilms. *Bacteroides* is not used independently as a numeric TMDL target in the Public Review Draft Staff Report as described in more detail in the response to PAH Comments 9 and 10.

PAH Comment 17: It would be very helpful if maps with sampling locations were provided, in order to relate sampling data reported in tables or charts back to the physical setting. For example, Table 2.1 and Figure 1.2 are challenging to relate to one another. The sub watersheds labeled on Figure 1.2 are not all listed on Table 2.1 and vice versa. It would certainly be helpful if these were congruent.

Response: Thank you for this recommendation. . The maps and figures have been revised to better allow the reader to relate one to another.

PAH Comment 18: In some places, the Peer Review Draft Staff Report refers to “domestic animals” instead of “livestock”. If the source were really cows, then it would be better to define the animal host of concern as such. Otherwise, “domestic animals” could include pets (dogs, mainly), which can be significant sources but don’t appear to be a focus here.

Response: The Public Review Draft Staff Report refers to “domestic animals” to be inclusive of other animal waste sources, including livestock and pets that could not be considered as contributing natural background bacteria levels. Implementation measures are proposed for domestic animal wastes, including waste from dogs, cows, and livestock other than cows.

PAH Comment 19: Section 2.1.2, Page 27: The box “Bacteria Water Quality Objective” relates “natural background levels” to first “coliform”, which should be clarified as either “fecal coliform” or “total coliform”. The 2nd and 3rd uses specify “fecal coliform”.

Response: Your description of the water quality objective accurately reflects that which is contained in the Water Quality Control Plan for the North Coast Region. The first use of the term “coliform” is intended to be read as a generic class, made specific by the following two uses which define objectives based on “fecal coliform.”

PAH Comment 20: Section 2.1.2, Page 27: last paragraph has a typographical error: “pathogen” should be plural “pathogens”.

Response: The typographical error has been corrected in the Public Review Draft Staff Report.

PAH Comment 21: Section 2.1.2.1, Page 27-28: It is unclear what “significant human disturbance” means in this context. The phrase “zero human waste” in the use on Page 28 implies that it is acceptable to discharge human waste into water bodies. The distinction between “treated” and otherwise altered, versus untreated, would seem useful here. Surely the intent is not to suggest that it is acceptable to allow a known discharge of low amounts of raw sewage or human feces into natural waters.

Response: The Water Quality Control Plan for the North Coast Region does not define the term “natural background,” but leaves the interpretation open to the Board’s discretion. For the purposes of this TMDL, staff proposes that “natural background” be interpreted to mean the quality of water found in the absence of *significant* human landscape disturbance or stream channel alteration. The term “natural background” is not intended to be interpreted as a *completely* undisturbed condition, nor is it in reference to a particular historic period. With that said, the Regional Water Board only permits the point source discharge of *treated* wastewater into the Russian River, at no more than 1% of the ambient flow and only during the wet season. Unpermitted discharges of human waste appear to be occurring and must be addressed via implementation of this TMDL. Attainment of REC-1 water quality standards may very well result in the control of all unpermitted discharges of human waste. Staff has begun a program to monitor *minimally* disturbed catchments, so as to evaluate the levels and types of bacteria that occur when humans are present on the landscape, but human waste is adequately controlled. The results of the “reference stream” study will help to interpret the Basin Plan narrative water quality objective of natural background conditions, by providing a numeric range for the bacterial markers in use. The Public Review Staff Report has been revised to prevent possible confusion by removing the term “zero human waste”.

PAH Comment 22: Section 2.2.1, Page 33: It should be noted that not all of the assays available are “quantitative”. For example, the horse assay that is listed in Griffith et al., 2013, yields presence/absence, not gene copy numbers. While Griffith et al., 2013 mentions that a quantitative marker for horse is available, it was not validated in that study.

Response: The Public Review Draft Staff Report has been modified to clarify the range of protocols available for the *Bacteroides* assays.

PAH Comment 23: Section 2.2.1.1, Page 33: How is it known that above 10% of the reporting limit is above “natural background”?

Response: In the Peer Review Draft Staff Report, staff proposed that natural background be set at the analytical reporting limit of the laboratory method. The Peer Review Draft Staff Report then described that compliance with the natural background target be derived by allowing 10% of the samples to exceed the analytical reporting limit. This approach was based on the State Water Board’s policy for assessment of impaired waters for year-round bacteria measurements. The loading capacity, load and wasteload allocations for *Bacteroides* bacteria have been removed from the Public Review Draft Staff Report. *Bacteroides* bacteria are still recommended in ‘Chapter 9 – Monitoring’ of the in the Public Review Draft Staff Report (along with the other source tracking methods described) to assess possible sources causing exceedance of the other numeric TMDL targets.

PAH Comment 24: Section 2.2.1.1, Page 33: How long are markers able to persist in disinfected waters? What is the evidence that markers in disinfected waters are, or are not, able to indicate persistent pathogens in disinfected waters?

Response: A review of scientific literature on relative persistence of markers related to pathogens found very few studies. These studies are now briefly discussed in Section 2.2.1 in the Public Review Draft Staff Report.

PAH Comment 25: Figures 3.1 and 3.2: The legend appears to be mislabeled. The red is “Target Exceeded”, not “Target Attained”. This change would make the labeling consistent with the data in Table 3.1.

Response: The legend labels in Figures 3.1 and 3.2 have been corrected in the Public Review Draft Staff Report.

PAH Comment 26: Tables 3.1 and 3.2: Here and in prior sections of the text, the authors are encouraged to change the nomenclature from “genes/100 mL” to “gene copies/100 mL”.

Response: The units associated with *Bacteroides* bacteria qPCR results have been corrected throughout the Public Review Draft Staff Report.

PAH Comment 27: Tables 3.1 and 3.2: It would be helpful if the Tables had a footnote with the citation to the original source of these data, since whether the samples were acquired during dry or wet weather would be useful to know, and other timing or conditions of sampling.

Response: The Tables were presented only as a summary of the data collected from several different studies conducted during the development of the TMDL. The Peer Review Draft Staff Report serves only to summarize the results of those studies. Additional details on the timing or conditions of sampling are presented in the list of references cited in the Public Review Draft Staff Report. The report has been revised to make clearer, which individual studies were conducted to develop the data reported in the TMDL. Further, the reader is directed to our website where each of the study reports is readily available. The Tables have been revised to provide additional information, useful to the reader’s interpretation of the data.

PAH Comment 28: Table 3.5, Page 47: It would be very useful if the single sample *E. coli* data corresponding to the *Bacteroides* data (Tables 3.3 and 3.4) were reported, preferably alongside the latter. Otherwise, this report gives the impression that the main diagnosis of non-attainment is made on the basis of a few select host-specific qPCR results.

Response: The U.S. EPA (2012) REC-1 criteria for *E. coli* bacteria concentrations are based on a distribution of samples collected over a 30-day period. Accordingly, single samples of *E. coli* bacteria concentrations in this TMDL were not assessed individually to assess impairment of REC-1. The *Bacteroides* bacteria concentrations were used to assess the narrative objective of natural background conditions, not for REC-1 impairment. As such, *Bacteroides* bacteria concentrations were assessed independently of the *E. coli* data to assess compliance with the objective. The independent application of the water quality objectives was conducted only for developing lines of evidence of impairment in Chapter 3 of the Peer Review Draft Staff Report. The TMDLs and allocations are based only on the USEPA (2012) REC-1 criteria for *E. coli* and enterococci bacteria concentrations in ‘Chapter 7 – TMDL Calculation and Allocations’ of the in the Public Review Draft Staff Report. *Bacteroides* bacteria are recommended (along with the other source tracking methods described) only to assess possible sources as described in ‘Chapter 10 – Monitoring’ of the in the Public Review Draft Staff Report. Therefore, a table with corresponding *E. coli* and *Bacteroides* data alongside the later could lead to a misinterpretation of the data.

PAH Comment 29: Section 8.2.2, P119-120: The possible compliance actions refer to disinfection of wastewater pathogens. This is the goal, but compliance is measured by indicator organisms, not pathogens.

Response: Several groups of intestinal bacteria are used as indicators. These bacteria indicate if a waterbody has been contaminated and pathogens are present. Most strains of indicator bacteria do not directly pose a health risk to swimmers and those recreating in the water. But, indicator bacteria often co-occur with human pathogens and are easier to measure than the actual pathogens that may pose the risk of illness. It is impractical to directly measure the wide range of types of fecal-borne pathogens (bacteria, viruses, and protozoans) and the methods to detect human pathogens are characteristically expensive and inefficient, or may be not available. *E. coli*, enterococci and *Bacteroides* bacteria were used in the Russian River Watershed as indicators of pathogens. Language in the Public Review draft has been modified to make this point clear.

COMMENTS FROM NICHOLAS J. ASBOLT (NJA)

NJA Comment 1: Overall, the authors should be congratulated on a detailed and thorough report that addresses the 16 hydrologic areas of the Russian River TMDL Project that is probably one of the first to include state-of-the-art molecular fecal indicators to complement their interpretations.

Response: Comment noted. Thank you.

NJA Comment 2: It is clear with the detection of human and cattle markers at most locations sampled that significant impact occurs across the watershed.

Response: Comment noted. Regional Board Staff concur.

NJA Comment 3: Since fecal sources may mobilize differently during rain events it was good to see data collected from rain events (e.g., Fig 3.1).

Response: Comment noted.

NJA Comment 4: Section 4.3.3.1. Given the clear identification of human sewage in stormwater, these discharges can be considered a likely major human pathogen contributing source. The last sentence in the Section is inappropriate and misleading.

Response: Comment noted. Regional Board Staff concur. The last sentence in that Section has been removed in the Public Review Draft Staff Report.

NJA Comment 5: Section 4.4.2. Excellent to see data presented on the potential contributions from recreational use of the river system at some sites, which showed clear increased human-target MST markers downstream of recreators.

Response: Comment noted. Regional Board Staff concur.

NJA Comment 6: This section on assessing potential pathogens using the Phylochip technology is great to see by giving a different perspective on assessing fecal contamination, and seems to generally support the MST results.

Response: Comment noted. Regional Board Staff concur.

NJA Comment 7: It is the view of this reviewer that EPA or others do not need to conduct more epidemiology studies to show again that sewage-contaminated recreational waters increase human health Gastro-Intestinal illness rates.

Response: Comment noted.

NJA Comments 8: The Peer Review Draft Staff Report appears to be caught between two slightly different goals; being to meet water quality standards based on bacteriological indicators versus protection of public health. The first is the regulatory requirement of the TMDL, the second is the intent of the regulation, but at times is lost in the translation with regulatory bacteriological criteria that are not related to health risk.

- Section 2.1.2. Fecal coliform bacteria criteria are problematic, due to their environmental growth unrelated to health risk. The water quality objectives based on fecal coliform concentrations presented are very out of date with respect to public health risk, noting reflection of this by the authors.
- The Peer Review Draft Staff Report misrepresents the preferred criteria of U.S. EPA (2012). There does not seem to be a dose-response relationship between *E. coli* bacteria concentration and gastrointestinal illness, just a threshold. However, a dose-response relationship does exist with enterococci bacteria. U.S. EPA maintained *E. coli* in the 2012 recreational water criteria, not because it was better than enterococci, rather, because of historical precedent and stakeholder interest in maintaining an *E. coli* criterion. The U.S. EPA, and this reviewer's, preference is for the enterococci criterion.
- Reword Section 6.2 so it does not suggest *E. coli* is the best indicator for freshwater. That was a political/regulator interpretation to continue with the previous approach, but is not backed by science in the U.S. or Europe.

Response: The Peer Review Draft Staff Report has been modified to base the TMDLs and allocations solely on the *E. coli* and enterococci bacteria concentrations. Although the U.S. EPA did not include *E. coli* bacteria in their NEEAR epidemiological study, the U.S. EPA did review and cite other scientific literature that found linkages between *E. coli* bacteria and illness, from which they derived the recommended *E. coli* criteria. For example, the U.S. EPA reviewed published studies and concluded that *E. coli* bacteria are good predictors of GI illness in fresh waters.

Staff agrees that water quality objectives based on fecal coliform concentrations are outdated. The State Water Board is currently developing a statewide amendment to the Inland Surface Waters, Enclosed Bays, and Estuaries Plan to protect recreational users from the effects of pathogen in California waterbodies. The amendment is currently scheduled for State Water Board consideration in the spring of 2016. The amendment is intended to incorporate the latest science and information, including a consideration of U.S. EPA criteria. The Public Review Draft Staff Report has been revised to base the TMDLs and allocation on *E. coli* and enterococci bacteria in place of fecal coliform bacteria in order reflect current science and with the expectation that the State Water Board's current efforts to develop a statewide amendment to the Inland Surface Waters, Enclosed Bays, and Estuaries Plan will likely replace fecal coliform numeric values for the protection of recreation uses.

An assessment of REC-1 using enterococci bacteria concentration measurements and the U.S. EPA (2012) criteria has been added to 'Chapter 3 – Evidence of Impairment' of the Public Review Draft Staff Report. Language in the Peer Review Draft Staff Report incorrectly implied that U.S. EPA (2012) had found *E. coli* bacteria as a better indicator of health risk from water contact recreation than enterococci bacteria. It will be proposed to the Regional Water Board that a TMDL based on the Basin Plan narrative water quality objective for bacteria in the Russian River be deferred. *Bacteroides* bacteria were used independently to assess natural background bacteriological quality in the Peer Review Draft Staff Report, using the analytical reporting limit of the *Bacteroides* genetic markers to define the natural background loading capacity and assign TMDL load and waste load allocations. Regional Board staff is

currently conducting a natural background study of bacteria concentrations in relatively undisturbed subwatersheds within the Region that will inform future efforts to identify and address exceedances of the Basin Plan narrative water quality objective for bacteria. The loading capacity, load and wasteload allocations for *Bacteroides* bacteria have been removed from the Public Review Draft Staff Report. However, *Bacteroides* bacteria are still recommended in ‘Chapter 9 – Monitoring’ of the Peer Review Draft Staff Report (along with the other source tracking methods described) to assess possible sources causing exceedance of the numeric TMDL targets.

NJA Comment 9:

These comments relate to the use of single bacteria indicator of pathogens.

- Measurement of a single bacteria indicator should not be used alone as a basis for deciding risk to public health. Other information should accompany the risk decision including the presence of human sewage or cattle manure as confirmed by sanitary survey and/or the use of specific *Bacteroides* markers or equivalent.
- Bacteriological measures in regions predominantly impacted by non-cattle-derived manures are likely to be over-protective of actual human pathogen risks when pathogen indicator bacteria are used.
- Locations sampled that do not exceed the *E. coli* criteria, but do show high levels of positive human and/or bovine MST marker presence is consistent with the lack of a dose-response relationship between risk and *E. coli* concentrations.
- Section 2.1.2.1. The interpretation of “Natural Background” based on the lack of significant human disturbance seems very appropriate. However, it is unclear how sanitary surveys would be used to confirm “Natural Background.”

Response: The assessment of animal-specific *Bacteroides* bacteria was conducted as one of several lines of evidence for exceeding water quality objectives. Since *E. coli*, enterococci and fecal coliform bacteria can all originate from natural sources, any exceedance of the concentration-based TMDLs should be confirmed to not be originating from natural sources. ‘Chapter 9 – Monitoring’ of the Public Review Draft Staff Report increases the flexibility by allowing additional source tracking methods to assess the possible sources the impairment including additional animal-specific host *Bacteroides* bacteria, bacteriophages, viruses, and wastewater chemicals.

NJA Comment 10:

These comments relate to the draft TMDL for protection of the SHELL beneficial use.

- Section 2.1.2.3. This reviewer is unaware of the science that supports fecal coliform numeric objectives (43 or 49 cfu/ 100 mL) for protection of shellfish harvest.
- Section 2.2.3. The discussion of fecal coliform bacteria and possible shellfish consumption risk is not based on science. While the regulatory target is discussed, there is no discussion of the relationship to public health risk. Coliform bacteria come from many sources that pose no public health risk. The lack of this relationship has been known for decades, but regulations have not changed.

Response: Due to the uncertainty associated with fecal coliform bacteria and possible shellfish consumption risk, additional data or better analytical techniques are needed to increase the accuracy of the TMDL. Staff will propose to the Regional Water Board that it defer establishing a TMDL and allocations for the protection of shellfish consumption, so that it can be determined whether the bacteria water quality objective for SHELL needs to be updated, or whether SHELL is still a potential use in the

Russian River. Regional Water Board staff believes a statewide effort will best address impairments to SHELL beneficial use, including the evaluation of more protective water quality objectives. Further, implementation of the proposed pathogen TMDL to address REC-1 protection may adequately address the protection of SHELL, as well. As more information and techniques are developed, impairments to SHELL beneficial will be revisited.

NJA Comment 11: Several statements on *Bacteroides* bacteria are misleading or incorrect.

- Page 31. The sentence “*Bacteroides* bacteria are not found in ambient surface waters without sources of mammalian waste.” is incorrect.
- Page 33; first paragraph. The description of *Bacteroides* bacteria is misleading, as there is apparently no recognition of the non-enteric members of *Bacteroides* (e.g., plant matter degraders).

Response: The Public Review Draft Staff Report has been revised to describe a wider range of *Bacteroides* bacteria.

NJA Comment 12: Page 28, last paragraph. It seems to infer that the laboratory actually counted viable *Bacteroides* bacteria.

Response: The Public Review Draft Staff Report clarifies that *Bacteroides* bacteria concentrations are based on a count of gene copies per volume, and not culturable *Bacteroides* bacteria.

NJA Comment 13: The logic reported in Section 2.2.1.1 for the 30/60 gene copies per 100mL reporting limit seems reasonable. In Chapter 3, use of the 60 human-targeted MST and 30 bovine-targeted MST marker gene copies per 100 mL seems appropriate to support impaired water status, given that traditional fecal indicators are inadequate alone to make a call relative to potential human health risk. However:

- Recommend that the initial Chapter 2 tables state which MST markers were targeted;
- Please identify the actual markers and protocols used associated with tables and figures;
- Performance for each type of sample also needs to be specified;
- Please identify the actual markers and protocols to interpret the 30 or 60 gene copies per 100 mL limits reported on pages 32 & 33 (Tables 2.4 & 2.5); and,
- It is important to confirm animal fecal sources by multiple MST markers, not the general (All) *Bacteroides* marker presence.

Response: The *Bacteroides* markers used in the TMDL development were identified in in the Peer Review Draft Staff Report (e.g. HuBac and BoBac). The *Bacteroides* markers were recommended by U.C. Davis researchers (Shilling et al. 2009). The U.S. EPA (2010) Method B was the protocol used to analyze *Bacteroides* markers in water by TaqMan® Quantitative Polymerase Chain Reaction (qPCR) assay. The specific *Bacteroides* markers used and the U.S. EPA (2010) Method B protocol have been cited in all relevant Public Review Draft Staff Report Tables and Figure descriptions.

NJA Comment 14: Tables 3.1 through 3.4. Further samples should be included before making the exceedance decision or else leave it undetermined. For example, with less than 3 samples taken for a number of sites, the real measurement range of the marker is left unclear. A minimum number of

samples of 5 - 10 are probably more appropriate to make an exceedance decision.

Response: Staff agrees that an adequate sampling size should be collected for a decision on use impairment. The State Water Board Policy for developing the Section 303(d) list identifies a minimum sample size of 5 for assessing bacteria concentrations for impairment. The exceedance rates based on sample sizes less than 5 have been removed from Tables 3.3 and 3.4 in the Public Review Draft Staff Report.

NJA Comment 15: Section 2.1.2.2, page 29, correctly discusses *Klebsiella* spp. as one of a number of fecal coliforms that may have no relationship to fecal matter. But, that is just one of many genera of fecal coliforms that are not related to fecal waste.

Response: The Public Review Draft Staff Report has been revised to describe the wider range of fecal coliform bacteria.

NJA Comment 16: Section 2.2.2, page 35 and elsewhere. The Peer Review Draft Staff Report implies that *E. coli* bacteria are from fecal matter and only from warm-blooded animals. *E. coli* bacteria can also be found in cold-blooded animals and insects, and can grow naturally in surface waters.

Response: The Public Review Draft Staff Report has been revised to describe the wider range of sources of *E. coli* bacteria.

NJA Comment 17: Table 3.7. There are several misleading items in the table:

- Recommend that the column of percent pathogen detected be removed.
- Several of the “potential” pathogens should be removed from this table: *Klebsiella pneumonia*, *Streptococcus spp.*, and *Vibrio cholera*.

Response: Table 3.7 has been modified in the Public Review Draft Staff Report according to the recommendations.

NJA Comment 18: Section 3.4.2. Given the presence of human and cattle fecal matter, it is a reasonable assumption to make that at least some of the recovered *Cryptosporidium* oocysts were of human-infectious genotypes. Normally *Giardia* cysts are orders of magnitude higher than oocysts of *Cryptosporidium* in fresh feces and sewage – so why are the *Giardia* results not reported? Please provide by site the number of samples and the recoveries for each so the data can be adequately interpreted. In addition, the drinking water safety statement cannot be justified unless more data is collected.

Response: The collection of water samples for the analysis of *Cryptosporidium* and *Giardia* oocysts was not part of any of the studies conducted for this TMDL. The discussion of oocysts was based on data collected and analyzed by the Sonoma County Water Agency, under a separate program they implement as directed by the requirements of the Safe Drinking Water Act. The information was presented in the TMDL staff report as another line of evidence for impairment of recreation in the Russian River. Detail on the samples collected was added to Table 3.8 of the Public Review Draft Staff Report.

NJA Comment 19: Figure 4.8. Minor typo on Y-axis title for correct spelling of ‘*Bacteroides*’

Response: The typo on Figure 4.8 has been corrected in the Public Review Draft Staff Report.

NJA Comment 20: Section 4.3.1.1. The fundamental science in assaying infectious enteric viruses has improved greatly since the time the total coliform were derived and described in Title 22 (e.g., 2.2 MPN/100 mL etc.), and reflects a need to move onto more relevant pathogen performance measures for wastewaters in the State of California.

Response: The California Recycled Water Criteria (Title 22) describes the bacteriological and treatment standards for the recycle and reuse of treated wastewater. Waste discharge requirements for direct discharges of municipal wastewaters to surface waters in the Russian River Watershed are required by the Basin Plan to use advanced treatment technologies and comply with discharge rate limitations in order to protect beneficial uses of the Russian River, which includes municipal water supply and contact recreation. NPDES permit writers in the North Coast Region have interpreted advanced treatment to be equivalent to disinfected tertiary recycled water as defined in California Code of Regulations, title 22, section 60301.230, and have incorporated the title 22 standard into NPDES permits as effluent limitations and disinfection specifications to demonstrate adequate disinfection. The disinfection limitations and specifications that are incorporated into NPDES permits, and other waste discharge permits that regulate the production of recycled water, are reviewed and approved by the State Water Resources Control Board Division of Drinking Water (formerly the California Department of Public Health and California Department of Health Services), in accordance with a Memorandum of Agreement Between the Department of Health Services and the State Water Resources Control Board on the Use of Reclaimed Water. While Regional Board Staff agree that performance monitoring of treated municipal wastewater effluent may be more relevant to indicate removal of the most significant etiological agents of GI illnesses (human enteric viruses), the State Water Board’s Division of Drinking Water and Environmental Management considers that compliance with the title 22 standards for disinfected tertiary recycled water, including filtration and disinfection, will ensure an essentially pathogen free effluent (CDHS 2007).

NJA Comment 21: Section 4.3.1.2. The discussion of holding pond waters reaching the river system is unclear. No data is presented on rain-induced overflows of these ponds. What is the occurrence of holding recycled water holding ponds overflowing and reaching surface waters?

Response: As described in section 4.3.1.2 of the Public Review Draft Staff Report, recycled water holding ponds are used in the Russian River Watershed to both store tertiary-treated recycled water for water reclamation and as a means to comply with the Basin Plan’s prohibition of discharges of waste to the Russian River and its tributaries during the period of May 15 through September 30. All permitted operators of recycled water holding ponds in the Russian River Watershed manage pond volume through agricultural and urban recycled water use during the summer months and other times of the year when there is a low threat that runoff of recycled water will occur. The operators of recycled water holding ponds are permitted to discharge to surface waters during the period of October 1 through May 14. Because this authorized surface water discharge period coincides with the time when most rainfall occurs in the Russian River Watershed, the potential for rainfall-induced overflows from recycled water holding ponds is not significant. The Public Review Draft Staff Report has been revised to clarify this

point.

NJA Comment 22: Chapter 4, page 69 & Figure 4.11. The Peer Review Draft Staff Report states that it is not clear whether the sources of *E. coli* bacteria measured in recycled water holding ponds are of human origin or from birds and other wildlife that frequent the storage ponds. It would have been useful to also measure bird vs. human MST data to indicate the level of waterfowl fecal contribution.

Response: The *E. coli* bacteria data was collected as a monitoring requirement established in the 2002 and 2007 NPDES permits for the Town of Windsor. The requirement to monitor the treated effluent to the Town's recycled water system has since been discontinued. Staff agrees that information on the human and bird genetic markers would have been helpful in interpreting the source of the *E. coli* bacteria. However, Staff expects that monitoring studies will be designed to assess the relative contributions from birds and humans as part of the BLRPs that will be required by this TMDL.

NJA Comment 23: Clearly, rain-induced sewage contamination into storm water drains or directly into the river system is the main concern, not recycled water holding ponds. Bird or wildlife coliform sources to recycled ponds probably come with minimal risk as compared to human sewage/seepage into the river system. Has treatment of storm water discharges or containment in treatment ponds and reuse been considered as a way of controlling what appears to be the major health risk wastewater within the watershed, other than the lack of compliance to 'treated' wastewater discharges (e.g. Table 4.4)?

Response: Regional Board Staff agrees that non-human sources of fecal indicator bacteria in recycled water holding ponds are a minimal human health risk, especially as compared to other sources identified in this TMDL. There are numerous structural and non-structural management practices that owners and operators for Multiple Separate Storm Sewers Systems (MS4s) may consider for controlling pathogens in storm water. The TMDL requires that MS4 permittees attain waste load allocations in this TMDL by meeting effluent limitations for *E. coli* and enterococci bacteria. But, it does not prescribe the method or manner by which the effluent limitations will be achieved, as is appropriate according to California law.

NJA Comment 24: Section 4.3.1.4. Recommend that the Peer Review Draft Staff Report documents the amount of exfiltration from sewers in the watershed, as that is probably one of the largest single sources to manage.

Response: There are approximately 1,151 miles of sanitary sewer line throughout the Russian River Watershed. As described in section 4.3.1.5 of the Public Review Draft Staff Report, exfiltration from sanitary sewer systems is being managed in accordance with statewide general waste discharge requirements. This TMDL requires owners of publicly-owned sanitary sewer systems to amend their Sewer System Management Plans to describe actions that they will take to further minimize SSOs, spills, and exfiltration from their sanitary sewer systems.

NJA Comment 25: Section 4.3.1.5. It is incorrect to assume that environmental *E. coli* are not excreted by fish. The paper cited clearly shows that sediment-borne *E. coli* were present in fish intestines, and others have shown the maintenance of *E. coli* through growth in sediments. In addition, 'transport vehicle' is a more correct term than 'vector' based on the context of the discussion.

Response: The Public Review Draft Staff Report has been clarified to more accurately describe the sources *E. coli* bacteria found in from fish feces and corrected the use of the term ‘vector.’

NJA Comments 26: Sections 4.4.2 and 4.4.3. The relative contribution from human recreators versus homeless groups along the river is unclear. Given the high estimates of people unsheltered, their contribution to bacteria loads should be assessed or estimated. Human virus to pathogen indicator ratios would be expected to be higher from sites impacted by homeless people than those impacted by municipal sewage or sewage-impacted stormwater, given the higher likelihood of infections amongst the homeless than those expected amongst the general population.

Response: Regional Board Staff agrees that information on the relative contributions between human recreators versus homeless groups would be helpful. However, it would be difficult to discern differences because both sources frequent the same general areas. The implementation chapter describes that both recreators and homeless sources are priorities for cleanup and will be addressed in the BLRPs that will be required by this TMDL.

NJA Comment 27: Table 4.5. Why are the 1,151 miles of gravity sanitary sewer not mapped?

Response: Accurate spatial information is not available in many areas to produce an unbiased figure. Where this information is lacking, one of the first elements of a BLRP would be to compile adequate spatial information of sewer distribution systems for effective tracking and management.

NJA Comment 28: Tables 4.5 and 4.6. The inferred SSO discharges of at least 30 gals/mile of gravity sewer per year may be a large underestimation of the actual overflows.

Response: The frequency and volume of SSOs are dependent on so many factors, for example, age, composition, and construction of the sewer lines, management of the oversight agency, proximity of the sewer line to surface waters. As such, it would be incorrect to estimate a region-wide overflow rate using the information in Tables 4.5 and 4.6. However, Staff believes that the SSO volumes in Table 4.6, which were reported to the SSO database, accurately reflect the volume of sanitary sewer overflows experienced by sanitary sewer systems in the Russian River Watershed over the stated time period.

NJA Comment 29: Section 4.3.3.1. The last sentence in the Section is inappropriate and misleading.

Response: Since the sentence does not add to the discussion, it has been removed from the Public Review Draft Staff Report.

NJA Comment 30: Section 4.3.2.2. The comment about >10% slope is relevant. But, proximity to riparian zones and high intensity rain periods also are important factors with respect to higher risk scenarios and should be discussed. Soil-filtered groundwaters, impacted by surface sewage, may remove most bacteriological indicators but still contain infectious human enteric viruses. Please present available data on rain-induced biosolids and map where this may occur.

Response: Biosolids application where ground slope exceeded 10 percent was used as an example

when the Regional Water Board Executive Office may require an Erosion Control Plan. The reviewer correctly points out that there are other, equally important, site conditions for which the Executive Officer would require preparation and submission of an Erosion Control Plan for a biosolids land application project. The last paragraph of section 4.3.2.2 of the Public Review Draft Staff Report has been revised.

The reviewer also correctly points out that infectious human enteric viruses that have not been inactivated during the pathogen reduction processes required for land application of municipal biosolids could, under certain conditions, travel through soil to reach groundwaters. Currently, the spatial data are not available for where biosolids are applied. Staff expects that this information will be included in the Erosion Control Plan developed by the public entity applying biosolids as a soil amendment.

NJA Comment 31: Section 4.3.2.3. There is no apparent discussion on maintenance or survey of the private system discharges for actual performance. In the Sydney Australia drinking water catchment, it was lack of maintenance rather than set-back distances from waterways that dictated pathogen risks from onsite systems.

Response: Staff concurs with the reviewer's point that maintenance is a primary factor dictating pathogen risks from onsite systems. The implementation plan has been revised to include operation and maintenance requirements for OWTS located in the geographic area of the Advanced Protection Management Program.

NJA Comment 32: Section 4.4.6. The Peer Review Draft Staff Report should include a discussion of several relevant pathogens from livestock, specifically human-infectious *Giardia* from adult cattle, hepatitis E serogroup C from hogs, and *Campylobacter jejuni* from chickens.

Response: The Public Review Draft Staff Report includes the recommended relevant pathogens from livestock in the list of pathogens described.

NJA Comment 33: Section 4.4.7. The Peer Review Draft Staff Report should also discuss performance testing or life-time expectation for such performance of pond liners, and barrier protection for rain event-driven overflows. The key problem with all ponds is the high rain event-driven overflow that is all but inevitable within the lifetime of most ponds – and indicated to be within the 20-y peak stream flow rate in the report.

Response: Staff concurs with the reviewer's point that the life-time performance of pond liners is an important factor. The seepage rate for new manure ponds (1×10^{-6} cm/sec unit) as described in the Peer Review Draft Staff Report shows compliance with United States Department of Agriculture – Natural Resources Conservation Service (NRCS) Waste Storage Facility Code 313. This is a widely accepted standard used throughout the United States. The NRCS funds millions of dollars in upgrades to farms in the United States each year, but projects must meet strict NRCS codes. In addition, cow dairies are required to submit surface water and groundwater quality results to the North Coast Region Water Board. Conditions vary widely throughout the North Coast Region. Regional Water Board Staff may require additional water quality protections based on the results of these monitoring reports and permit compliance inspections.

Overflow of manure ponds is of the highest concern to the North Coast Region Water Board. Existing cow dairies in the North Coast region must meet minimum standards including adequate sizing of manure ponds and no overflow of manure ponds for the protection of surface water and groundwater. Upon enrollment of dairy facility in the Dairy Program, the dairy operator must certify that manure will not flow to surface water or degrade groundwater quality.

California Code of Regulations Title 27, Environmental Protection – Division 2, Solid Waste, Chapter 7, Subchapter 2, Article 1, Section 22560 prescribes minimum standards for discharges of animal waste at confined animal facilities, and the regional water board shall impose additional requirements, if such additional requirements are necessary to prevent degradation of water quality or impairment of beneficial uses of waters of the state. Title 27 section 22562 states that: “Confined animal facilities must be designed and constructed to retain all facility wastewater generated, together with all precipitation on, and drainage through, manured areas during a 25 year, 24-hour storm.”

The requirement to comply with Title 27 standards is discussed throughout the dairy general permit and conditional waiver. Certification by the dairy operator that the discharge is in compliance with Title 27 standards is provided the permittee’s Annual Report. Dairy operators monitor the level of their manure ponds and have contingency plans to protect water quality in the event of a failure in waste containment. Regional Water Board Staff conduct compliance inspections and review surface water and groundwater monitoring results to confirm water quality protection. Permit noncompliance may result in enforcement action taken by Regional Water Board Staff.

NJA Comment 34: Section 4.4.7. The Peer Review Draft Staff Report should identify the areas where manure is land applied and compare to significant bovine fecal pollution increases during rain events.

Response: Regional Board Staff agree that such information would help identify linkages between land application of manure and possible discharges to surface waters during storm event. The spatial resolution of the monitoring conducted during the development of this TMDL was not designed for identifying potential impairment from specific parcels of land, for example land treated with applied manure. However, we observed that locations with higher concentrations of bovine-host *Bacteroides* were in areas with dairies. Based on this general observation, Regional Board Staff have concluded that waste from dairies may be contributing to the observations of bovine-host *Bacteroides* in ambient surface waters.

NJA Comment 35: Section 7.2, p110. There is a misunderstanding over the use of *Bacteroides* and the epidemiologic study conditions used to derive the new EPA criteria. The study sites with human sewage impact included wastewater discharges from UV or chlorinated secondary effluent. In these locations, qPCR *Enterococcus* spp. and total *Bacteroides* were the best indexes for GI health outcome. This is presumably due to enteric viruses and other pathogens being somewhat resistant to the standard disinfection processes used by such facilities. Why do you drop information from disinfected wastewaters when applying the *Bacteroides* WLAs?

Response: The loading capacity, load and wasteload allocations for *Bacteroides* bacteria have been removed from the Public Review Draft Staff Report. However, *Bacteroides* bacteria are still recommended in ‘Chapter 9 – Monitoring’ of the Peer Review Draft Staff Report (along with the other source tracking methods described) to assess possible sources causing exceedance of the numeric TMDL targets. The use of total coliform bacteria as the routine challenge organism for recycled water

disinfection systems is accepted as protective of public health by the State Water Resources Control Board Division of Drinking Water. Regional Water Board Staff are not aware of any significant difference in resistance to standard disinfection processes between coliform bacteria and *Bacteroides* bacteria. Consequently, Staff concludes that information gained by measuring total coliform bacteria from point source effluent monitoring (immediately after disinfection) does not require augmentation with the collection of *Bacteroides* data, as well. It is staff's view that the presence of *Bacteroides* bacterial genetic material, as measured by qPCR immediately following disinfection of a wastewater effluent, would only confirm that disinfection was successful.