



County of Sacramento

January 4, 2016

Amy Ha, PE
Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114

**Subject: Comments to Tentative Waste Discharge Requirements
 Kiefer Landfill, Sacramento County**

Ms. Ha,

The Sacramento County Department of Waste Management and Recycling (DWMR) is submitting this comment letter in response to the Kiefer Landfill Tentative Waste Discharge Requirements (WDRs) issued by the Regional Water Quality Control Board (RWQCB) on December 4, 2015.

Comments

Item 1 – WDR Finding 4.a (Page 2): “Implementation of an engineered alternative, evapotranspirative, final cover over the lined areas of the landfill following submittal the evapotranspirative final cover demonstration results and written Executive Officer approval.”

PROPOSED REVISION: Delete text.

REASON: Implementation of an engineered alternative, evapotranspirative (ET), final cover over lined areas of the landfill is not covered in the Report of Waste Discharge / Joint Technical Document. Consistent with Finding 88, DWMR is collecting monitoring data from the existing M-1 final ET cover, and will evaluate whether an ET cover could be used over composite lined areas in the future.

Item 2 – WDR Finding 30 (Page 9): “... The proposed expansion area of the landfill’s Sedimentation Basin...”

PROPOSED REVISION: Revise language to read, “... The creation of the proposed Sedimentation Basin...”

REASON: Revision more accurately reflects the context of the sentence.

Item 3 – WDR Finding 41 (Page 11): Well MW-6A1 listed as Corrective Action.

PROPOSED REVISION: Change MW-6A1 to Detection.

REASON: DWMR believes that sulfate impact at this well is not significant enough to move this well to Corrective Action without further data (ref. Section 3.3.2 of semiannual reports).

Item 4 -- WDR Finding 41 (Page 12): Well MW-37C.

PROPOSED REVISION: For MW-37C, under the *Zone* column, add C.

REASON: Typographical correction.

Item 5 – WDR Finding 50, mid-paragraph (Page 14): “The extraction wells are shown in Attachment D1 and D2.”

PROPOSED REVISION: Revise language to read, “The extraction wells are shown in Attachments D1 and D2.”

REASON: Typographical correction.

Item 6 – WDR Finding 77 (Page 21): “... Currently, two phases of the final evapotranspirative cover system have been installed on the southern slopes. Monitoring devices are installed within the Phase 2 cover area to assess the performance of the evapotranspirative cover. This Order requires the last portion of evapotranspirative cover to be installed on southern slopes of Module M-1 by 2018...”

PROPOSED REVISION: Revise language to read, “Currently, two phases of the final cover system have been installed on the southern slopes. Monitoring devices are installed within the Phase 2 cover area to assess the performance of the evapotranspirative cover. This Order requires the last portion of *the south slope final cover* to be installed on southern slopes of Module M-1 by 2018...”

REASON: The Phase 1 final cover was 34 acres of a prescriptive clay cover, not an evapotranspirative cover. Revision more accurately reflects the closure status at the site.

Item 7 -- WDR Order B.13 (Page 31): “(3) Surface water; (4) Freeboard”

PROPOSED REVISION: Revise language to read, “(3) Surface water monitoring; (4) Freeboard monitoring”.

REASON: Revision more accurately reflects the requirement.

Item 8 – WDR Order B.14 (Page 31): “Only extracted groundwater with non-detect VOC concentrations may be discharged into an infiltration basin.”

PROPOSED REVISION: Revise language to read, “Only extracted groundwater that has been treated and tested to remove VOCs prior to contact with unlined surface soil in any infiltration basin may be discharged into such infiltration basins.”

REASON: DWMR is evaluating several different treatment options for use in conjunction with the infiltration basin that will remove the VOCs from the groundwater prior to the extracted groundwater infiltrating into the subsurface. DWMR understands that extracted groundwater may not cause degradation to the aquifer and is evaluating options that meet that standard. The

Discharger will submit a work plan to the RWQCB for approval prior to initiating any change to the current discharge.

Please see the attached letter from Brown and Caldwell for further discussion of this subject.

Item 9 – WDR Order D.7 (Page 33): “The Discharger shall comply with all Storm Water Provisions listed in Section L of the SPRR dated January 2012 which are attached hereto and made part of this Order by reference.”

PROPOSED REVISION: Revise language to read, “...SPRR dated *December 2015*...”

REASON: Typographical correction.

Item 10 – WDR Order E.3 (Page 34): “As detailed in Finding 77...”

PROPOSED REVISION: Revise language to read, “As detailed in Finding 76...”

REASON: Typographical correction.

Item 11 – WDR Order G.7 (Page 37): “The Discharger shall monitor corrective action monitoring wells on a quarterly basis...”

PROPOSED REVISION: Change *quarterly* to *semiannually*.

REASON: Over the course of the past 25 years, DWMR has conducted both semiannual and quarterly monitoring at the site and has evaluated seasonal variations. The current MRP No. R5-2007-0107 only requires semiannual monitoring. The purpose of Corrective Action Plan (CAP) monitoring is to assess the effectiveness of the CAP. Sufficient data has been collected to show trends developed by the CAP and a lack of seasonal variations. Going forward, additional frequency of data acquisition (quarterly monitoring) would not modify operations of the CAP or serve any other beneficial use in corrective action.

After 20 years of the CAP program, the data shows declining concentrations and approximately 81 percent of VOC mass removed from the groundwater during this period.

Please see the attached letter from Brown and Caldwell for further discussion of this subject.

Item 12 – WDR Order H.9.a (Page 38): “Methodology used to verify intermediate cover thickness (i.e. potholing). At a minimum, intermediate cover thickness shall be verified in a grid pattern on 100-foot centers over the eastern slopes of Module M-1.”

PROPOSED REVISION: Revise language to read, “Methodology used to verify intermediate cover thickness (*e.g.* potholing). At a minimum, intermediate cover thickness shall be verified using a grid pattern on *300-foot* centers over the eastern slopes of Module M-1. *At locations, if any, where the cover is determined to be less than 12 inches, cover thickness will be re-verified using a grid pattern on 100-foot centers.*”

REASON: DWMR believes the cover thickness to be in excess of 12 inches over the eastern slopes of Module M-1, and that potholing on 300-foot centers will provide adequate assurance that the cover meets the minimum cover requirements of 12 inches. If a pothole reveals there is

less than 12 inches of cover at a specific location, DWMR will pothole using a 100-foot grid on an increased frequency in the vicinity of that pothole.

Item 13 – MRP (Monitoring and Reporting Program) Section A.2.b (Page 7-8): “In the event of a shutdown of the landfill gas extraction system, the Discharger shall notify Board staff via e-mail, fax, or telephone within 24 hours of knowledge and shall provide weekly status updates. This requirement excludes shutdown events where the landfill gas system restarts itself or whether the system is restarted manually within 24 hours. All shutdowns, regardless of the type of restart, shall be summarized in the semiannual reports.”

PROPOSED REVISION: Revise language to read, “In the event of a shutdown of the landfill gas extraction system *exceeding 24 hours*, the Discharger shall notify Board staff via e-mail, fax, or telephone within 24 hours of knowledge and shall provide weekly status updates. This requirement excludes shutdown events where the landfill gas system restarts itself or whether the system is restarted manually within 24 hours. All shutdowns *in excess of 24 hours* shall be summarized in the semiannual reports.”

REASON: DWMR suggests that LFG system downtimes in excess of 24 hours be reported. Reporting of all system shutdowns regardless duration would provide little beneficial information. Complete system shutdowns are rare for the Kiefer LFG collection system. For example, during the period of July 1, 2014 through June 30, 2015 there were no system shutdowns in excess of one hour. The system has redundant destruction capacity with the flare station being capable of destroying the entire collection system production. Only if the electricity transmission lines serving both the energy plant and the flare station fail would the collection system be shut down for more than one hour.

As an alternative requirement, reporting of collection system flowrates in a manner similar to the reporting requirements for the Elk Grove Landfill would provide a better indication of the collection system performance.

Item 14 - MRP Section A.2.b (Page 8): “Landfill gas monitoring reports shall be included with the semiannual reports and shall include an evaluation of potential impacts of landfill gas on the unsaturated zone beneath and adjacent to the landfill and compliance with the Water Quality Protection Standard”

PROPOSED REVISION: Revise language to read, “Landfill gas monitoring reports shall be included with the semiannual reports and shall include an *annual* evaluation of potential impacts of landfill gas on the unsaturated zone beneath and adjacent to the landfill and compliance with the Water Quality Protection Standard”

REASON: Per the schedule presented in Table III, soil gas screening will be conducted semiannually, and subsequent sampling (at targeted locations) for laboratory analysis of VOCs will be conducted annually. As VOCs will be sampled annually, assessing the groundwater related impacts of landfill gas and compliance with the Water Quality Protection Standard is more appropriate on an annual basis with the receipt of the VOC data.

Item 15 – MRP Section A.6 (Page 11): Table listing groundwater wells in the Corrective Action Monitoring Program and their respective sampling frequency.

PROPOSED REVISION: Change the Sampling Frequency for the Corrective Action Monitoring Program from quarterly to semiannually.

REASON: See discussion in Item 11 above.

Please see the attached letter from Brown and Caldwell for further discussion of this subject.

Item 16 – MRP Section A.6 (Page 11): Table lists monitoring well MW-6A1 as a corrective action well.

PROPOSED REVISION: Delete MW-6A1 from the list of corrective action wells.

REASON: As stated above in Item 3, DWMR believes that sulfate impact at this well is not significant enough to move this well to Corrective Action without further data.

Item 17 – MRP Section B.1.d (Page 15): “Cumulative tabulated monitoring data for all monitoring points and constituents for groundwater, unsaturated zone, leachate, and surface water.”

PROPOSED REVISION: Delete the word, “*Cumulative.*”

REASON: Cumulative tabulated monitoring data consists of a large body of data inconsistent with the data analysis performed in the Semiannual Report. The Semiannual Report has always shown relevant historical data; however, DWMR recommends that the cumulative tabulated monitoring data be presented with the Annual Monitoring Report (as required in the previous WDRs and in MRP R5-2016-XXXX Section B.2), where historical trends and analysis are discussed.

Item 18 – MRP Section C.4.b (Page 20): “B-zone concentration limits shall be calculated using background wells MW-10B, MW-38B, and MW-39B, and future background wells MW-34A and MW-35A.”

PROPOSED REVISION: Replace “*MW-34A and MW-35A*” with “*MW-34B and MW-35B.*”

REASON: Typographical correction.

Items 19 – MRP Section C.4.c (Page 20): “C-zone concentration limits shall be calculated using background well MW-10C.”

PROPOSED REVISION: Propose calculating CLs for Zone C using either all data from Zone C wells or using the intrawell comparisons from each Zone C well (MW 2C, MW-10C, MW-12C, MW-20C, MW-37C and Well E).

REASON: The last 17 years of monitoring data shows no reported VOC detections in the C-zone wells over that period. DWMR believes determining concentration limits using either of the proposed methods would more accurately represent the water quality within the C-zone. Additionally MW-10C is proximate to current operations and will be decommissioned prior to excavation within Module M-7.

Please see the attached letter from Brown and Caldwell for further discussion of this subject.

Item 20 – MRP Table I (Page 24): Units Column, Temperature, degrees Fahrenheit.

PROPOSED REVISION: Change temperature reporting to degrees Celsius.

REASON: Kiefer Landfill historical groundwater data is in Celsius. DWMR requests maintaining reporting in Celsius for program and database continuity.

Item 21 – MRP Tables I, II, IV and V, Monitoring Parameters (Pages 24, 25, 27 and 28): Carbonate.

PROPOSED REVISION: DWMR proposes that Carbonate be removed from the constituent list.

REASON: DWMR does not believe that this testing is necessary because the standard carbonate alkalinity test method (2320 B., attached) defines carbonate as zero whenever $\text{pH} < 8.3$ (at Kiefer Landfill, pH does not exceed 8.3 at any monitoring well).

Item 22 – MRP Tables I, II, IV and V, Monitoring Parameters (Pages 24, 25, 27 and 28): Calcium, Magnesium, Potassium, and Sodium.

PROPOSED REVISION: DWMR proposes that Calcium, Magnesium, Potassium, and Sodium be moved to the 5-year Constituents Of Concern (COC) list.

REASON: For the past 10 years, DWMR has monitored for anions (bicarbonate, chloride, nitrate and sulfate) and electrical conductance (EC). These constituents either have associated drinking water standards (chloride, nitrate and sulfate) or are VOC indicators (bicarbonate and EC). In the tentative MRP, the RWQCB has proposed to include calcium, magnesium, potassium, and sodium for routine sampling and statistical analysis. The collection of these additional analytes (which do not have associated drinking water standards, and with the exception of sodium, do not have any water quality goals) may provide cation/anion balance for quality control purposes, or possibly serve as a check to see if a metallic cation is being missed. Such a check would be more appropriately conducted as part of a COC screening event, where additional metals are monitored. DWMR proposes including cation / anion balance information on a 5-year COC list to provide quality control evaluation at the two wells with the highest levels of total VOCs annually (per Note 5 of Table I) and all background and constructed module POC wells every 5 years (per Note 4 of Table I).

Please see the attached letter from Brown and Caldwell for further discussion of this subject.

Item 23 – MRP Table III, footnote 1 (Page 26): “The Discharger may prescreen the gas sample to determine if the sample is required to be laboratory analyzed using Method TO-15 by using an approved gas analyzer to establish methane concentrations at the sampling point. If while using an approved sampling and analysis plan procedure the Discharger detects methane concentrations exceeding 1.0 percent by volume, then a gas sample shall be obtained and laboratory analyzed for specific VOCs using EPA Method TO-15. Both the screening results and the laboratory analysis results shall be reported. Otherwise, the Discharger shall report the methane and total VOC screening results and no further laboratory analysis is required.”

PROPOSED REVISION: Revise last sentence in paragraph to read, “Otherwise, the Discharger shall report the screening results and no further laboratory analysis is required.”

REASON: The gas analyzer (Landtec GEM) currently used by DWMR for taking routine landfill gas field measurements does not analyze for VOCs. The proposed revision provides flexibility, that the screening results reported shall be those measured by the approved gas analyzer used to do the screening.

Item 24 – MRP Table VI, Monitoring Parameters For Detection Monitoring (Pages 29, 30):

PROPOSED REVISION: DWMR proposes that, for monitoring locations with no individual VOC concentrations above 1 ppb, the compounds ethanol, methyl iodide (aka iodomethane) and vinyl acetate be removed from the constituent list, and that a search for unknown chromatographic peaks (SPRR Section I.17) be waived.

REASON: DWMR can achieve much lower detection and reporting limits for the other VOCs listed in Table VI by removing these three compounds (which are nondetect or believed to be nondetect at all monitoring wells) from this list and waiving the unknown chromatographic peak search requirement.

As an example of the type of improvement in detection and reporting limits that may be expected, please refer to EPA Method 8260B Revision 2 (December 1996), Tables 1 and 2, for wide-bore and narrow-bore capillary columns, respectively. Wide-bore capillary columns can handle a greater variety and concentration range of compounds (including ethanol, methyl iodide and vinyl acetate), but utilize much higher Method Detection Limits (MDLs), as can be seen in the referenced tables. The wide-bore column (Table 1 of EPA 8260B) cannot measure compliance with the current Public Health Goals of 0.06 ug/l and 0.05 ug/l for tetrachloroethene (PCE) and vinyl chloride, respectively, as the MDLs listed for these compounds in Table 1 are substantially in excess of these PHGs. PCE and vinyl chloride are currently being detected in Kiefer Landfill corrective action monitoring wells.

Methyl iodide and vinyl acetate were tested for in 2015 at corrective action wells MW-2A1, 4A, 4B, 5A, 7AR, 7B, 16A, 18A, 19A, 20A, 21A, 21B, 22A, 23A and 29A, and no detections of these two compounds were recorded. This list of fifteen corrective action monitoring wells includes the ten monitoring wells with the highest measured concentrations of VOCs at the site, and all monitoring wells (6) currently exceeding drinking water standards (MCLs). Methyl iodide and vinyl acetate have no drinking water standards or health-based water quality objectives, although vinyl acetate has a published odor threshold of 88 ug/l.

At all detection wells and lesser-impacted corrective action wells, DWMR currently utilizes a low-level EPA method, which excludes methyl iodide and vinyl acetate, in compliance with our current MRP No. R5-2007-0107, which does not contain a list of required VOCs for semiannual monitoring. The low-level method currently in use has MDLs for PCE and vinyl chloride below current PHGs.

Ethanol is not regularly analyzed at any well, but has not been detected as a tentatively identified compound at monitoring wells. Subject to MRP No. R5-2016-XXXX, ethanol will be monitored at the most impacted sites on an annual basis going forward, since ethanol is on the list of COCs (see MRP Table VIII), as are methyl iodide and vinyl acetate. Ethanol has no health-based water quality objectives, although it has a published odor threshold of 760,000 ug/l.

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Please contact me at 876-9429 if you have questions or require additional information.

Sincerely,



Keith Goodrich, P.E.
Principal Civil Engineer

Attachments: Brown and Caldwell Letter
2320 B. Alkalinity

Copy: Brion McGinness, LEA

Brown and Caldwell Letter

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January 4, 2016



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11020 Sun Center Drive, Suite 200
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Subject: Comments to Tentative Waste Discharge Requirements
Kiefer Landfill, Sacramento County

Ms. Ha,

This letter presents Brown and Caldwell's (BC) response to specific items presented in the Kiefer Landfill Tentative Waste Discharge Requirements (WDRs) and Tentative Monitoring and Reporting Plan (MRP) issued by the Regional Water Quality Control Board (Water Board) on December 4, 2015. The Tentative WDRs and MRP are listed in the following link:

http://www.waterboards.ca.gov/centralvalley/board_decisions/tentative_orders/#cosac

This letter presents general and specific comments to items presented in the WDRs and MRP based on our review, and are intended to supplement the comments provided by the Sacramento County Department of Waste Management and Recycling (DWMR), in their letter dated January 4, 2016.

General Comments

Several comments provided by DWMR in reference to the Tentative WDRs and MRP were related to monitoring frequency, monitoring parameters, development of concentration limits, and potential CAP pilot studies. BC provides general comments followed by our rationale and proposed revision to the WDRs and MRP.

General Comment 1. BC recommends Semi-Annual Monitoring for Corrective Action Program (CAP) in groundwater versus Quarterly monitoring as identified in section G.7 (WDR, p. 37) and section A.6 (MRP, p. 11).

Background and Rationale: The primary objective of monitoring for the CAP system is to assess the effectiveness of the corrective action technology in returning water quality conditions to approved water quality objectives (WQOs). DWMR has monitored the effectiveness of the existing CAP over the past 20 years, monitoring on a semi-annual basis from 1995 to 2015. BC presented a comprehensive evaluation of the CAP to the Water Board in a 2004 letter and recommended conducting a comprehensive groundwater optimization program to improve the efficiency of the CAP.

In 2006 BC submitted a Work Plan to conduct the groundwater optimization program to the Water Board, based on the 2004 letter. This Optimization Program consisted of two components: (1) Optimization of the existing groundwater extraction system, and

(2) optimization of the associated groundwater monitoring network. The Optimization Program was conducted in 2012, and included a sequential extraction well system shutdown and restart, four quarterly monitoring events at 9 key corrective action monitoring wells and all 14 extraction wells, as well as monthly monitoring at corrective action monitoring well MW-28A. The results of the Optimization Program were presented to the Water Board in January 2014, and did not recommend any changes to monitoring frequencies. An aerial photo depicting the locations monitored for the Program, which includes the majority of the contaminant plume, is attached as Figure 1.

Additionally on March 29, 2013, BC submitted a Work Plan to conduct a Landfill Gas Mitigation Program to the Water Board. BC and DWMR completed the actions specified in the Work Plan, and BC submitted a Landfill Gas Mitigation (LGM) System Summary Report to the Water Board on April 29, 2015.

This LGM System Summary Report addressed vadose zone and groundwater impacts and concluded that improvements to the current groundwater extraction well field and LGM program will improve the groundwater extraction well field performance and enhance the overall system in meeting water quality standards. This evaluation did not recommend any changes to monitoring frequencies. In their letter dated July 9, 2015, the Water Board requested a Work Plan to implement the recommendations presented in the LGM System Summary Report for the groundwater CAP system that included semi-annual monitoring. The July 9 letter also recognized the successful efforts of the 2012 Optimization Program.

Hence, BC believes that a requirement for quarterly monitoring for the CAP would not improve the effectiveness of corrective action. DWMR will continue to utilize quarterly monitoring on an infrequent basis at selected locations to collect information for tasks in support of the CAP and LGM Program.

Proposed Revision – Maintain the semi-annual monitoring and reporting frequency for both the CAP and the DMP.

General Comment 2. BC suggests modifying the Monitoring Parameters – Groundwater listed on Table I (MRP, p. 24) to shift cations (calcium, magnesium, sodium, potassium) from semi-annual monitoring to the 5 Year COC list.

Background and Rationale: The anions bicarbonate, chloride, nitrate and sulfate have always been a part of semiannual monitoring for groundwater, although bicarbonate monitoring has not been required by the Water Board. The MRP adds the cations calcium, magnesium, sodium and potassium to the current semi-annual monitoring programs although the data quality objective is unclear. With more than 20 years of data, DWMR has demonstrated that bicarbonate and EC are the most important indicators of volatile organic compounds (VOCs) in groundwater.

The anions (bicarbonate, chloride, nitrate and sulfate) and electrical conductance (EC) either have associated drinking water standards (chloride, nitrate and sulfate) or are VOC indicators (bicarbonate and EC). Cations do not have primary MCLs, and would only be used for cation/anion balance (essentially a quality control issue).

BC further confirmed the correlation between bicarbonate, EC and VOCs during the 2012 Groundwater Optimization Program. In May and November 2012, BC and

DWMMR monitored cations and anions at 23 monitoring wells as part of the Groundwater Optimization Program. The data obtained from this work reinforces the conclusion that bicarbonate is the only significant constituent of concern, with bicarbonate concentrations increasing as LFG/VOC increases. The 2012 cation/anion data also showed that charge balance was attained with less than 5% variation on average. The anion charge data, relying heavily on the very straightforward bicarbonate alkalinity test, showed much better correlation (99%) with electrical conductivity across the well field than the cation data (95%). These data can be supplied upon request.

Proposed Revision – Monitor and analyze for cations (calcium, magnesium, sodium and potassium) every five years at COC wells, and prepare cation/anion balances at that time.

General Comment 3. Groundwater Concentration Limits (CL) should be consistent with hydrogeologic conditions in Zones A, B, and C, allowing DWMMR flexibility in choosing the statistical methods allowed by Title 27, sections 20415(e)(8) or 20415(e)(8)(E).

Rationale: BC prepared the Kiefer Landfill Detection Monitoring Program (KLF-DMP) (BC, 2015), a part of the Joint Technical Document submitted by DWMMR to the Water Board. In this KLF-DMP document, BC provided hydrogeologic evidence that Zone C is not hydraulically connected to the Zone A or Zone B water bearing unit.

Finding 36 (p. 10) in the WDRs agrees that Zone A and B are hydraulically connected (located in the Mehrten Formation) whereas Zone C (lower Mehrten and Valley Springs Formation) is hydraulically separate from Zones A and B. MRP Section “C.4. – Concentration Limits (CLs)” (p. 20) states that background concentrations for Zone A, B and C shall be developed from individual Zone A (MW-10A, -38A and -39A), B (MW-10B, -38B and -39B) and C (MW-10C) wells.

Since Zone A and Zone B represent different depth intervals of the same water bearing zone, the general water quality in these zones is expected to be similar and CLs could be calculated separately or as one value.

Historic sampling and water quality analysis of Zone C wells indicates that this water bearing zone has not been impacted. Furthermore, relatively similar water levels are observed in Zones A, B and C wells. Similar water levels suggest a small potential downward gradient. This interpretation is supported by the low level of impacts reported for Zone B wells.

For the Zone C wells, there have been no confirmed VOC impacts for the past 17 years, and inorganic constituent concentrations are less than those at upgradient background wells in the B Zone. The absence of VOCs combined with limited hydrologic connection between Zone C and Zone B, suggest that inorganic constituents in the C zone wells represent naturally occurring conditions. Variations in constituent concentrations result from differences in aquifer material (fine versus coarse grained units). It is therefore believed that naturally occurring conditions, or background values, are best represented using all data collected from Zone C wells.

Proposed Revisions: 1) Calculate CLs for Monitoring Parameters for Zone A and Zone B wells separately. Also calculate Zone A/B combined. If there is no significant

difference between the CLs calculated using both methods, then the overall monitoring program will combine Zone A and Zone B into one unit as proposed in the KLF-DMP; 2) Calculate CLs for Zone C using either all data from Zone C wells or intrawell comparisons from each Zone C well (MW-2C, MW-10C, MW-12C, MW-20C, MW-37C and Well E).

General Comment 4. The language in WDR Order B.14 (Page 31) states: “Only extracted groundwater with non-detect VOC concentrations may be discharged into an infiltration basin.” DWMR requests flexibility to plan and conduct Pilot Studies. All Pilot Studies will include Water Board approved Work Plans, laboratory testing, and pre-treatment prior to discharge to unlined portions of the infiltration basins, without degrading underlying soil or groundwater.

Rationale: The average VOC concentrations in untreated influent for 2015 are representative of the last 5 to 10 years and are relatively low in concentration:

Table 1 Untreated Influent VOC Concentrations	
	Average VOC Concentrations in Untreated Influent for 2015
Tetrachloroethene	1.4 µg/L
Trichloroethene	2.0 µg/L
cis 1,2-dichloroethene	2.2 µg/L

Given the low levels of VOCs in extracted groundwater and the low risk for impacting soil or groundwater, DWMR proposes the revised language presented below. DWMR is considering several treatment options and will submit a work plan to the Water Board for approval prior to initiating any modification of the current groundwater treatment system. Prior to the initiation of any Pilot Study, DWMR will prepare a work plan outlining laboratory testing and pre-treatment for VOCs to assess effectiveness of other treatment options.

Proposed Revisions: Revise language of WDR Order B.14 (Page 31) to read, “Only extracted groundwater that has been treated and tested to remove VOCs prior to contact with unlined surface soil in any infiltration basin may be discharged into such infiltration basins.”

Specific Comments

The following specific comments are either identified as BC comments or as DWMR item comment (please refer to DWMR’s attached letter for these comments). For the DWMR item, comments, responses provided in this letter are an expansion on the discussion presented in the attached DWMR letter.

BC Specific Comment 1. WDR Finding 24 (p. 7) refers to Quaternary Alluvium as a ‘geologic unit’.

Rationale: The KLF-DMP (BC, 2015) used the naming convention established by Blair and Others (1991). As discussed in this report, quaternary units others have proposed are based on geomorphic or buried-soil information rather than on criteria by which formal formations are distinguished. More importantly, the criteria used by others cannot be easily distinguished in drill

cuttings. In the Oroville area, Blair and Others (1991) used this same broader definition but designated all post-Mehrten sediments as the Laguna Formation. This same definition has been used for the Site in that units identified as "Quaternary Alluvium" represent the same alluvial deposits as the Laguna Formation and could not be distinguished in drill cuttings.

Proposed Revision: Use Laguna Formation for all post-Mehrten Formation sediments.

BC Specific Comment 2 – MRP C.4 lists pH as a constituent that requires concentration limits to be calculated.

Rationale: Title 27 Section 20415(e)(10)(A) by reference to historical data allows for a procedure for determining a background value for each constituent that does not display appreciable variation. Based on the most recent 15 years of data, pH does not vary from pH 6.5-8.5.

Proposed Revision – Employ the historical pH range of pH 6.5-8.5.

BC Specific Comment 3 – Table I (MRP, p. 24) lists Turbidity as a field parameter and requires that Concentration Limits (CLs) must be calculated for this parameter.

Rationale: Turbidity is used to evaluate monitoring well conditions and is dependent upon the development of a well and not groundwater quality and cannot be used to assess potential impacts from the landfill units.

Proposed Revision – Remove requirement for calculation of CLs for turbidity.

DWMR Item 11 – WDR Order G.7 (Page 37): "The Discharger shall monitor corrective action monitoring wells on a quarterly basis"

Response: See discussion for General Comment 1.

Proposed Revision: Change quarterly to semiannually.

DWMR Item 15 – MRP Section A.6 (Page 11): Table listing groundwater wells in the Corrective Action Monitoring Program and their respective sampling frequency.

Response: See response to General Comment 1.

Proposed Revision: Change the Sampling Frequency for the Corrective Action Monitoring Program wells from quarterly to semiannually.

DWMR Item 19 – MRP Section C.4.c (Page 20): "C-zone concentration limits shall be calculated using background well MW-10C."

Response: See response to General Comment 3.

Proposed Revision: Calculate CLs for Zone C using either all data from Zone C wells or using the intrawell comparisons from each Zone C well (MW-2C, MW-10C, MW-12C, MW-20C, MW-37C and Well E).

DWMR Item 22 – MRP Tables I, II, IV and V, Monitoring Parameters (Pages 24, 25, 27 and 28): Calcium, Magnesium, Potassium, and Sodium.

Response: See response to General Comment 2.

Proposed Revision: DWMR proposes that Calcium, Magnesium, Potassium, and Sodium be moved to the 5-year Constituents Of Concern (COC) list.

Amy Ha
Regional Water Quality Control Board, Central Valley Region
January 4, 2016
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If you have any questions regarding these comments please call me at 530-204-5210.

Very truly yours,

Brown and Caldwell



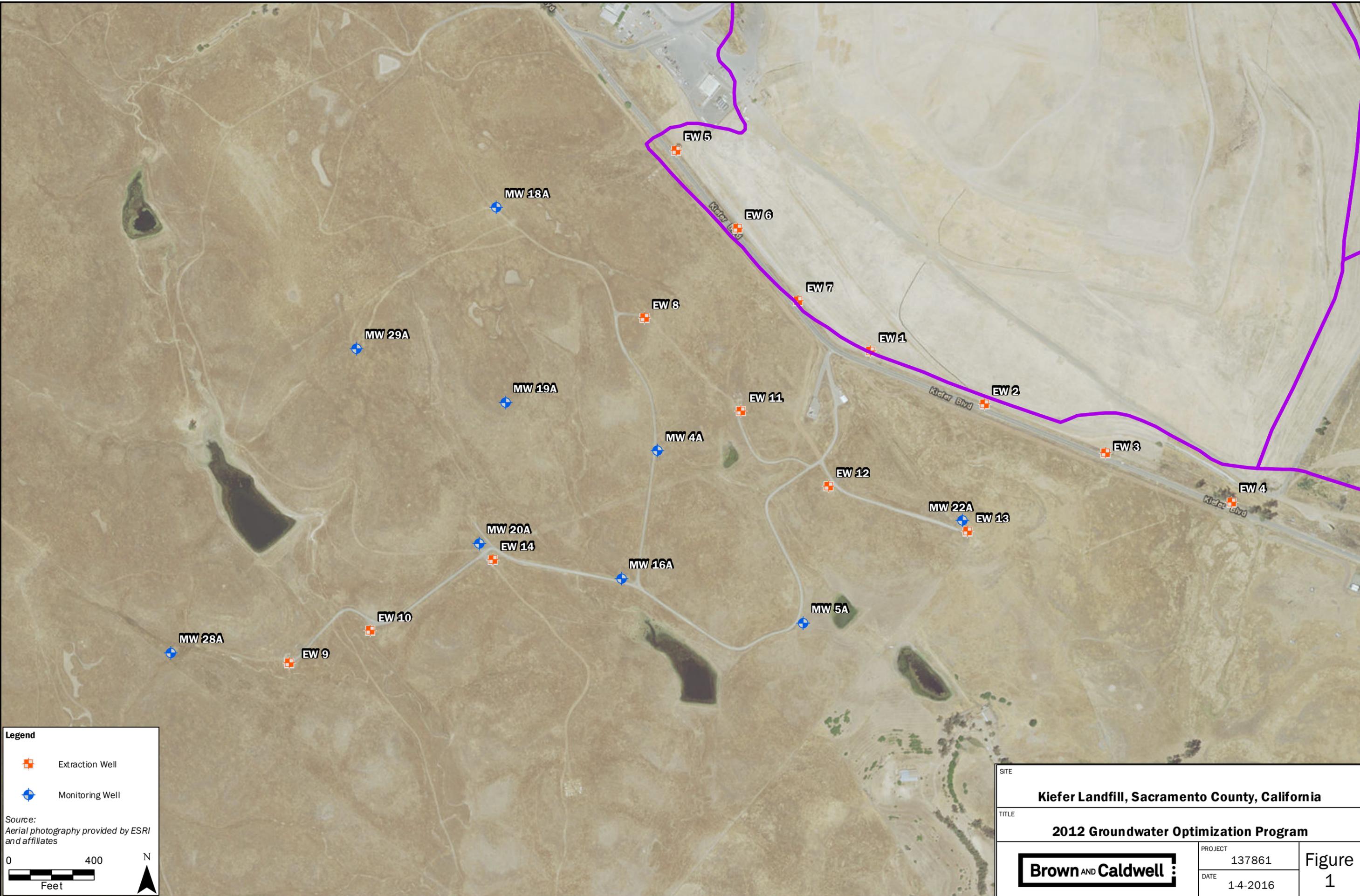
Jeff Bold, PhD
Supervising Scientist



David Zuber, PG No. 5933
Vice President
JB:ds

Attachment

P:\37000\137861 - Pilot Test - GW Optimization\GIS_MAPDOCS\WORKING\Kiefer_Fig2-2_11X17_20120808v2.mxd



Legend

-  Extraction Well
-  Monitoring Well

Source:
Aerial photography provided by ESRI and affiliates

0 400
Feet



SITE		
Kiefer Landfill, Sacramento County, California		
TITLE		
2012 Groundwater Optimization Program		
Brown AND Caldwell	PROJECT	137861
	DATE	1-4-2016
		Figure 1

2320B. Alkalinity

2320 ALKALINITY*

2320 A. Introduction

1. Discussion

Alkalinity of a water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include

contributions from borates, phosphates, silicates, or other bases if these are present. Alkalinity in excess of alkaline earth metal concentrations is significant in determining the suitability of a water for irrigation. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes. Raw domestic wastewater has an alkalinity less than, or only slightly greater than, that of the water supply. Properly operating anaerobic digesters typically have supernatant alkalinities in the range of 2000 to 4000 mg calcium carbonate (CaCO₃)/L.¹

2. Reference

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* Approved by Standard Methods Committee, 1997.

2320 B. Titration Method

1. General Discussion

a. Principle: Hydroxyl ions present in a sample as a result of dissociation or hydrolysis of solutes react with additions of standard acid. Alkalinity thus depends on the end-point pH used. For methods of determining inflection points from titration curves and the rationale for titrating to fixed pH end points, see Section 2310B.1a.

For samples of low alkalinity (less than 20 mg CaCO₃/L) use an extrapolation technique based on the near proportionality of concentration of hydrogen ions to excess of titrant beyond the equivalence point. The amount of standard acid required to reduce pH exactly 0.30 pH unit is measured carefully. Because this change in pH corresponds to an exact doubling of the

hydrogen ion concentration, a simple extrapolation can be made to the equivalence point.^{1,2}

b. End points: When alkalinity is due entirely to carbonate or bicarbonate content, the pH at the equivalence point of the titration is determined by the concentration of carbon dioxide (CO₂) at that stage. CO₂ concentration depends, in turn, on the total carbonate species originally present and any losses that may have occurred during titration. The pH values in Table 2320:I are suggested as the equivalence points for the corresponding alkalinity concentrations as milligrams CaCO₃ per liter. "Phenolphthalein alkalinity" is the term traditionally used for the quantity measured by titration to pH 8.3 irrespective of the colored indicator, if any, used in the determination. Phenolphthalein or metacresol purple may be used for alkalinity titration to pH 8.3. Bromocresol green or a mixed bromocresol green-methyl red indicator may be used for pH 4.5.

c. Interferences: Soaps, oily matter, suspended solids, or precipitates may coat the glass electrode and cause a sluggish response. Allow additional time between titrant additions to let electrode come to equilibrium or clean the electrodes occasionally. Do not filter, dilute, concentrate, or alter sample.

d. Selection of procedure: Determine sample alkalinity from volume of standard acid required to titrate a portion to a designated pH taken from ¶ 1b. Titrate at room temperature with a properly calibrated pH meter or electrically operated titrator, or use color indicators. If using color indicators, prepare and titrate an indicator blank.

Report alkalinity less than 20 mg CaCO₃/L only if it has been determined by the low-alkalinity method of ¶ 4d.

Construct a titration curve for standardization of reagents.

TABLE 2320:I END-POINT pH VALUES

Test Condition	End Point pH	
	Total Alkalinity	Phenolphthalein Alkalinity
Alkalinity, mg CaCO ₃ /L:		
30	4.9	8.3
150	4.6	8.3
500	4.3	8.3
Silicates, phosphates known or suspected	4.5	8.3
Routine or automated analyses	4.5	8.3
Industrial waste or complex system	4.5	8.3

Color indicators may be used for routine and control titrations in the absence of interfering color and turbidity and for preliminary titrations to select sample size and strength of titrant (see below).

e. Sample size: See Section 2310B.1e for selection of size sample to be titrated and normality of titrant, substituting 0.02*N* or 0.1*N* sulfuric (H₂SO₄) or hydrochloric (HCl) acid for the standard alkali of that method. For the low-alkalinity method, titrate a 200-mL sample with 0.02*N* H₂SO₄ from a 10-mL buret.

f. Sampling and storage: See Section 2310B.1f.

2. Apparatus

See Section 2310B.2.

3. Reagents

*a. Sodium carbonate solution, approximately 0.05*N*:* Dry 3 to 5 g primary standard Na₂CO₃ at 250°C for 4 h and cool in a desiccator. Weigh 2.5 ± 0.2 g (to the nearest mg), transfer to a 1-L volumetric flask, fill flask to the mark with distilled water, and dissolve and mix reagent. Do not keep longer than 1 week.

*b. Standard sulfuric acid or hydrochloric acid, 0.1*N*:* Prepare acid solution of approximate normality as indicated under Preparation of Desk Reagents. Standardize against 40.00 mL 0.05*N* Na₂CO₃ solution, with about 60 mL water, in a beaker by titrating potentiometrically to pH of about 5. Lift out electrodes, rinse into the same beaker, and boil gently for 3 to 5 min under a watch glass cover. Cool to room temperature, rinse cover glass into beaker, and finish titrating to the pH inflection point. Calculate normality:

$$\text{Normality, } N = \frac{A \times B}{53.00 \times C}$$

where:

- A* = g Na₂CO₃ weighed into 1-L flask,
- B* = mL Na₂CO₃ solution taken for titration, and
- C* = mL acid used.

Use measured normality in calculations or adjust to 0.1000*N*; 1 mL 0.1000*N* solution = 5.00 mg CaCO₃.

*c. Standard sulfuric acid or hydrochloric acid, 0.02*N*:* Dilute 200.00 mL 0.1000*N* standard acid to 1000 mL with distilled or deionized water. Standardize by potentiometric titration of 15.00 mL 0.05*N* Na₂CO₃ according to the procedure of ¶ 3b; 1 mL = 1.00 mg CaCO₃.

d. Bromcresol green indicator solution, pH 4.5 indicator: Dissolve 100 mg bromcresol green, sodium salt, in 100 mL distilled water.

*e. Mixed bromcresol green-methyl red indicator solution:*³ Use either the aqueous or the alcoholic solution:

- 1) Dissolve 100 mg bromcresol green sodium salt and 20 mg methyl red sodium salt in 100 mL distilled water.
- 2) Dissolve 100 mg bromcresol green and 20 mg methyl red in 100 mL 95% ethyl alcohol or isopropyl alcohol.

f. Metacresol purple indicator solution, pH 8.3 indicator: Dissolve 100 mg metacresol purple in 100 mL water.

g. Phenolphthalein solution, alcoholic, pH 8.3 indicator.

*h. Sodium thiosulfate, 0.1*N*:* See Section 2310B.3i.

4. Procedure

a. Color change: See Section 2310B.4b.

b. Potentiometric titration curve: Follow the procedure for determining acidity (Section 2310B.4c), substituting the appropriate normality of standard acid solution for standard NaOH, and continue titration to pH 4.5 or lower. Do not filter, dilute, concentrate, or alter the sample.

c. Potentiometric titration to preselected pH: Determine the appropriate end-point pH according to ¶ 1b. Prepare sample and titration assembly (Section 2310B.4c). Titrate to the end-point pH without recording intermediate pH values and without undue delay. As the end point is approached make smaller additions of acid and be sure that pH equilibrium is reached before adding more titrant.

d. Potentiometric titration of low alkalinity: For alkalinities less than 20 mg/L titrate 100 to 200 mL according to the procedure of ¶ 4c, above, using a 10-mL microburet and 0.02*N* standard acid solution. Stop the titration at a pH in the range 4.3 to 4.7 and record volume and exact pH. Carefully add additional titrant to reduce the pH exactly 0.30 pH unit and again record volume.

5. Calculations

a. Potentiometric titration to end-point pH:

$$\text{Alkalinity, mg CaCO}_3/\text{L} = \frac{A \times N \times 50\,000}{\text{mL sample}}$$

where:

- A* = mL standard acid used and
- N* = normality of standard acid

or

$$\text{Alkalinity, mg CaCO}_3/\text{L} = \frac{A \times t \times 1000}{\text{mL sample}}$$

where:

- t* = titer of standard acid, mg CaCO₃/mL.

Report pH of end point used as follows: “The alkalinity to pH _____ = _____ mg CaCO₃/L” and indicate clearly if this pH corresponds to an inflection point of the titration curve.

b. Potentiometric titration of low alkalinity:

Total alkalinity, mg CaCO₃/L

$$= \frac{(2B - C) \times N \times 50\,000}{\text{mL sample}}$$

where:

- B* = mL titrant to first recorded pH,
- C* = total mL titrant to reach pH 0.3 unit lower, and
- N* = normality of acid.

c. Calculation of alkalinity relationships: The results obtained from the phenolphthalein and total alkalinity determinations offer a means for stoichiometric classification of the three principal forms of alkalinity present in many waters. The classification ascribes the entire alkalinity to bicarbonate, carbonate, and

TABLE 2320:II. ALKALINITY RELATIONSHIPS*

Result of Titration	Hydroxide Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Bicarbonate Concentration as CaCO ₃
$P = 0$	0	0	T
$P < \frac{1}{2}T$	0	$2P$	$T - 2P$
$P = \frac{1}{2}T$	0	$2P$	0
$P > \frac{1}{2}T$	$2P - T$	$2(T - P)$	0
$P = T$	T	0	0

*Key: P —phenolphthalein alkalinity; T —total alkalinity.

hydroxide, and assumes the absence of other (weak) inorganic or organic acids, such as silicic, phosphoric, and boric acids. It further presupposes the incompatibility of hydroxide and bicarbonate alkalities. Because the calculations are made on a stoichiometric basis, ion concentrations in the strictest sense are not represented in the results, which may differ significantly from actual concentrations especially at $\text{pH} > 10$. According to this scheme:

1) Carbonate (CO_3^{2-}) alkalinity is present when phenolphthalein alkalinity is not zero but is less than total alkalinity.

2) Hydroxide (OH^-) alkalinity is present if phenolphthalein alkalinity is more than half the total alkalinity.

3) Bicarbonate (HCO_3^-) alkalinity is present if phenolphthalein alkalinity is less than half the total alkalinity. These relationships may be calculated by the following scheme, where P is phenolphthalein alkalinity and T is total alkalinity (¶ 1b):

Select the smaller value of P or $(T-P)$. Then, carbonate alkalinity equals twice the smaller value. When the smaller value is P , the balance $(T-2P)$ is bicarbonate. When the smaller value is $(T-P)$, the balance $(2P-T)$ is hydroxide. All results are expressed as CaCO_3 . The mathematical conversion of the results is shown in Table 2320:II. (A modification of Table 2320:II that is more accurate when $P \approx \frac{1}{2}T$ has been proposed.⁴)

Alkalinity relationships also may be computed nomographically (see Carbon Dioxide, Section 4500-CO₂). Accurately measure pH, calculate OH^- concentration as milligrams CaCO_3 per liter, and calculate concentrations of CO_3^{2-} and HCO_3^- as milligrams CaCO_3 per liter from the OH^- concentration, and the phenolphthalein and total alkalinities by the following equations:

$$\text{CO}_3^{2-} = 2P - 2[\text{OH}^-]$$

$$\text{HCO}_3^- = T - 2P + [\text{OH}^-]$$

Similarly, if difficulty is experienced with the phenolphthalein end point, or if a check on the phenolphthalein titration is desired, calculate phenolphthalein alkalinity as CaCO_3 from the results of the nomographic determinations of carbonate and hydroxide ion concentrations:

$$P = 1/2 [\text{CO}_3^{2-}] + [\text{OH}^-]$$

6. Precision and Bias

No general statement can be made about precision because of the great variation in sample characteristics. The precision of the titration is likely to be much greater than the uncertainties involved in sampling and sample handling before the analysis.

In the range of 10 to 500 mg/L, when the alkalinity is due entirely to carbonates or bicarbonates, a standard deviation of 1 mg CaCO_3/L can be achieved. Forty analysts in 17 laboratories analyzed synthetic samples containing increments of bicarbonate equivalent to 120 mg CaCO_3/L . The titration procedure of ¶ 4b was used, with an end point pH of 4.5. The standard deviation was 5 mg/L and the average bias (lower than the true value) was 9 mg/L.⁵

Sodium carbonate solutions equivalent to 80 and 65 mg CaCO_3/L were analyzed by 12 laboratories according to the procedure of ¶ 4c.⁶ The standard deviations were 8 and 5 mg/L, respectively, with negligible bias.⁶ Four laboratories analyzed six samples having total alkalinities of about 1000 mg CaCO_3/L and containing various ratios of carbonate/bicarbonate by the procedures of both ¶ 4a and ¶ 4c. The pooled standard deviation was 40 mg/L, with negligible difference between the procedures.

7. References

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