More on Feasibility of the NRDC proposed 200 NTU Turbidity Limit and NAHB Proposed 1000 NTU Action Level
Last Update: May 29, 2009

Overall Summary

NRDC has proposed that a 200 NTU compliance limit be adopted for all construction sites with greater than one acre of disturbed soil (but less than 30 acres, where the 13 NTU limit based on ATS technology is proposed in the EPA ELG). Citing papers from Dr. McLaughlin (included in the docket as Exhibits 4 and 10 in the NRDC comments to the proposed C&D ELG), NRDC says that cheap technology is available that can meet this 200 NTU limit. The primary technologies found to be most effective in the McLaughlin papers are termed Passive Treatment Systems (PTS), which include PAM flocculation logs or some other passive flocculation delivery system. Auxiliary BMPs often used include skimmer outlets to ponds and fiber check dams (FCD).

Our review of the McLaughlin papers do confirm that where PTS has been tried under the direction of qualified experts, they have been shown to be effective at reasonable initial cost. However, they do not demonstrate the consistency required for an ELG compliance limit of 200 NTU, and frequent maintenance and adjustments may create ongoing costs that are much higher than the original installation cost. The 200 NTU might serve better as a technology based action level on sites where PTS are deployed, since exceedence of this level appears in most cases to be indicative of a problem with the PTS. The biggest problem with these systems is that they do not appear to be very robust. In a large number of the test cases, the PTS evidently failed during the storm event, or between one storm event and another. In fact, in several instances, the author reported the results from rain events where the PTS remained fully intact throughout. In one series of tests (Table 3, Exhibit 10) the PTS remained intact for 7 rain events, but failed in some way in nine rain events, or for a majority of the rain events. The author admits that expert installation, maintenance, and repair are needed to keep the NTU level consistently under 200 NTU, and that this requires a "great deal of diligence". The PTS system also must be frequently upgraded or modified as soil disturbance activities progress; this was particularly the case for one three acre LID site. For this site, the author suggested an "off-site" settling pond, but this is not an available solution for most construction sites.

Recently, NAHB has proposed that sites over 30 acres monitor their discharge for turbidity, using an "action level" of 1000 NTU. Exceedence of this action level would require, among other actions, a review as to the effectiveness of the existing BMPs at the specific site where the exceedence occurred. NAHB believes that PTS systems are one of several viable technology choices as BMPs at sites where this 1000 NTU level has been exceeded. However, given the problems outlined in this report, NAHB does not believe that a numeric compliance limit can or should be used in conjunction with PTS.

Summary of Exhibit 10

Exhibit 10 is actually the earlier of the cited McLaughlin papers, sot it is discussed first here. The greater part of the data used to justify a 200 NTU limit from PTS treatment comes from this paper. When McLaughlin states that a 200 NTU limit would be feasible, he specifically applied this statement to sites that properly employed passive flocculation systems termed Passive Treatment Systems (PTS). The following is a direct quote summary of the points made in McLaughlin Exhibit 10 concerning the 200 NTU limit, that deal with the proper installation and operation of PTS. Note that these appear to require considerable on site staff expertise and "a great deal of diligence" to operate properly.

- Erosion and sediment control systems need to be designed to include PTS from the beginning.
- Successful PTS requires sufficient training of construction site staff, primarily those involved in grading and utility installation, in PTS functions and problems to avoid. It is likely a person trained in PTS will be needed on staff, or as a contractor.
- In most cases, the key factor in successful PTS use is routing all water from disturbed areas into the water conveyance with PTS installed. Bypass flows of untreated runoff is often the cause of turbidity spikes.
- The area immediately around the sediment basins needs to be stabilized at all times so as to not contribute untreated, turbid runoff into the basin.
- A great deal of diligence will be required to avoid spikes above any target turbidity level.
- One suggested strategy for LID projects is to site the sediment basins just outside the construction envelope to avoid compromising the basin functions during construction activities. While this will disturb a slightly larger area (5-10%), the benefits will likely be substantial.

The first example of successful PTS in Exhibit 10 is a study of a gravel road improvement project in the North Carolina mountains (original paper: McLaughlin, R. A., S. E. King, and G. D. Jennings. 2009. Improving construction site runoff with fiber check dams and polyacrylamide. J. Soil and Water Cons. (accepted)). This test compared a PTS consisting of PAM logs plus a Fiber Check Dam (FCD) with "standard practices". The "standard practices" are described as small rock check dams (RCD) in ditches along steep terrain. Apparently there was no room for settling ponds on this backcountry road project. Not surprisingly, the areas of the site with standard RCD had discharges with very high turbidity. This problem contributed to the much better performance for the PTS + FCD treated areas, however it is still clear that many individual samples exceeded 200 NTU (see Table 1 from Exhibit 10).

Table 1

Site 1 (27 storms)			Site 2 (9 storms)	
Turbidity (NTU)	Standard Rock	FCD + PAM	Standard Rock	FCD + PAM
Average	3813	34	867	115
Median	2488	16	308	45
Single Sample High	14768	335	3419	533

Table 2 represents a selected number of the above tests where the FCD+PAM was "installed and properly functioning" for the two construction sites.

Table 2

	Average Site 1 (22 storms)	Average Site 2 (7 storms)
Number of Samples	12	15
Rainfall (in)	1.06	0.68
Turbidity (NTU)	20	81
Standard Deviation (NTU)	15	28
Maximum (NTU)	50	125

A couple of questions arise. The above Table indicates that something went wrong in 5 of 27 storm events at Site 1, and two of nine storm events at Site 2, and apparently during these rain events, the discharge turbidity would have frequently failed to meet a 200 NTU limit. This represents potential violations occurring in essentially one out of every five rain events, which is an intolerable condition for a compliance limit. EPA ELGs typically calculate Daily Maximum limits based on the 99th percentile of the available data (screened by EPA). A failure rate of one in five rain events is therefore not indicative of a numeric compliance limit. It may be more suited as an action level for the FCD+PAM technology. What happened to the FCD+PAM treatment? Was it unavoidable? Do the PAM logs and FCD require frequent maintenance or replacement during the actual storm events in order to meet the 200 NTU limit? In such rough terrain, it may not even be either feasible or safe to maintain or repair these BMPs during the active discharge of stormwater.

Exhibit 10 goes on to describe operations at several other construction sites, including a 3 acre LID site. These sites evidently had a traditional settling pond, however, there was no comparison to the discharge from the ponds with or without a PTS system. Table 3 shows the results for seven rainfall events where fully functional PTS are in place, but does not show the results for nine other storm events where the PTS was undermined by continual grading activity at the sites. Evidently, many or possibly all of these nine events were at an LID site, which required frequent soil grading activity. The results from the seven intact PTS sites are promising, although one of the seven rain events reported a maximum turbidity of 336 NTU, which would be a violation. Also, it is important to note that these seven tests did not include a single truly heavy rain event. Only three of the rain events were at or slightly over one inch; two of the rain events were less than 0.5 inches, which should not generate much sediment runoff even without a PTS. The fact remains that nine additional events, a majority, evidently did not at all consistently meet a 200 NTU limit. There is no information on the rain intensity or total rainfall for the nine "failed" events. Furthermore, with the LID site, it appears that most of the additional disturbances that undermined PTS effectiveness could not be avoided. The author suggested that this problem could be solved by installing an off-site pond. This solution would not be possible at most construction sites.

Table 3

Date	Rainfall (in.)	Average Turbidity	Std. Dev.	Maximum Turbidity
9/16/2008	1.15	167	93	339
11/4/2008	0.88	43	27	108
11/14/2008	1.17	50	19	98
11/25/2008	0.35	40	22	80
11/30/2008	1.01	37	8	48
12/25/2008	0.34	38	22	116
1/06/2009	0.68	11	12	46
	Averages	55	29	119

Finally, Table 4 of Exhibit 10 examines some simulated rain event experiments performed at the NC State Sediment and Erosion Control Research and Education Facility (SECREF). The experiment series looked at different pond outlets, both with and without PAM. The experiments showed that while the sediment capture rate was >97% for all tests, the PAM affected the average (weighted by volume) turbidity in the discharge to a much greater extent than the type of pond outlet. However, with the average turbidity as high as 162 NTU, the 200 NTU level would almost certainly have been exceeded for some grab samples.

Table 4

Sampling Position	No PAM* (NTU)	PAM** (NTU)
Basin In (untreated)	843a	847a
Rock Outlet	758ab	152b
Skimmer Outlet	353c	162b
Grass Buffer	498bc	70b
Forest Buffer	na	108b

Discussion of Exhibit 4 in Regards to a 200 NTU Limit and the NAHB Proposed 1000 NTU Action Level

This Exhibit is more recent, and formally endorses a numeric limit of 200 NTU for PTS systems, and supports the EPA 13 NTU limit for ATS systems. It is co-authored by Dr. McLaughlin and Alex Zimmerman; although it would appear that Zimmerman was the primary author of the sections on ATS, and McLaughlin was the primary source on PTS effectiveness, based on their biographical descriptions. Many of the claims in this exhibit are debated by NAHB in their comments. For example, the paper states in bullet form that the 13 NTU EPA limit can be met by ATS technology anywhere in the country, yet in the text, a site in North Carolina is reported to reduce turbidity from over 1000 NTU to "...<20 NTU in many cases." (Page 12, Exhibit 4.) Even though both statements support the effectiveness of ATS, this is am important discrepancy when discussing absolute numeric compliance limits. NAHB does not dispute that ATS treatment can be effective at reducing turbidity, but believes 1) the full costs have been underestimated, 2) it is impractical to implement as written in the EPA ELG, and 3) it removes turbidity far below natural turbidity levels in most receiving streams, making its use superfluous and not cost effective, and in some instances detrimental to natural biota and downstream bank stability. There are also documented cases from State agencies of flocculant overdose with detrimental effects.

As to the applicability of a specific 200 NTU numeric compliance limit, little new data over what was already in Exhibit 10 is presented, and this limit has not been subjected to a rigorous statistical evaluation. The data shows that 200 NTU or less can be met in a majority of cases, but this requires very significant, frequent, and immediate interventions on the part of trained personnel. Even then, there will be frequent instances at different sites or during certain rain events where the 200 NTU limit is exceeded through no fault or lack of attention on the part of the site operator. It would therefore appear that 200 NTU could possibly serve as an action level for PTS technology, requiring the initiation of corrective measures, but it is not suitable as a numeric compliance limit.

Recently, NAHB has proposed that an action level of 1000 NTU be implemented for all sites with greater than 30 acres of disturbed soils, that would otherwise have qualified for the EPA proposed Option 2. Exceedence of this action level would require an inspection and re-evaluation of the BMPs required in the SWPPP, as well as additional sampling to verify the problem has been corrected. A second consecutive exceedence would require notification of the appropriate regulatory agency.

This 1000 NTU action level, while high, should effectively target the few construction sites that contribute the majority of sediment to the discharges from construction sites. Many studies, including ones from the Auckland Regional Council (July 2008 paper, cited in previous 1000 NTU Action Level document), indicate that the greatest amount of sediment discharged from construction sites comes from a limited number of sites and rain events. High energy rain events create the greatest erosion and also the largest volume of runoff within a short time frame. The contributing factors that create sites that are at high risk for excessive sediment discharge could be regional in origin, or could be due to immediately local conditions. Sites with erosible soils and steep topography that are susceptible to sudden intense downpours represent the highest risk sites. These also are the sites most likely to exceed 1000 NTU in their discharge, even when conventional BMPs, including properly sized and designed settling basins are in place.

NAHB expects that exceedence of this proposed action level would be rare, but that it would occur at those sites most likely to contribute the most sediment discharge to US waters. Based on Washington State tubidity data for King County (greater Seattle), discharge from sites with conventional BMPs exceeds the 1000 NTU slightly more than one percent of the time. However, the action level could be exceeded more frequently in other parts of the country. In Exhibit 4 (page 7), McLaughlin discusses instances where even properly designed sediment basins can have average discharges of greater than 1000 NTU. McLaughlin-Zimmerman does not discuss whether better erosion control measures upstream from the basin could have reduced the discharge turbidity. However, NAHB is aware that at conventional BMPs are not 100% effective at all sites. An action level of 1000 NTU would help identify the sites requiring additional BMPs and BMP technologies. The PTS treatments described by McLaughlin should not be required at every site, and may have varying effectiveness at sites where they are implemented. However, PTS should be included among the BMP options that could be implemented, in order to insure that the turbidity of the discharge does not exceed 1000 NTU in any future rain event.