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GENERAL CONSTRUCTION PERMIT: ACTION LEVELS AND NUMERIC EFFLUENT LIMITS ANALYSIS

RECOMMENDATION OF ALTERNATIVES

Prepared for
California Building Industry Association (CBIA)
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EXECUTIVE SUMMARY

Flow Science Incorporated (Flow Science) has reviewed the proposed numeric effluent limits (NELs) and the proposed numeric action limits (NALs) for pH and turbidity that are included in the April 22, 2009, draft NPDES permit for discharges of storm water associated with construction activities (draft General Permit). Flow Science also reviewed the proposed bioassessment requirements included in the draft permit.

Based on our review of the draft General Permit and our review of data related to turbidity and pH in receiving waters and storm water runoff (Flow Science 2008), we conclude that it is indefensible to establish a single statewide NEL for turbidity or pH. A significantly larger dataset and more comprehensive analysis will be required to properly establish NELs, and it will be necessary to calculate NELs for areas smaller than an ecoregion and in consideration of the varying environmental characteristics found throughout California and at individual construction sites.

Use of NALs in the proposed General Permit may be appropriate, but it is unclear how the proposed NALs (particularly for turbidity) were derived. Contrary to the recommendations of the Blue Ribbon Panel, it appears that the NALs for turbidity and pH are within the range of normal data variability and would not serve to identify "upset values." Natural or background conditions were not considered in the derivation of NALs, and the proposed NAL values would be applied uniformly statewide.

Flow Science recommends that NELs be deleted from the current proposed General Permit, that NALs be used for the next permit term, and that the State Water Board and dischargers embark upon a well-designed, carefully-planned program of data collection to gather data required to refine NALs and to establish scientifically valid NELs.

A detailed summary of our comments is provided below.

NEL for pH

The proposed NEL for pH was calculated as plus or minus three standard deviations from the mean of a Caltrans dataset. The calculation method used to derive the NEL is not appropriate, in part because the data upon which the calculation were based are neither normally nor log-normally distributed. The proposed NEL for pH was developed without consideration of receiving water quality, and the pH of receiving waters under natural conditions exceeds the proposed NEL in some regions of the state. Additionally, rain water that has had little time to contact soil or earth will fall below the proposed NEL range. Flow Science recommends that the proposed NEL for pH be removed from the permit, and that additional data be collected to facilitate development of an appropriate NEL for pH by characterizing regional variability in pH, variations in pH with storm size, and the impact of BMPs on the pH of runoff.

NEL for turbidity

The basis for the proposed NEL for turbidity of 500 NTU is unclear, although it appears that many broad and general assumptions were made in the calculation. Flow Science has several specific concerns:

- The eco-region data used for the development of the NEL for turbidity are limited and are not appropriate for use in NEL development; for example, these data do not describe variability in sediment concentrations within or between individual storm events.
- The Regional Board enforcement data used to develop the turbidity NEL include four (4) data points, all located within one region of the state, with runoff turbidity values significantly higher than the proposed NEL.
- The proposed NEL does not consider background conditions in receiving water, and numerous studies demonstrate that turbidity in receiving water often exceeds the proposed NEL of 500 NTU.
- No scientific basis exists for the 1:3 relationship between turbidity (NTU) and suspended sediment concentrations, and it is inappropriate to use a fixed relationship for all regions of the state and for all storm conditions.
- Although the proposed NEL is called a “technology-based NEL,” no evidence has been provided to define the technology (or technologies) that would consistently achieve a turbidity of 500 NTU in effluent from construction sites; we find no evidence that the Clean Water Act requirements for assessing “best conventional pollutant control technology” or “best practicable control technology” were addressed.

In summary, insufficient data exist to support the proposed NEL of 500 NTU, and Flow Science recommends that this General Permit requirement be deleted until such time that a scientifically appropriate limit can be developed.

Compliance storm for pH and turbidity NELs

The draft General Permit includes a design storm (a 5-year, 24-hour storm) to be applied to the proposed NELs. As detailed in these comments, additional analysis is required to establish a scientifically defensible design storm for use with NELs. The data collection program that Flow Science recommends should include, among other parameters, collection of data on rainfall amount, rainfall intensity, BMPs and/or other control measures employed at construction sites, and background soil and receiving water conditions. Flow Science recommends that NELs be deleted from the current draft permit, and that a design storm and scientifically valid NELs be developed concurrently using data to be collected during the next permit term.

NELs for discharges from Active Treatment Systems (ATS)

The proposed NEL does not consider background conditions in receiving water, and use of ATS could result in turbidity well below natural levels. As noted by the Blue Ribbon Panel, discharge of water that has turbidity significantly lower than receiving waters can result in downstream erosion and hydromodification. Thus, ATS should be used only where, or to the extent necessary to protect sensitive receiving waters. Further, available data indicate that effluent from ATS may not consistently meet the proposed NELs for turbidity. As with the design storm for NELs, the basis of the recommended 10-year, 24-hour storm as the compliance storm is unclear.

NAL for pH

The proposed NAL for pH is calculated at plus or minus one standard deviation from the mean of the Caltrans dataset, which is neither normally nor log-normally distributed. For normally distributed data, about 38% of the samples in the Caltrans dataset would fall outside the

proposed NAL, so that the proposed NAL does not indicate “upset values,” as recommended by the Blue Ribbon Panel. Finally, the proposed NAL does not consider or allow for the normal variability that is observed in California’s streams. Flow Science recommends that a larger range be used for NALs for pH, and that data be collected to allow for NAL refinement.

NAL for Turbidity

The draft General Permit proposes an NAL for turbidity of 250 NTU. This basis for this value is unclear, and it appears to be far too low to indicate “upset values”; indeed, about 75% of the data in the Caltrans dataset would exceed the proposed NAL value. Flow Science recommends that a higher value (say 500 NTU) be used while data are collected during the next permit term to allow the refinement of the NAL.

Compliance storm for NALs

The current permit does not include a design storm for use with NALs, contrary to the recommendations of the Blue Ribbon Panel. Flow Science recommends that a detailed analysis be conducted to develop a design storm to be used with NALs. The State Board may wish to consider use of a 24-hour, 85-percentile design storm, which is consistent with the design storm used in recently adopted Tier I MS4 permits. Data should be collected during the next permit term to evaluate and refine the design storm.

Recommended data collection program

Storm flow characteristics and constituent concentrations can vary from facility to facility, from storm to storm, and from sample to sample. As detailed in these comments and in Flow Science (2008), available data are insufficient to support development of scientifically valid NELs. A well-designed, carefully-planned program of data collection should be undertaken at a representative set of facilities over a period of years in order to provide the information and data necessary to support NEL development. Data should be collected to characterize variability in flow and concentration within a storm and from storm-to-storm; variability by region and soil type; relationship to rainfall amount and storm intensity; and BMP effectiveness.

Bioassessment monitoring

Bioassessment monitoring is required for risk level 3 projects that are 30 acres in size or greater. Flow Science has several concerns with the proposed bioassessment requirements. It is unlikely that the bioassessment could differentiate an impact of a construction project from a natural variability or the effects of large storms. It may not be feasible to conduct biomonitoring outside of the construction site, and it is unclear how the index period and the 30-acre cutoff for the bioassessment were derived. Several requirements for biomonitoring in the draft General Permit are unclear and require clarification. Finally, the State Water Board should clarify how the biomonitoring results are to be used.

BACKGROUND INFORMATION

The Federal Water Pollution Control Act (the Clean Water Act, CWA) was amended in 1972 to prohibit the discharge of pollutants to waters of the United States from any point source that was not covered by a National Pollution Discharge Elimination System (NPDES) permit. In 1987, Section 402(p) was added to the CWA to regulate municipal and industrial storm water discharges under the NPDES Program. Final regulations that establish storm water permit application requirements for Construction Activities and other categories of industrial activities were adopted by the U.S. Environmental Protection Agency (USEPA) on November 16, 1990. The 1990 regulations required NPDES permits for discharges of storm water to waters of the United States from construction sites that encompassed five (5) or more acres of soil disturbance. Final regulations published on December 8, 1999, expanded the existing NPDES program to address storm water discharges from construction sites that disturb land equal to or greater than one (1) acre and less than five (5) acres (small construction activity).

The California State Water Resources Control Board (SWRCB) adopted a statewide General Permit for Discharges of Storm Water Associated with Construction Activity (General Permit) that applies to most storm water discharges associated with construction activity¹. The current General Permit (Water Quality Order No. 99-08-DWQ, adopted on August 19, 1999) requires “*dischargers where construction activity disturbs one acre or more to: 1) develop and implement a Storm Water Pollution Prevention Plan (SWPPP) which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters; 2) eliminate or reduce nonstorm water discharges to storm sewer systems and other waters of the nation; and 3) perform inspections of all BMPs.*” (p. 1-2 of draft Fact Sheet for WQO 99-08-DWG)

In 1999, when the current General Permit was adopted, the SWRCB stated that “*It is not feasible at this time to establish numeric effluent limitations. The reasons it is not feasible to establish numeric effluent limitations are discussed in detail in SWRCB Order Nos. WQ 91-03 and WQ 91-04. Therefore, the effluent limitations contained in this General Permit are narrative and include the requirement to implement appropriate BMPs.*” (draft Fact Sheet for WQO 99-08-DWG at p. 4) Among other things, SWRCB Order Nos. WQ 91-03 and WQ 91-04 addressed issues regarding the inclusion of numeric effluent limits for toxic pollutants in municipal separate storm sewer systems (MS4s) storm water permits.

In 2004, the SWRCB conducted a public hearing on a draft General Industrial Storm Water Permit. The first draft of the proposed permit did not contain numeric effluent limits,

¹ The General Permit does not apply to construction activities on Tribal Lands, in the Lake Tahoe Hydrologic Unit, or those performed by the California Department of Transportation (Caltrans).

while a later draft included benchmarks contained in the USEPA multi-sector general permit. The hearings on the draft General Industrial Permit raised the issue of whether numeric limits should be applied to discharges of storm water. The environmental community has generally asserted that the current permit system is too complicated, and that numeric effluent limits would make it easier to measure compliance. In contrast, the regulated community argued that due to the unique nature of storm events and storm water discharges, any numeric limit that is placed in a storm water permit must take into consideration the episodic and unique nature of storm events. The adoption of the General Industrial Permit was effectively put on hold at that point.

In September 2005, the SWRCB staff convened a panel of nationally recognized storm water experts (Blue Ribbon Panel) to examine the feasibility of developing numeric effluent limits for storm water discharges. These experts were tasked with answering the following questions, as they pertain to industrial, construction, and municipal permits: “1) *is it technically feasible to establish numeric effluent limitations, or some other quantifiable limit, for inclusion in storm water permits?*; and 2) *how would such limitations or criteria be established, and what information and data would be required?*” The Blue Ribbon Panel was also asked to address “*both technology-based limitations or criteria and water quality-based limitations or criteria. In evaluating establishment of any objective criteria, the Blue Ribbon Panel should address all of the following: 1) the ability of the Water Board to establish appropriate objective limitations or criteria; 2) how compliance determinations would be made; 3) the ability of dischargers and inspectors to monitor for compliance; and 4) the technical and financial ability of dischargers to comply with the limitations or criteria.*” (Blue Ribbon Report)

In June of 2006, the Blue Ribbon Panel issued a final report entitled “*The Feasibility of Numeric Effluent Limits Applicable to Discharges of Storm Water Associated with Municipal, Industrial, and Construction Activities*” (Blue Ribbon Report). In this report, the Blue Ribbon Panel suggested that “Action Levels” (ALs) might be feasible for storm water discharges, and could be set in a number of different ways. For discharges from construction sites, the Panel concluded that Numeric Effluent Limits (NELs) are likely “not feasible” if chemical addition is not permitted. The Blue Ribbon Panel also listed a number of factors that should be considered before NELs or ALs are established for storm runoff from construction sites, including natural background receiving water quality, the need for a “design storm,” and the need to consider site-specific factors in establishing NALs or NELs.

In early 2007, the Board published a Preliminary Draft General Construction Permit (Preliminary Draft), and adoption of the General Construction Permit will precede adoption of the General Industrial Permit. The General Construction Permit, when adopted, will supersede the current General Permit (Order 99-08-DWQ). The Preliminary Draft included both action levels (ALs) and numeric effluent limits (NELs). The ALs and NELs included in the draft General Permit would be imposed uniformly statewide, and as such were developed without consideration of local water quality issues, or differences in soil types, within individual regions or watersheds. Further, the SWRCB did not consider information regarding background water quality.

The U.S. Environmental Protection Agency (EPA) is currently developing effluent limitation guidelines for the Construction and Development industry pursuant to a judicial order in *Natural Resources Defense Council et al v. EPA et al* (C.D. Cal. 2006, Case No. CV-04-8307

GHK). The order calls for EPA to publish a proposed rule by December 2008 and a final rule by December 2009 (USEPA, 2007).

REVIEW OF LIMITS PROPOSED BY STATE BOARD IN CONSTRUCTION GENERAL PERMIT (APRIL 22, 2009)

In May 2009, the SWRCB issued a draft Construction General Permit (draft General Permit) that contains provisions to regulate storm flow discharges from construction sites. The draft General Permit contains both numeric effluent limitations (NELs) and numeric action levels (NALs). In the draft General Permit, dischargers at risk level 3 sites must maintain a numeric effluent limit (NEL) for pH within a range of 6.0-9.0 units and a NEL for turbidity below 500 NTU (p. 28 of the draft General Permit). **Table 1** presents NELs for each risk level. The discharger is required to comply with the NELs unless the storm event causing the discharges is determined after the fact to be equal to or larger than the 5-year, 24-hour storm (a compliance storm; expressed in tenths of an inch of rainfall) (p. 29 of the draft General Permit).

Table 1 also presents the numeric action levels (NALs) included in the draft General Permit for discharges from risk level 2 and 3 construction sites. Exceedance of an NAL would not constitute a permit violation, but rather would require specific actions to be taken by the discharger. Failure to take those corrective actions could constitute a permit violation. No design storm is provided by the draft General Permit for NALs.

Table 1. Numeric effluent limitations, numeric action levels, test methods, detection limits, and reporting units (p. 28 of the draft General Permit).

Parameter	Test Method	Discharge Type	Min. Detection Limit	Units	Numeric Action Level	Numeric Effluent Limitation
pH	Field test with calibrated portable instrument	Risk Level 2	0.2	pH units	lower NAL = 6.5 upper NAL = 8.5	N/A
		Risk Level 3			lower NAL = 6.5 upper NAL = 8.5	lower NEL = 6.0 upper NEL = 9.0
Turbidity	EPA 0180.1 and/or field test with portable instrument	Risk Level 2	0	NTU	250 NTU	N/A
		Risk Level 3			250 NTU	500 NTU

Discharges of storm water from Active Treatment Systems (ATS) are required to comply with turbidity NELs of 10 NTU as daily flow-weighted average and 20 NTU for any single

sample (**Table 2**) unless the storm event causing the discharges is determined after the fact to be equal to or larger than the Compliance Storm Event of the 10-year, 24-hour storm (p. 6 of the Attachment F).

Table 2. Numeric effluent limitations, numeric action levels, test methods, detection limits, and reporting units for ATS use (p.1 of Attachment F).

Parameter	Test Method	Discharge Type	Min. Detection Limit	Units	Numeric Action Level	Numeric Effluent Limitation
Turbidity	EPA 0180.1 and/or field test with portable instrument	For ATS discharges	Not specified	NTU	N/A	10 NTU for Daily Flow-Weighted Average & 20 NTU for Any Single Sample

No numeric limitations for receiving water are proposed. Dischargers are required to ensure that discharges do not cause or contribute to an exceedance of applicable existing water quality standards (p. 31 of the draft General Permit) and to execute monitoring requirements for each risk level (**Table 3**). Risk Level 3 dischargers with a total project-related ground disturbance exceeding 30 acres are also required to conduct bioassessment monitoring before and after project completion (p. 10 of draft General Permit and p. 23 of the draft Fact Sheet).

Table 3- Required Monitoring Elements for Risk Levels (p. 20 of the draft Fact Sheet)

	Visual	Non-visible Pollutant	Effluent	Receiving Water
Risk Level 1			not required	not required
Risk Level 2	three types required: non-storm water, pre-rain and post-rain	As needed (see below)	pH, turbidity	not required
Risk Level 3			pH, turbidity, and SSC if turbidity NEL exceeded	pH, turbidity, SSC, and bioassessment

NUMERIC EFFLUENT LIMITATIONS (NELS)

NEL for pH

In the draft General Permit, dischargers at risk level 3 sites must meet a numeric effluent limit for pH within a range of 6.0-9.0 units (p. 28 of the draft General Permit). Flow Science has several concerns with this proposed NEL.

- **An NEL at plus or minus three standard deviations from the mean is not an appropriate metric.** The pH NEL values were established by “*calculating three standard deviations above and below the mean pH of runoff from highway construction sites in California.*” (p. 15 of the draft Fact Sheet). The SWRCB staff appear to have assumed that the Caltrans data in the dataset used to derive the NELs for pH are normally distributed; however, the data² are neither normally nor log-normally distributed according to the normality test (i.e., Kolmogorov-Smirnov test) conducted by Flow Science. It appears that the SWRCB staff did not test the data against the assumed normal distribution. The calculation of mean will be appropriate only if the distribution of the data is known. If data are not normally distributed, the use of a mean and a standard deviation based on the normal distribution would over- or under-estimate pH values that could occur within the normal variation of data. In addition, even if normality of the data is assumed, Flow Science’s calculation yields a mean \pm 3 standard deviations of 5.4 – 9.4 (not 6.0 - 9.0).
- **The proposed NEL is not “clearly above the normal observed variability” as the Blue Ribbon Panel recommended.** The Blue Ribbon Panel recommended that an NEL should be established to indicate an “*upset value, which is clearly above the normal observed variability.*” (p. 17 of Blue Ribbon Report, emphasis added) If data were normally distributed, 95.4% (mean \pm 3 standard deviations) of the data points in the dataset would fall within the proposed range, and 4.6% would fall outside those limits. Thus, for a normally distributed dataset, roughly 4.6% of the samples would be likely to exceed the proposed NEL. Approximately 5% of Caltrans data (2002) exceed the proposed limit.
- **The proposed NELs were developed without consideration of receiving water quality.** The draft General Permit may require effluent from construction sites to be treated to a level that is different from the receiving water. pH values outside the range of the proposed NELs occur naturally in some streams (see Section 4 of Flow Science (2008)). For example, some areas of the State include alkaline soils, and pH in runoff from these soil types may be higher than average values. Background receiving water pH

² pH data from Caltrans (2002) were obtained from the report, which was obtained at the link provided in the draft Fact Sheet, and include 76 data points collected between 1999 and 2002.

ranges as high as 8.9 in the Trinity River near Weitchpec (see **Figure 1** and Section 4 and Table 18 at p. A-20 of Flow Science (2008)) and 9.5 in San Diego Creek (see p. A-23, Flow Science (2008)). Because of regional variations in natural or background pH levels, it is inappropriate to apply a uniform NEL statewide. Where natural or background pH levels fall outside or at the margins of the proposed NEL range, the NEL should not apply.

- **The pH of rainfall falls outside the proposed NEL.** Data collected by the U.S. Geological Survey (USGS) indicate that rain in California has a long-term average pH that varies between 5.3 and 6.0, depending upon location (**Figure 2**). For individual storms, pH values as low as 4.5 have been observed (see, e.g., <http://nadp.sws.uiuc.edu/ads/2003/CA45.pdf>). If storm water runoff includes water that has not had significant contact time with soil or earth, it is possible for runoff pH values to be low and outside the range of the NELs. Samples with a pH value below 6.0 (i.e., below the NEL) should not be considered to constitute violations of the permit if insufficient contact time with the ground surface is the cause of the exceedance.
- **Regional variability in pH should be considered in establishing the pH NEL.** The Blue Ribbon Report recommended that in establishing NELs for discharges from construction sites, the SWRCB should consider “*the site’s climate region, soil condition, and slopes, and natural background conditions (e.g., vegetative cover) as appropriate and as data are available.*” (p. 17 of Blue Ribbon Report) The Caltrans data used to establish the NELs for pH were taken from six of the eleven Caltrans Districts (Caltrans 2002) and may not be fully representative of conditions throughout the State. Because soil alkalinity varies by region (as discussed above), regional factors may be an important influence on local pH levels of storm water runoff. The SWRCB should evaluate regional and local variations in soil chemistry and receiving water pH. The proposed NELs should not apply in any region or local area where natural conditions would cause or contribute to NEL exceedances.

NEL for turbidity

The turbidity NEL of 500 NTU was established using two data sets and SWRCB staff’s best professional judgment (BPJ).

“The turbidity NEL of 500 NTU was developed using an ecoregion-specific dataset developed by Simon et. al. (2004) and Statewide Regional Water Quality Control Board Enforcement Data. A 1:3 relationship between turbidity (expressed as NTU) and suspended sediment concentration (expressed as mg/L) is assumed based on a review of suspended sediment and turbidity data from three gages used in the USGS National Water Quality Assessment Program.” (p. 15 of the draft Fact Sheet).

“The results of the Simon et al. dataset and construction site administrative civil liability (ACL) data suggest that an appropriate turbidity numeric effluent limit may fall in the range of 500 to 1650 NTU.” (p. 17 of the draft Fact Sheet).

Overall, not enough information is provided to establish how SWRCB staff developed the NEL value for turbidity. Flow Science has several specific concerns as follows:

- **The eco-region data used for the development of the NEL for turbidity are limited and not appropriate for the purpose of NEL development.** Data from Simon et al. (2004) are not sufficient to support an NEL. Simon et al. (2004) present estimated suspended sediment concentrations (SSC) that are median values for 1.5-year flow events; these data are provided “*for the purpose of defining long-term transport conditions*” of sediment. The Simon et al. (2004) dataset do not characterize event-scale variability, even though data for individual storms will be used to assess compliance with the NEL. Even using staff’s estimate of 1:3 for turbidity:SSC (which is faulty, as described below), more than 50% of the data in over 40% of the State would greatly exceed the NEL. For example, *median* values of SSC in ecoregions 6 and 14 for a 1.5-year flow event are 1530 and 5150 mg/l, respectively (**Figure 3**). The state-wide “area-weighted average” median SSC concentration provided in the draft Fact Sheet (p. 16) is 1633 mg/l, which is likely greater than the proposed NEL of 500 NTU, and indicates that approximately 50% of samples from across the state would exceed the proposed NEL. In addition, the ecoregion data clearly indicate that some regions of the state experience greater erosion than others. For example, the median SSC concentration from ecoregion 5 (8.8% of California’s land area) is 35.6 mg/l, while the median SSC concentration from ecoregion 14 (21.7% of the State’s land area) is 5150 mg/l. These data indicate that a blanket, “one-size-fits-all” NEL is inappropriate for the State.
- **The enforcement data used to develop the turbidity NEL are not representative.** The enforcement data cited in the draft Fact Sheet (p. 15) include one data point from each of four construction projects located within one region (Central Valley Region) of California. As shown in **Figure 4**, these projects are located in the northern part of the state and are not representative of conditions in the more arid environments of southern California or of a broad range of soil types. The hydrologic conditions under which the data were collected (e.g., rainfall amount, storm intensity) are unknown, and the conditions that led to Regional Board enforcement at these locations are not specified by SWRCB staff in the draft Fact Sheet. Further, the values of these four data points range from 1400-1800 NTU, so that it is unclear how these numbers were used to derive the turbidity NEL of 500 NTU.
- **The proposed NEL does not consider background conditions in receiving water.** Background turbidity and/or suspended sediment levels in storm water runoff vary considerably both within different areas of the state and in response to different storm conditions (e.g., rainfall intensity, rainfall amount, and antecedent conditions). Thus, it makes no sense to adopt a single NEL for turbidity that is applied uniformly throughout the State. In addition, the Blue Ribbon Panel stated that in developing an NEL for turbidity, “... *it is important to consider natural background levels of turbidity or TSS [Total Suspended Solids] in setting Numerical Limits or Action Levels for construction activities. The difficulty in determining natural background concentrations/levels for all areas of the state could make the setting of Numeric Limits or Action Levels impractical*”

from an agency resource perspective.”(p. 16 of Blue Ribbon Report). In some environments, such as the Delta, native aquatic life is adapted to high levels of turbidity, and sediment is also important to stream stability and beach replenishment. Introducing discharges with sediment concentrations below natural levels into these environments can cause channel erosion, and hydromodification and can have adverse impacts on the aquatic ecosystem. In other environments, such as salmon spawning streams, clearer waters are necessary to support beneficial uses, and it is important that sediment discharges be maintained at lower levels for such environments. For these reasons, NELs established for sediment must be site- or watershed-specific, and must consider natural conditions.

- **Numerous studies demonstrate that turbidity in receiving water often exceeds the NEL of 500 NTU.**
 - As discussed above, the median suspended sediment concentrations (SSC) for 1.5-year recurrence interval flows for each ecoregion in CA range from 35 to 5150 mg/l (p. 16 of the draft Fact Sheet). Median SSC for the two biggest ecoregions (6 and 14) exceed 1500 mg/l SSC, indicating that they would exceed the NEL of 500 NTU using the 1:3 SSC:NTU formula proposed by SWRCB staff.
 - Caltrans monitoring data for turbidity show that “typical construction site runoff” in California ranges from 15 NTU to 16,000 NTU (Caltrans 2002). Available Caltrans data from 1999-2002 show that 60% of data exceed the proposed NEL of 500 NTU (**Figure 5**). Note that staff used Caltrans data only for the development of the pH NEL (not for development of the turbidity NEL), and only a summary of 1998 turbidity data are provided in the 2002 Caltrans report. Still, these data clearly indicate that an NEL of 500 NTU does not represent an “*upset value, which is clearly above the normal observed variability,*” as recommended by the Blue Ribbon Panel (p. 17 of Blue Ribbon Report, emphasis added).
 - The data from the Natural Loadings study (Yoon and Stein 2008) show that natural background sediment concentrations in undeveloped areas often exceed the proposed NEL. Storm water data were collected in watersheds with more than 95% undeveloped area and with no or minimal impact from development such as construction activity. Thus, this dataset presents valuable insight on natural background levels of suspended sediment, which were analyzed as total suspended solids (TSS). **Table 4** shows summary statistics derived from data collected from multiple sampling stations. Raw data (i.e., grab samples) are neither normally nor log-normally distributed. **Table 5** shows the statistics by watershed. In general, the variability in these datasets is quite large. For instance, TSS levels in storm water samples collected from tributaries located within the Santa Clara River watershed range from 2 to 103,000 (mg/l). Even though TSS and SSC are not easily interchangeable (Gray et al. 2000), and even though, as discussed below, there is no fixed relationship between these quantities and turbidity, the turbidity (NTU) equivalent to 103,000 TSS (mg/l) is certainly much larger than the proposed NEL of 500 NTU.

These data support the premise that NELs for turbidity should be site-specific and established after consideration of receiving water conditions.

- **No scientific basis exists for the 1:3 relationship between turbidity (NTU) and suspended sediment concentrations.** As noted above, SWRCB staff assumed a 1:3 relationship between turbidity (NTU) and suspended sediment concentrations (i.e., assumed that 3 mg/l SSC was equivalent to 1 NTU). This assumption is erroneous. NTU: TSS ranged from 1:0.8 to 1:2.2 in data collected by USEPA for “Environmental impact and benefits assessment for proposed effluent guidelines and standards for the construction and development category” (USEPA 2008). Although several authors have attempted to correlate turbidity measurements with gravimetric measurements of suspended sediment (Schroeder et al. 1981; Schubel et al. 1978; Schubel et al. 1979), a consistent relationship has not been established. Correlations are generally site-specific and may change over the course of a year, although not in a consistent fashion (Manka 2005). The suspended sediment-turbidity relationship shifts between the rising and falling limbs of the hydrograph (Knighton 1998). Variability in the suspended sediment-NTU correlations can be attributed to differences in size, composition, and refractive index of particles (Earhart 1984). For dilute solutions, there appears to be a linear relationship between the amount of light scattered and the amount of suspended material, but when suspended sediment levels are high, light cannot penetrate the sample and will distort the turbidity reading (Schubel et al. 1978). Data presented in these references indicate that the NTU:sediment ratio can vary from 1:0.014 to 1:33, indicating that the assumption that a constant 1:3 relationship exists between turbidity and TSS is suspect and represents a serious oversimplification. For instance, event-based storm water data from Orange County storm water monitoring programs from 1992 through 2006 demonstrate that the ratio of sediment concentrations (measured by Orange County as total suspended sediment) to turbidity (NTU) varied over two orders of magnitude (**Figure 6**). In conclusion, it is problematic to use any one fixed ratio for the relationship between turbidity (NTU) and suspended sediment concentrations.
- **The calculation of 1:3 using the USGS data is faulty.** It is unclear that how the 1:3 ratio for NTU:SSC was calculated using data from three USGS stations (p. 15 of the draft Fact Sheet). Of these three USGS stations, we were unable to locate any turbidity data for USGS station 11074000. Water-data reports 2008 for USGS stations 11447650 and 11303500 contain a total of 24 data points where both turbidity (NTRU³) and suspended sediment concentrations (mg/l) were collected on same dates. Note that turbidity data available from these USGS stations are in NTRU instead of NTU. Staff does not provide any explanation how NTRU values were converted to NTU values. Nonetheless, these limited USGS data demonstrate that ratio between NTRU and SSC ranges from 1.1 to 3.3, with a median value of 1.86 (**Figure 7**).

³ Nephelometric turbidity ratio unit, NTRU technology applies the same light sources as the NTU (EPA 180.1) but uses several detectors in the measurement. An instrument algorithm uses a combination of detector readings to generate the turbidity reading. For more detail see Gray et al. (2003): Proceedings of the federal interagency workshop on turbidity and other sediment surrogates, April 30-May 2, 2002, Reno, Nevada.

- **Although the proposed NEL is called a “technology-based NEL,” no evidence is provided to define the technology (or technologies) that would consistently achieve a turbidity of 500 NTU in effluent from construction sites.** At p. 17 of the Fact Sheet, State Board staff refers to the NELs as “technology-based NELs.” However, no analysis is provided to describe which BMPs, or combinations of BMPs and other measures, could be employed to consistently achieve the NEL. Requirements for establishing a technology-based effluent limit (TBEL) include analyses of available technologies and the treatment efficiency of those technologies based on USEPA guidance (e.g., the volume or flow rate to be treated, the efficiency of the treatment process, and the quality of storm flow influent to the treatment process). The Clean Water Act specifies that the assessment of best available technology “*shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate*” (Clean Water Act Section 304(b)(2)(B)). The Act also specifies that factors to be taken into account in assessing the best conventional pollutant control technology “*shall include consideration of the reasonableness of the relationship between the costs of attaining a reduction in effluents and the effluent reduction benefits derived, and the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources, and shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate.*” (Clean Water Act Section 304(b)(4)(B)) There is nothing in the record we have reviewed to indicate that these analyses have been completed.
- **Instruments to measure turbidity to levels higher than 1000 NTU are available.** The Fact Sheet for the draft permit states that turbidity meters “*commonly used for field measurement tend to have an effective measurement range of 0-1000 NTU*” (p. 17 of the draft Fact Sheet), and it is implied that this is one basis for the proposed NEL. However, our review of the Cole-Parmer instrument catalog reveals that hand-held turbidity meters capable of measuring turbidity levels of up to 4000 NTU (e.g., model WU-05563-20) are available at the same cost as meters that measure up to 1000 NTU. Thus, the capability of available turbidity meters appears to have no relationship to the proposed NEL for turbidity.

In summary, it is unclear how the 500 NTU for turbidity NEL was computed, although it appears that many broad and general assumptions were made in the calculation. Because conditions vary significantly within a region, from region to region, and from one individual storm event to another, we believe that it is indefensible to establish any single statewide NEL for sediment and it is premature to establish more refined, context-specific NELs for sediment. If and when they are developed, a significantly larger dataset will be required to properly establish NELs, and it may be necessary to calculate NELs for areas smaller than an ecoregion and in

consideration of various environmental characteristics found throughout California and at individual construction sites.

Compliance storm for pH and turbidity NELs

The draft General Permit proposes a compliance storm for NELs: *“In response to public comments on the last draft and the recommendations of the expert panel, this General Permit contains ‘compliance storm event’ exceptions from the technology-based NEL”* (p. 17 of the draft Fact Sheet). However, the draft General Permit does not specify a design storm for NALs. The draft General Permit requires discharges to meet the NELs unless a storm is larger than the compliance storm designated in the draft General Permit.

Discharges of storm water from Risk Level 3 sites shall comply with applicable NELs unless the storm event causing the discharges is determined after the fact to be equal to or larger than the Compliance Storm Event (expressed in inches of rainfall). For Risk Level 3 project sites applicable to NELs, this General Permit establishes a compliance storm event as the equivalent rainfall in a 5-year, 24-hour storm (p. 29 of the draft General Permit).

- **No basis has been provided for the design storm, and a smaller storm would be more appropriate.** The Caltrans data, the ecoregion dataset, and the enforcement data upon which the NELs for pH and turbidity are based, do not include information on storm size or rainfall intensity that were observed during data collection. The 5-year, 24-hour storm is a very large storm that is unlikely to occur during the typical life of most construction projects. Indeed, for this reason it is unlikely that the available data include measurements made during a storm of this size. It has not been established by SWRCB staff whether pH and turbidity in construction site runoff is a function of storm size or intensity, or if meeting the NEL limit for very large storms is even feasible.
- **Additional analysis is required to establish a scientifically defensible design storm.** In October 2007, the Southern California Coastal Water Research Project (SCCWRP) issued a report entitled, “Concept Development: Design Storm for Water Quality in the Los Angeles Region,” which presented the results of a study commissioned by the Los Angeles Regional Board (Ackerman et al. 2007). Although the study panel made significant progress in analyzing how a design storm should be developed, it noted that *“several technical challenges still exist before design standards for water quality can be incorporated into a regulatory framework, including extrapolating to other locations, further model validation, and assessing confidence in the model to achieve targets.”* (Ackerman et al. 2007) The report considered specifying both a design storm of one-inch of precipitation in the Los Angeles region, thus treating approximately 80% of the runoff volume, and a design storm of 0.75-inches rainfall volume or 0.25 in/hr intensity. Both of these storm sizes are significantly smaller than the storm size proposed in the draft permit. The report noted that *“capturing a minimally larger fraction of runoff volume or load would have required capturing significantly larger storm events.”*

- **Additional data are needed to support development of appropriate design storm.** While we are generally supportive of a design storm concept, the design storm will need to be established using turbidity and pH data collected over a broad and explicitly measured set of storm conditions (e.g., including both rainfall amount and intensity, and over a range of geological soil types, ecoregions and vegetative cover).

NELs for discharges from Active Treatment Systems (ATS)

The draft permit does not specify when ATS are required, but rather appears to leave its use to the discretion of individual dischargers. No NALs are proposed for effluent from ATS systems, but the draft permit does propose a NEL for turbidity. No NEL is proposed for pH in effluent from ATS. The draft permit specifies that turbidity of ATS discharges shall be less than 10 NTU as a daily flow-weighted average and less than 20 NTU for any single sample (p. 1 of Attachment F). The Compliance Storm Event for ATS discharges is the 10-year, 24-hour storm (p. 11 of the draft General Permit and p. 6 of Attachment F).

- **The proposed NEL does not consider background conditions in receiving water and can result in turbidity well below natural levels.** The Blue Ribbon Panel concluded that use of ATS could make NELs for construction site discharges feasible, but the Blue Ribbon Panel noted that “[t]he SWRCB should take into account the long-term effects of chemical use, operational and equipment failures or accidental releases.” (p. 15 of Blue Ribbon Report) The Blue Ribbon Panel also noted the difficulties associated with establishing NALs or NELs for turbidity, stating “... it is important to consider natural background levels of turbidity or TSS in setting Numeric Limits or Action Levels for construction activities. The difficulty in determining natural background concentrations/levels for all areas of the state could make the setting of Numeric Limits or Action Levels impractical from an agency resource perspective.” (Blue Ribbon Report at p. 15) Finally, the Blue Ribbon Panel noted that “active treatment systems could result in turbidity and TSS levels well below natural levels, which can also be a problem for receiving waters.” (p. 17 of Blue Ribbon Report) The Blue Ribbon Panel noted that turbidity in some areas of the state is naturally very high, particularly in arid or semi-arid regions. Requiring effluent turbidity that is “too low” (i.e., far lower than natural turbidity levels) can cause downstream erosion in natural channels. This effect would be especially pronounced where the construction site discharge is a large fraction of the water flow in the stream. When turbidity or TSS is too low in a discharge, downstream scouring of stream channels may occur, increasing stream hydromodification. Turbidity levels that are too low can also cause ecological concerns (see Section 6 of Flow Science (2008)). A turbidity value of 10 NTU is very low, and is significantly lower than observed storm event turbidity levels in all streams for which data have been reviewed (see Section 4 of Flow Science (2008)). The SWRCB should exercise great care in establishing NELs for turbidity, and should not require effluent to be treated to levels that are “cleaner” than natural background levels during storm events.
- **Use of ATS does not guarantee that effluent will meet the NELs under all**

circumstances. The draft General Permit also asserted that ATS could consistently provide effluent meeting the permit requirements (e.g., 20 NTU for any single sample), but this assertion was unsupported by scientific or technical evidence. Geosyntec Consultants have conducted a detailed review of ATS as applied to construction site runoff (Geosyntec 2007). Geosyntec’s review of ATS performance measures for multiple construction sites found that reported influent turbidity ranged between 2 NTU and 22,000 NTU, while reported ATS treated effluent turbidities ranged from <1 NTU to 45 NTU. While these values show that ATS systems can reduce the turbidity of construction runoff to below 10 NTU, they also show that effluent turbidity does exceed 20 NTU at times, even when the ATS system is operated appropriately. Thus, available evidence indicates that ATS would not consistently achieve the proposed NEL of 20 NTU.

- **No basis has been provided for use of the 10-year, 24-hour storm as the compliance storm.** See the discussion in ‘Compliance storm for pH and turbidity NELs.’

NUMERIC ACTION LEVELS (NALS)

NAL for pH

The draft General Permit contains NALs for pH with a value range between 6.5 and 8.5 pH units. These NALs would apply to discharges from risk level 2 and 3 sites. This range was derived by calculating one standard deviation above and below the mean pH of runoff from highway construction sites in California (p.18 of the draft Fact Sheet). Flow Science has several concerns with this proposed NAL, including many of the same concerns listed in this comment letter for the NELs for pH.

- **An NAL at plus or minus one standard deviation from the mean does not consider normal variability.** This method for establishing the NAL assumes that the available pH data are normally distributed. This assumption should be tested prior to using this method as commented in the NEL section; our evaluation indicates that the Caltrans dataset is not log-normally or normally distributed. If data were normally distributed, a range of plus or minus one standard deviation would include 68.2% of the data in the dataset that were used to calculate the NAL. This would mean that about 31.8% of stormwater samples can be expected to trigger an NAL exceedance and require subsequent action. Clearly, this is not consistent with the concept of an upset value as recommended by the Blue Ribbon Panel, in that a large portion of the dataset used to derive the NAL is within the normal observed variability. The NAL established using one standard deviation above and below assumed mean clearly are not “upset values.”
- **As with NELs, the proposed NALs do not consider site-specific conditions or receiving water conditions.** pH values in receiving waters under natural or background conditions exceed the proposed NAL for pH. The presence of alkaline soils can result in runoff with pH higher than the proposed NAL, and rainfall that has not had sufficient

contact time with soil or earth can result in pH values in runoff below the proposed NAL. See the discussion on the NEL for pH for additional detail.

NAL for Turbidity

For turbidity, the NAL proposed in the draft General Permit is 250 NTU. The draft Fact Sheet simply states that “BPJ was used to develop” the turbidity NAL of 250 NTU (p. 18 of the draft Fact Sheet). As discussed above for the NEL for turbidity, even a value of 500 NTU is clearly within the range of normal variability, and is routinely exceeded in many parts of the state during storm events. It appears that approximately 75% of the data in the Caltrans dataset would exceed the proposed NAL of 250 NTU. For these reasons, the origin of the proposed NAL of 250 NTU is unclear. We can find no basis for this number in either the datasets presented in the Fact Sheet supporting the draft General Permit or in our experience.

Compliance storm for NALs

Contrary to the recommendations of the Blue Ribbon Panel, no compliance storm has been proposed for NALs. The State Water Board should conduct an analysis of available data to establish a design storm for use with NALs; the Board may wish to consider use of a 24-hr 85-percentile storm is recommended as an interim design storm for use with NALs. The 24-hr, 85-percentile storm has been used in recent California Phase I MS4 permits for sizing storm water BMPs. This storm size could be used for NAL monitoring prior to development of a full dataset; when data become available to characterize TSS and pH in runoff from construction sites over a range of storm sizes and intensities, the design storm criteria for NALs should be adjusted as appropriate.

RECOMMENDED DATA COLLECTION PROGRAM

Storm water discharges are intermittent and highly variable, both in terms of flow rates/volumes and constituent concentrations. Storm flow characteristics and constituent concentrations can vary from facility to facility, from storm to storm, and from sample to sample. As detailed above and in Flow Science (2008), available data are insufficient to support development of scientifically valid NELs. Collection of a dataset to support NEL development will require a well-designed, carefully-planned program of data collection at a representative set of facilities over a period of years. Data should be collected to characterize variability in flow and concentration within a storm and from storm-to-storm; variability by region and soil type; relationship to rainfall amount and storm intensity; and BMP effectiveness.

BIOASSESSMENT MONITORING

Risk Level 3 dischargers with a total project-related ground disturbance exceeding 30 acres are required to conduct bioassessment monitoring before and after project completion (p.10 of draft General Permit and p. 23 of the draft Fact Sheet). Benthic macroinvertebrate samples are required to be collected upstream and downstream of the site’s discharge point in the receiving

water (p. 23 of the draft Fact Sheet) during an index period for each ecoregion that is a peak time of year when stream biota are in a stable and abundant state. The State Water Board has developed a map designating index periods for the ecoregions in the State (p. 23 of the draft Fact Sheet). A minimum number of four samples per a project are required: before and after the construction and upstream and downstream of the outfall (p. 1-2 of Appendix 5). “The ‘after’ sample(s) shall be collected after at least one winter season resulting in surface runoff has transpired) after project-related ground disturbance has ceased. ‘Before’ and ‘after’ samples shall be collected both upstream and downstream of the project’s discharge.” (p. 1-2 of Appendix 5) An exception is provided for a project that begins and is completed out of an index period, but the exception as currently written is not understandable and needs clarification or correction.

- **It is unlikely that the bioassessment could differentiate an impact of a construction project from an impact of natural variability.** The “after” sample(s) is(are) required to be collected after at least one winter season. If the bioassessment detects a difference between the “after” and “before” samples, it is unlikely to indicate whether this difference was caused by a severe storm event, “normal” inter-annual variations in abundance caused by a variety of ambient factors, or by the construction project. A single bioassessment at a project site before and after the construction could not evaluate whether the difference was within or out of natural temporal variation unless long-term bioassessment data already exist for the site.
- **The requirement of bioassessment monitoring outside of an area of a construction project area is not feasible.** It is unlikely that dischargers would be able to obtain access to areas outside of their project area, and they should not be required to do so.
- **The SWRCB staff should explain the basis for the 30-acre cutoff for the bioassessment.** The draft permit requires bioassessment samples to be collected for risk level 3 sites that are 30 acres in size or larger. No explanation has been provided to explain why a 30-acre threshold was selected.
- **Further clarification should be provided for requirements for bioassessment monitoring.** Page 1 of Appendix 5 provides an additional criterion for a discharger to meet for the bioassessment monitoring requirement:

“2. The project may discharge surface runoff to a freshwater Wadeable stream (or streams) that is either: (a) listed by the State Water Board or USEPA as impaired due to sediment, and/or (b) tributary to any downstream water body that is listed for sediment; and/or have the beneficial use SPAWN & COLD & MIGRATORY.”(p. 1 of Appendix 5)

The additional criterion is already incorporated in the risk level assessment as one component of the receiving water risk (p. 28 of the draft Fact Sheet). This needs further clarification or/and the additional criterion should be deleted in the Appendix 5.
- **Explanation should be provided regarding how the index period was developed.** Only a single map of the index period has been provided by the SWRCB staff, and it is

unclear how this map was developed. Additional justification for the index period should be provided.

- **Clarification of the bioassessment exception should be provided.** The exception to the bioassessment requirements that is presented in p. 1 of Appendix 5 requires a discharger both to pay exception fees and to conduct a bioassessment (under the bioassessment exception, a discharger is required to “*conduct bioassessment monitoring, as described in Appendix 4.*”) However, Appendix 4 contains no instructions for the bioassessment. We request that the SWRCB staff clarify this reference and provide the basis for the exception fee of \$7,500 per sample.
- **Will there be any regulatory action for the outcome of bioassessment?** No information is presented on how bioassessment results will be used. Will there be any follow-up after reporting results of habitat assessment and macroinvertebrate monitoring? What will be the outcome if either the habitat or macroinvertebrates were found to have been severely impacted?

Table 4. Statistical summary of pH and TSS (mg/l) levels in receiving water in undeveloped areas of southern California by watershed during storm events; source (Yoon and Stein 2008).

	Size	Min	25%	Median	75%	Max
pH	41	6.9	7.1	7.8	8.1	8.5
TSS (mg/l)	212	0	4	22	170	103,000

Size= number of data points; Min = minimum; Max = maximum; 25%=25th percentile; 75%=75th percentile



Table 5. Statistical summary of pH and TSS (mg/l) levels in receiving water in undeveloped areas of southern California by watershed during storm events; source (Yoon and Stein 2008).

Parameter	Watershed	Size	Min	25%	Median	75%	Max
pH	Calleguas	2	7.8	7.8	7.8	7.8	7.8
	LA River	4	7.5	7.6	7.8	7.9	8.0
	San Gabriel	8	7.7	7.9	8.0	8.1	8.2
	San Luis Rey	11	6.9	7.0	7.0	7.1	7.3
	San Mateo	4	7.0	7.1	7.4	7.7	7.7
	Santa Ana	9	8.3	8.3	8.4	8.5	8.5
	Santa Clara River	2	7.9	7.9	7.9	7.9	7.9
TSS	Arroyo Sequit	26	1	10	49	153	2220
	Calleguas	6	201	1820	2975	3190	3350
	LA River	13	4	8	23	115	260
	Malibu Creek	10	10	32	177	205	342
	San Gabriel	32	2	2	8	56	1100
	San Juan	21	2	2	51	95	932
	San Luis Rey	20	0	1	4	9	104
	San Mateo	17	2	10	158	990	5100
	Santa Ana	29	0	0	2	5	161
	Santa Clara River	17	2	133	269	4122	103000
	Ventura River	18	1	10	63	208	724

Size= number of data points; Min = minimum; Max = maximum; 25%=25th percentile; 75%=75th percentile

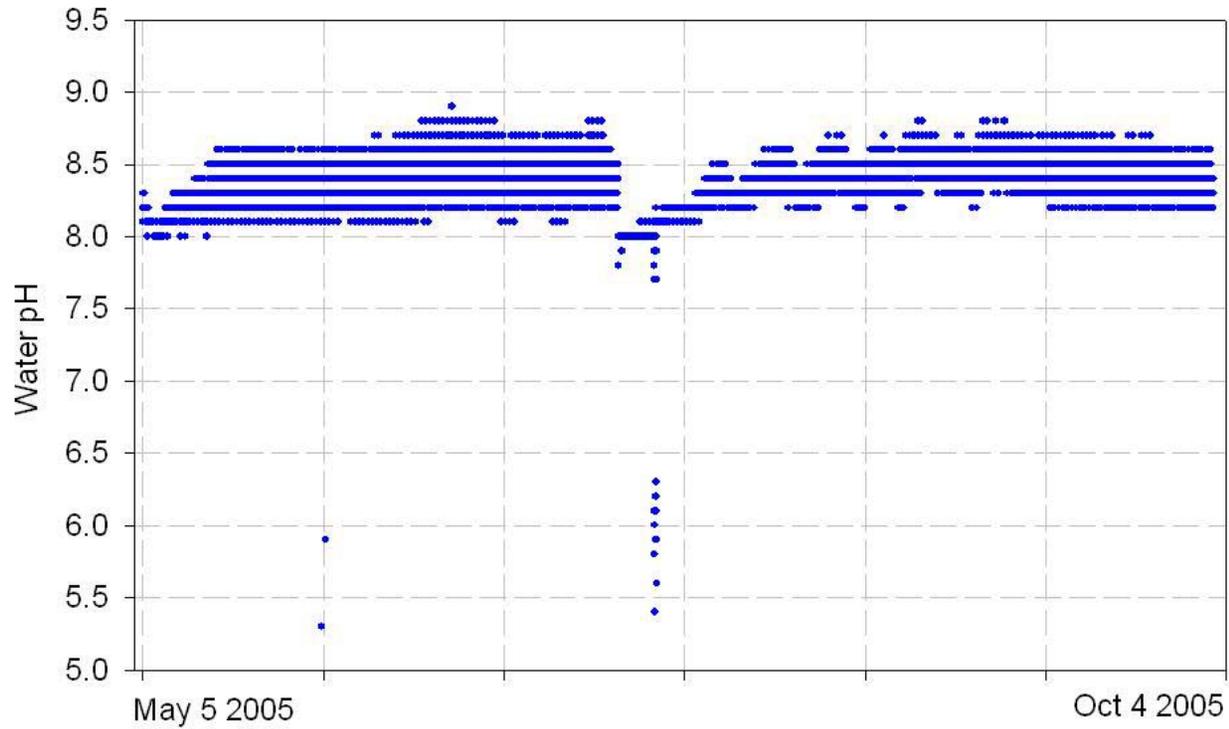


Figure 1. Hourly pH in the Trinity River near Weitchpec. The station (WPC) is located at latitude 41.179 and longitude -123.706. pH data (N=11,864) are available only from 05/05/2005 to 10/04/2005. Source: <http://cdec.water.ca.gov>.

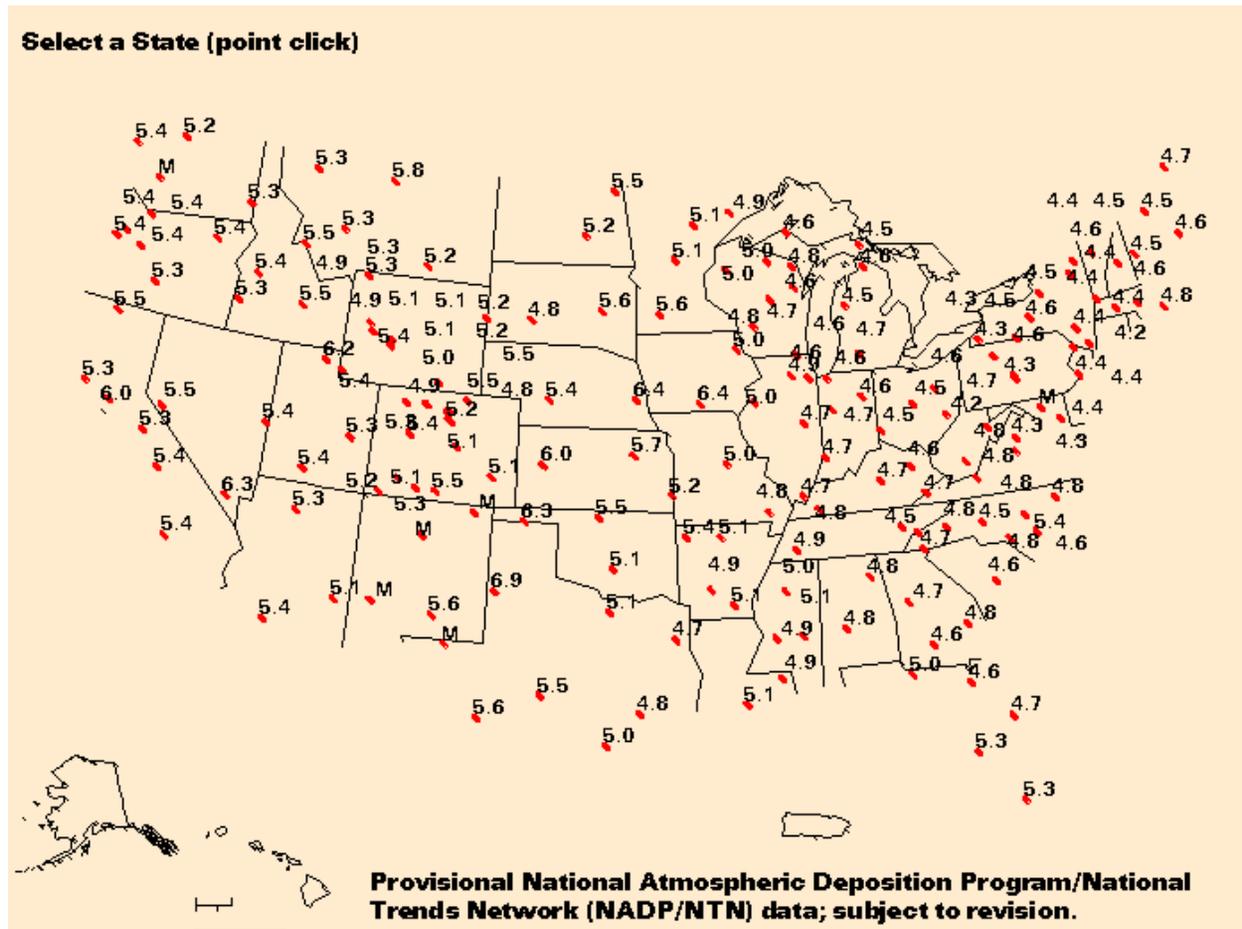


Figure 2. pH of precipitation for November 26 - December 23, 2001. Obtained from <http://water.usgs.gov/nwc/NWC/pH/html/ph.html>.

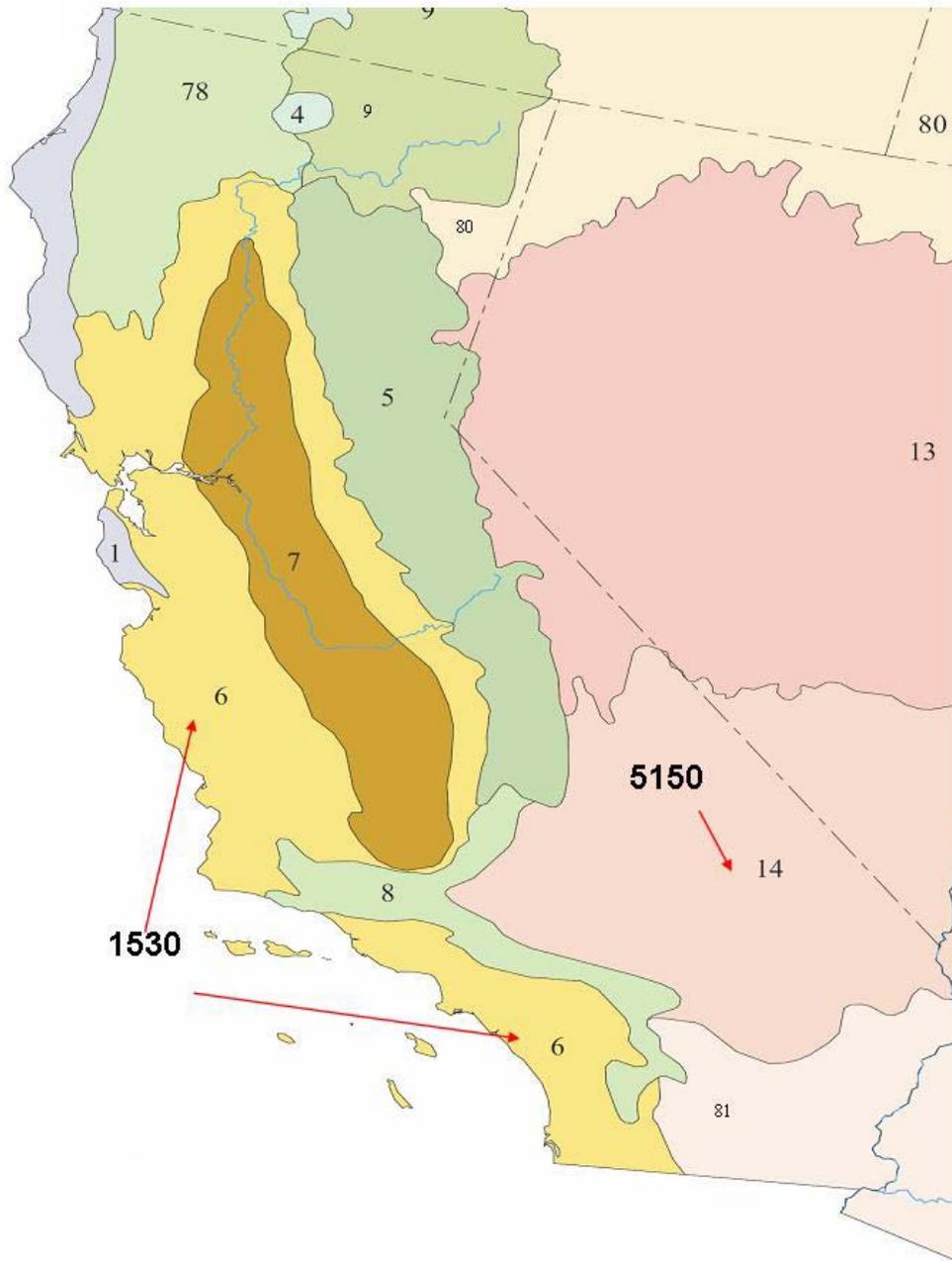


Figure 3. EPA level III ecoregion map with median suspended sediment concentrations (mg/l) for ecoregions 6 and 14 from Simon et al. (2004).

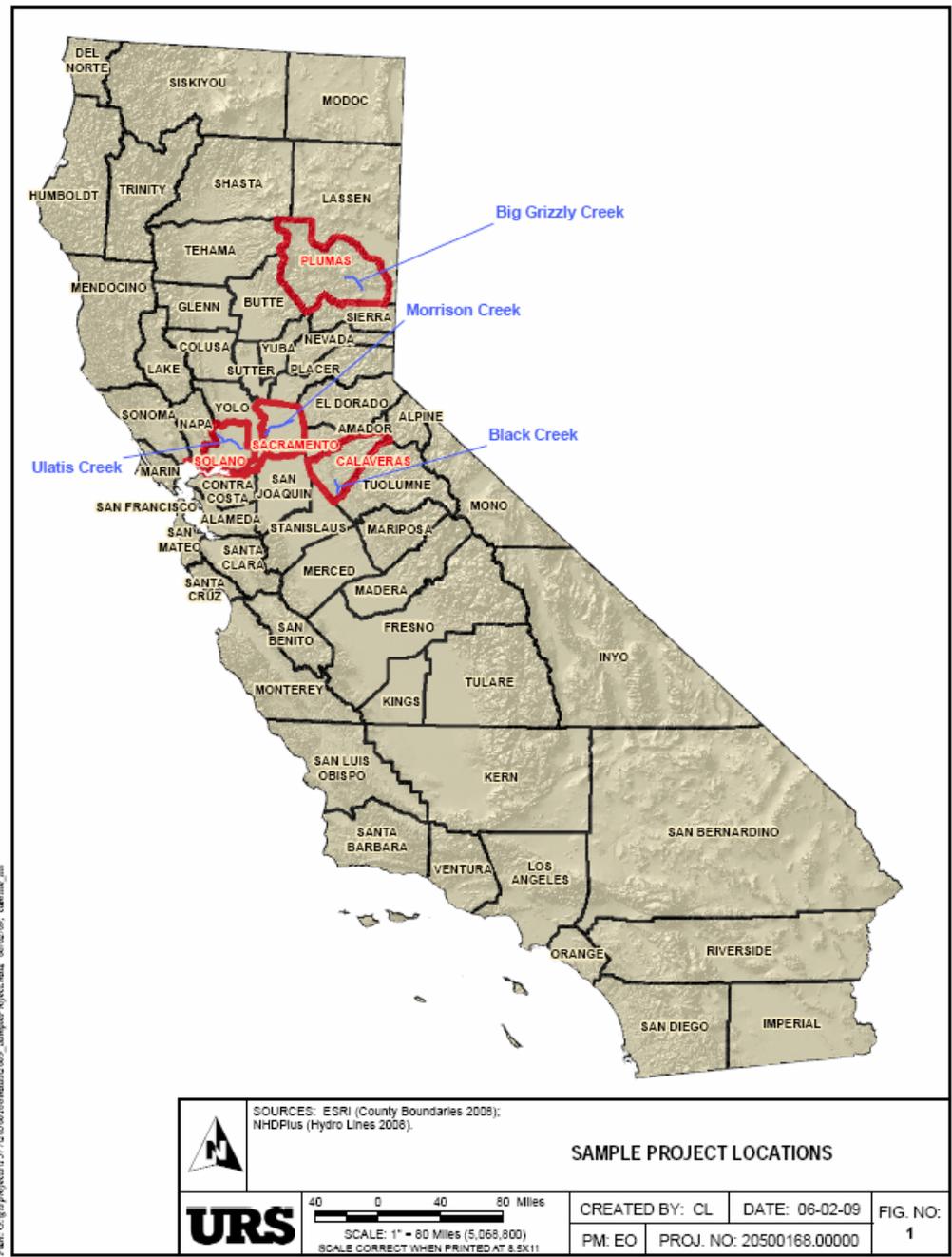


Figure 4. General locations of four sites where statewide Regional Water Quality Control Board enforcement data were collected. Map prepared by URS.

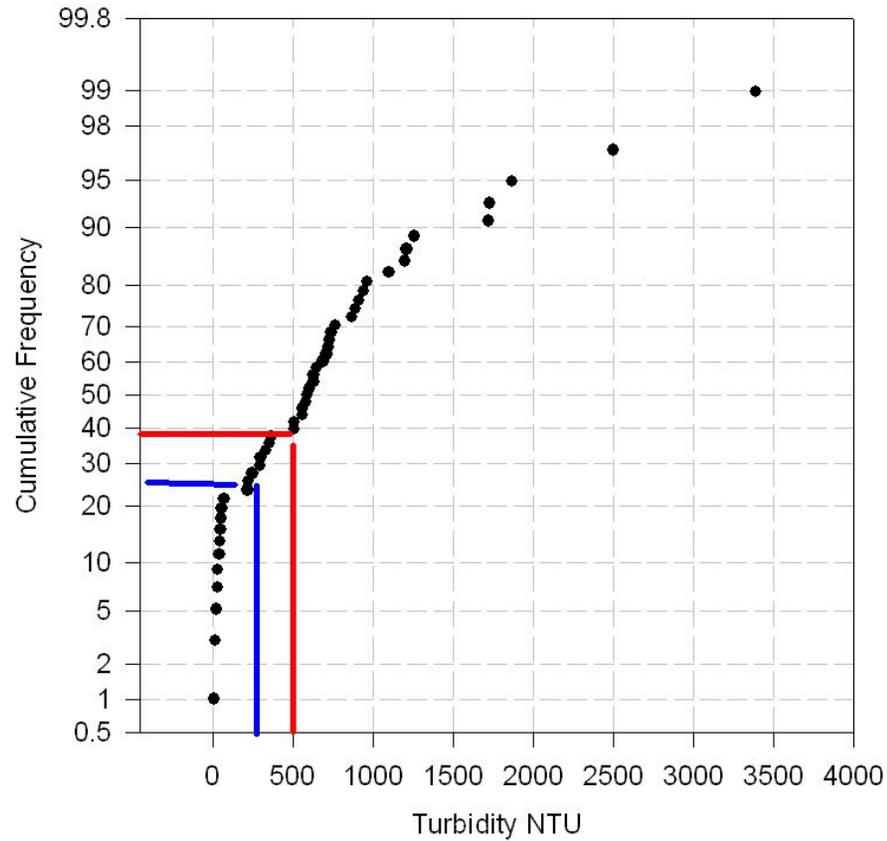


Figure 5. Cumulative percentile plot of Caltrans turbidity data, based on 49 data points collected during water year 1999/2000 and 2001/2002 (no data were collected during water year 2000/2001; Caltrans 2002). The data in the Caltrans (2002) dataset would exceed the proposed NEL of 500 NTU 60% of the time and would exceed the proposed NAL of 250 NTU 75% of the time.

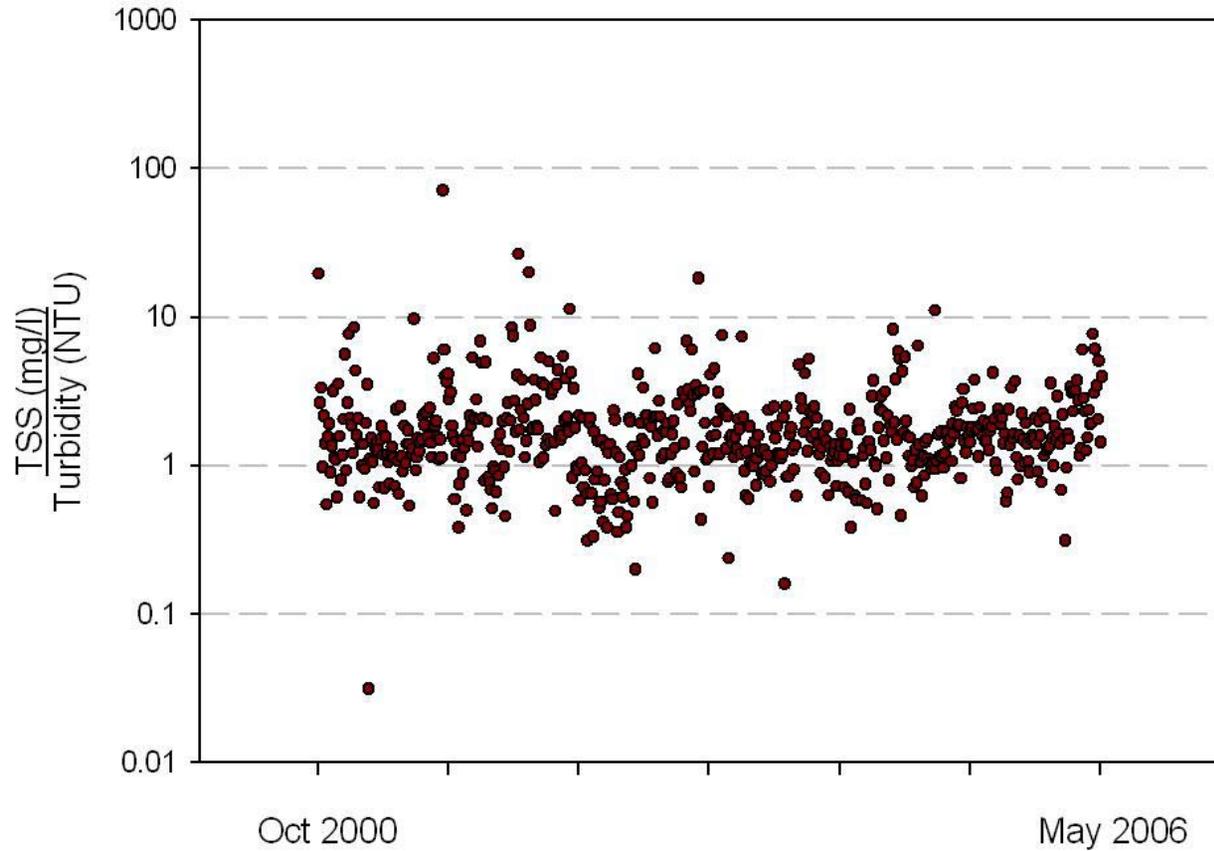


Figure 6. Ratios of total suspended solids (TSS, mg/l) to turbidity (NTU) in storm water samples (1992-2006) collected by Orange County. Source: http://www.ocwatersheds.com/StormWater/documents_damp_pea.asp.

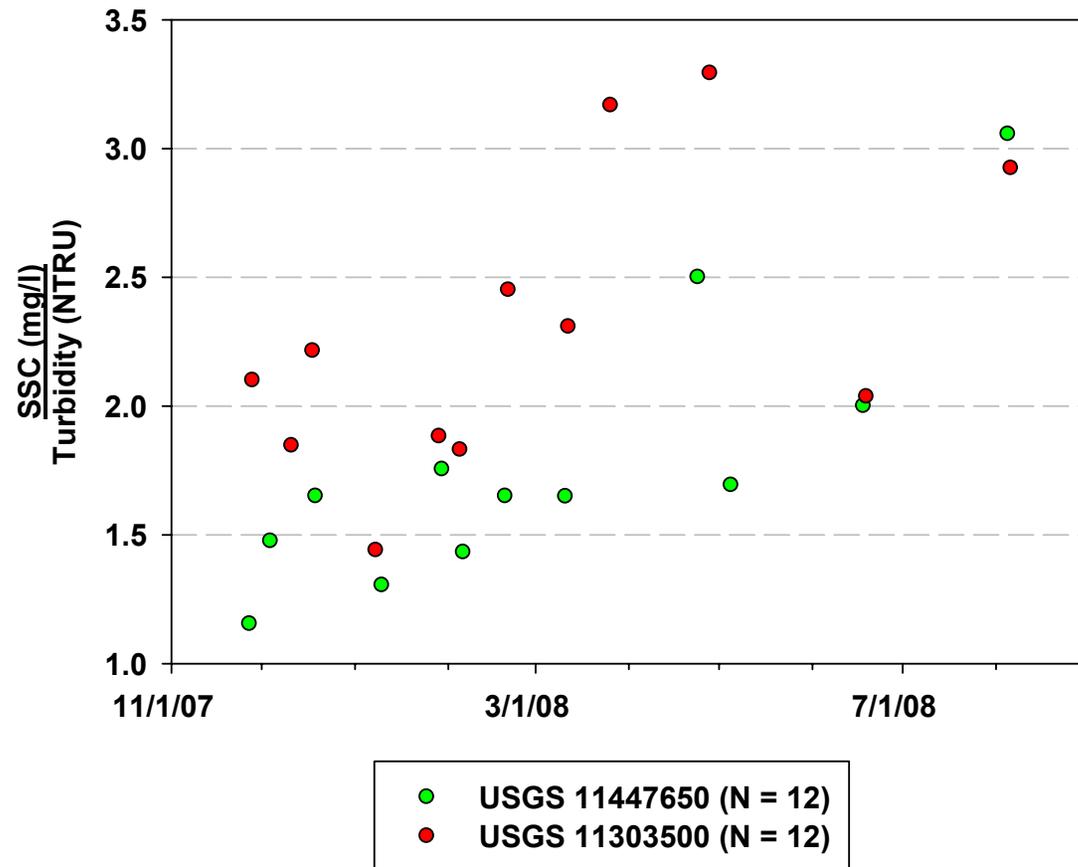


Figure 7. Ratios of suspended sediment concentration (SSC, mg/l) to turbidity (NTRU) in data collected from USGS stations from October 2007 to August 2008. Source of data: <http://waterdata.usgs.gov/usa/nwis/sw>.

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