be noted that a lack of storm response in the gravel with filter and sand trenches between October 2008 and March 2009 limits the detectability of a trend.

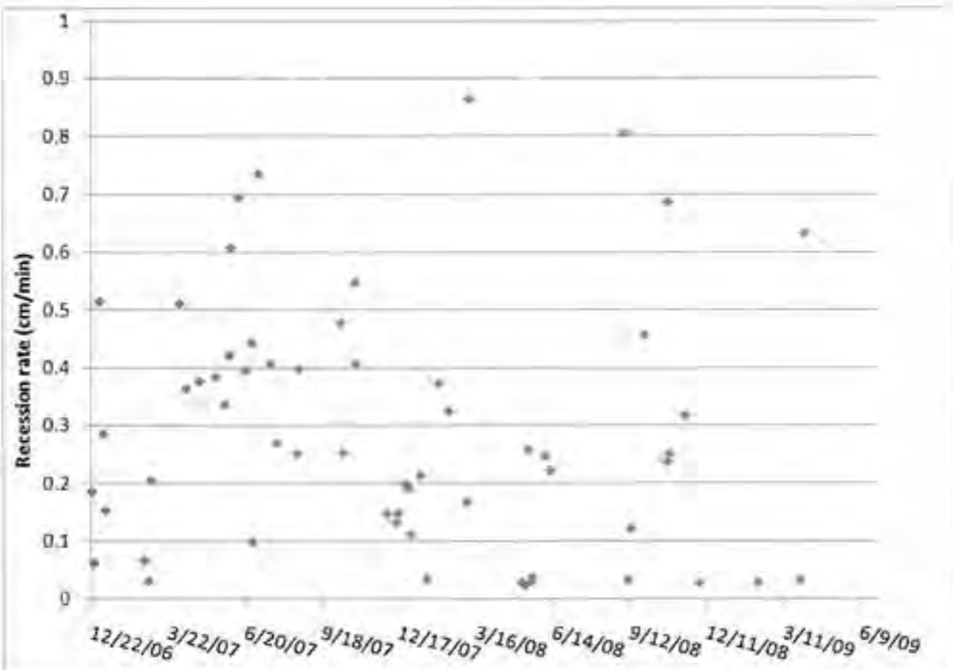

Figure 3-20. Plot of recession rate over time for the gravel trench.

The recession versus water level plots show a linear relationship between recession rate and water level. As the height of the water level peak increases, the recession rate increases (Figures 3-23, 3-24, and 3-25). This relationship can be explained in part by the change in the hydraulic gradient (difference in water level inside and outside the trench) and the increase in trench wall area through which the water can drain.

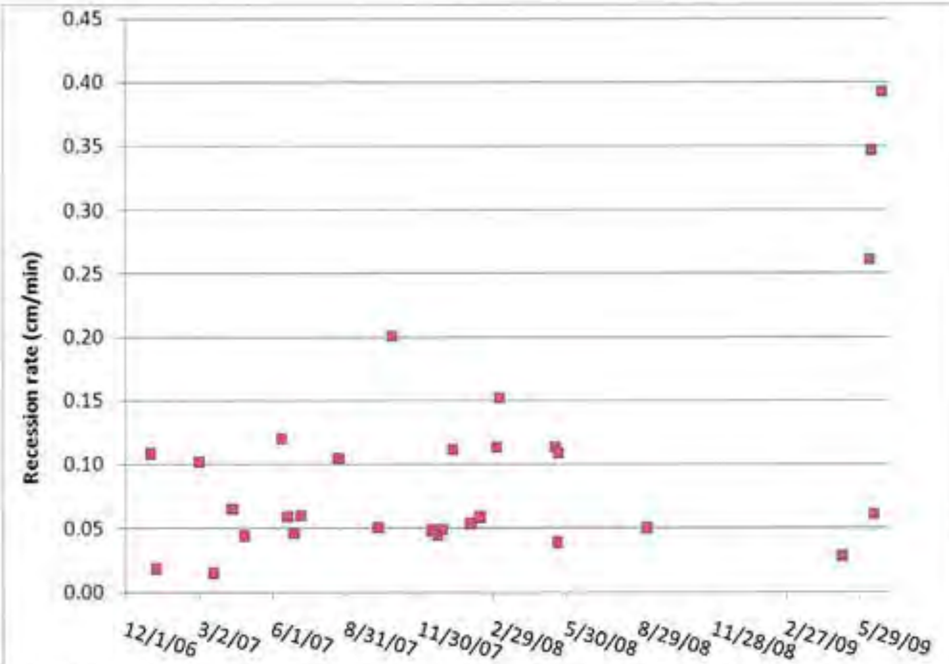

Figure 3-21. Plot of recession rate over time for the gravel with filter trench.

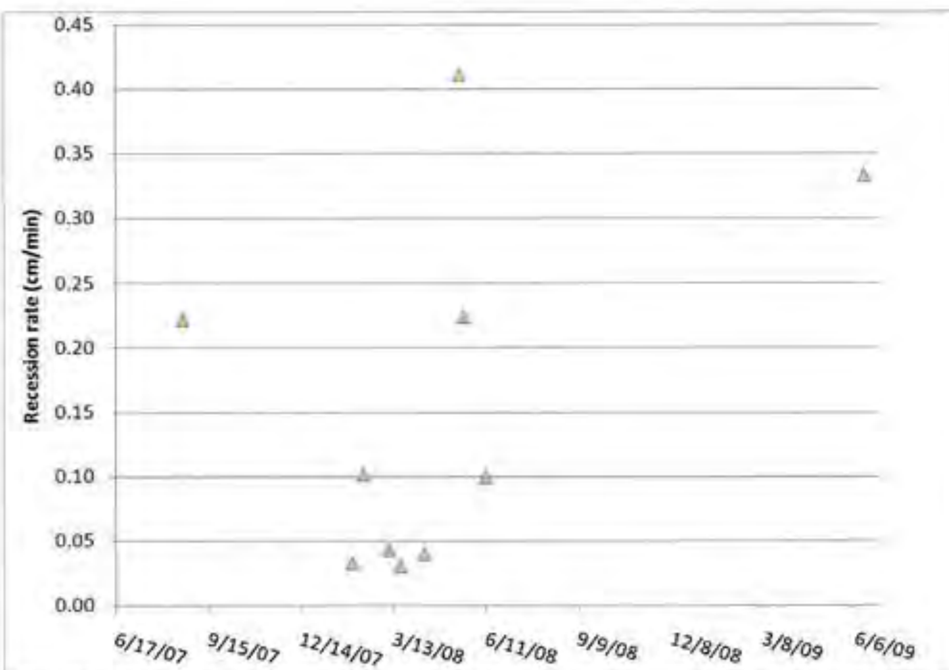

Figure 3-22. Plot of recession rate over time for the sand trench. Note that only data collected after the well replanting are plotted on this graph.

Linear fitting of this relationship shows R^2 values that are similar for all 3 trenches ranging from 0.71 to 0.73. Some of the scatter can be explained by the method used to calculate the recession rate. In some cases, it may have still been raining as the trenches started to drain. The sand trench plot had the line with the highest slope, 2.3. This slope value differs from the lower slopes of the other two trenches because only the very tops (greater than 30 cm) of the sand trench peaks are recorded, which is likely to drain faster because it has the highest gradient. The unfiltered gravel trench linear regression had a higher slope (0.8) than the gravel with filter trench (0.7). Both the recession rates and the water levels are highest for the right side gravel trench and it also showed a faster response during experiments.

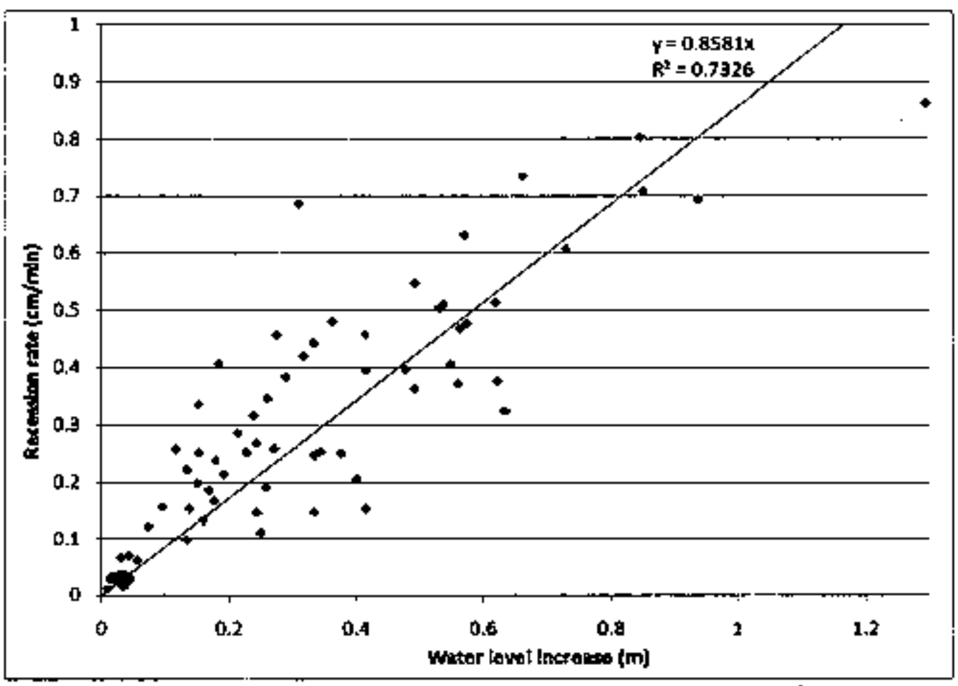

Figure 3-23. Plot of recession rate versus water level increase for the gravel trench.

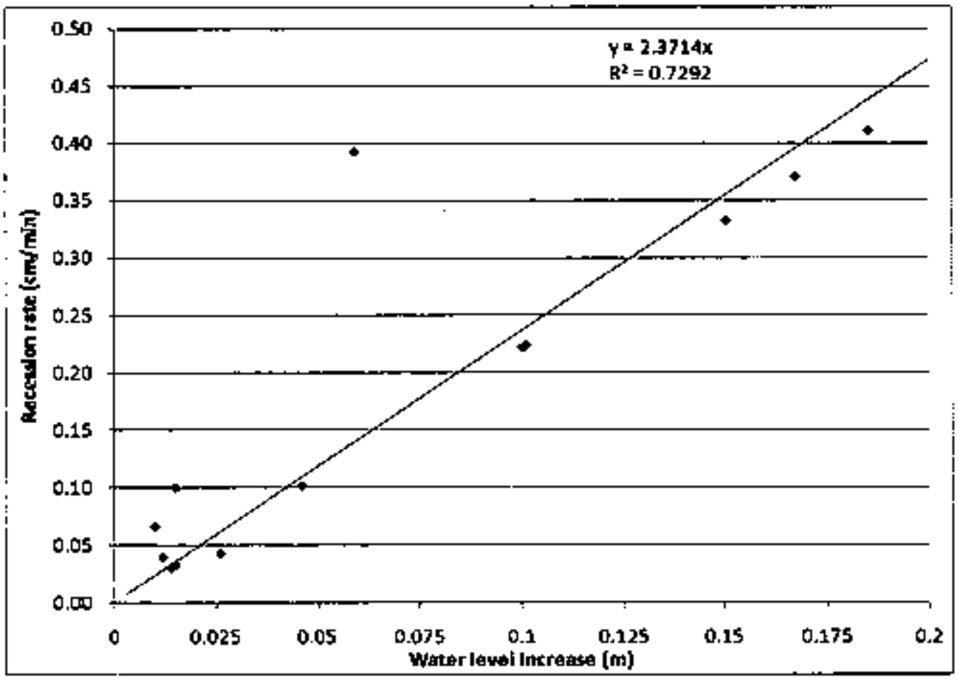

Figure 3-24. Plot of recession rate versus water level increase for the sand trench.

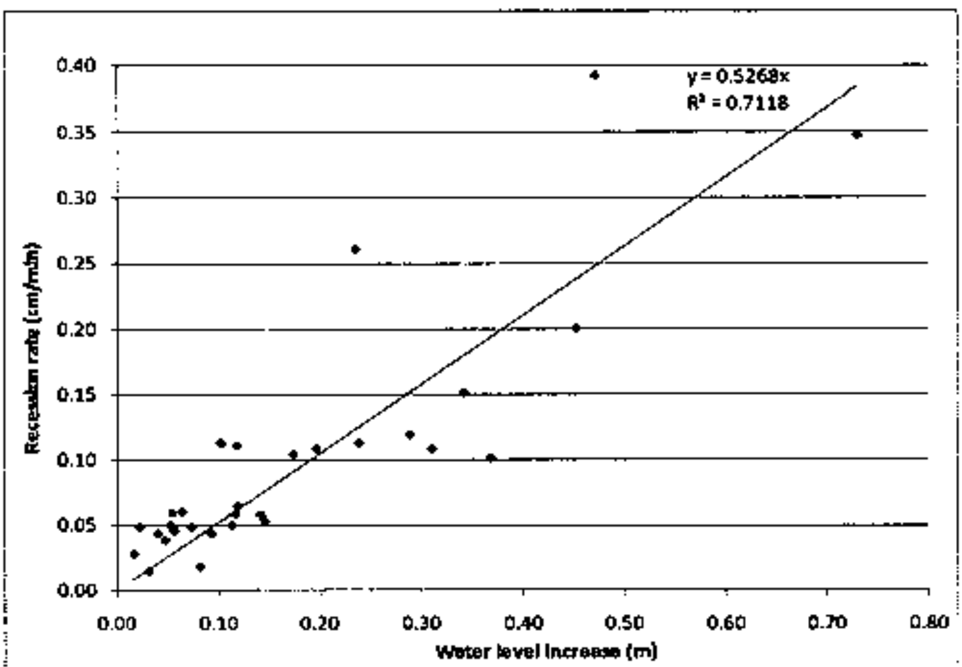

Figure 3-25. Plot of recession rate versus water level increase for the gravel with filter trench.

3.5 Individual Storm Events

3.5.1 Events with Large Responses

The data recording interval for all of the individual storm graphs is 15 minutes. The sand trench baseline is displayed as 0.3 m on all of the graphs. Of the 3 largest events, the same storm did not produce a maximum water level in more than one trench. This distinction between trench responsiveness points to differences in delivery of water during different storm events.

During the March 8-9, 2008 storm, the water level in the gravel trench reached 1.29 m above base level, the highest recorded water level of all 3 trenches (Figure 3-26). At this level, the water level would have exceeded the depth of the trench, 1.22 m (4 ft), thus potentially overflowing the trench. There was a response in the gravel with filter trench (less than 1/3 of the level of the gravel trench peak) but none detectable in the sand trench. The drainage rate of the gravel with filter trench was lower than that of the gravel trench.

The June 13, 2009 storm resulted in the highest recorded water level, 0.74 m above base level, in the center gravel with filter trench (Figure 3-27). This event was one of the last storms on record and marked a return to responsiveness in all 3 trenches. This response was also distinguished by the highest water level in the gravel with filter trench, which is the highest observed water level, 0.74 m above base level, for this trench. Furthermore, the drainage rates in the 2 gravel-filled trenches were uncharacteristically similar. Usually, the gravel trench showed evidence of emptying faster than the gravel with filter trench.

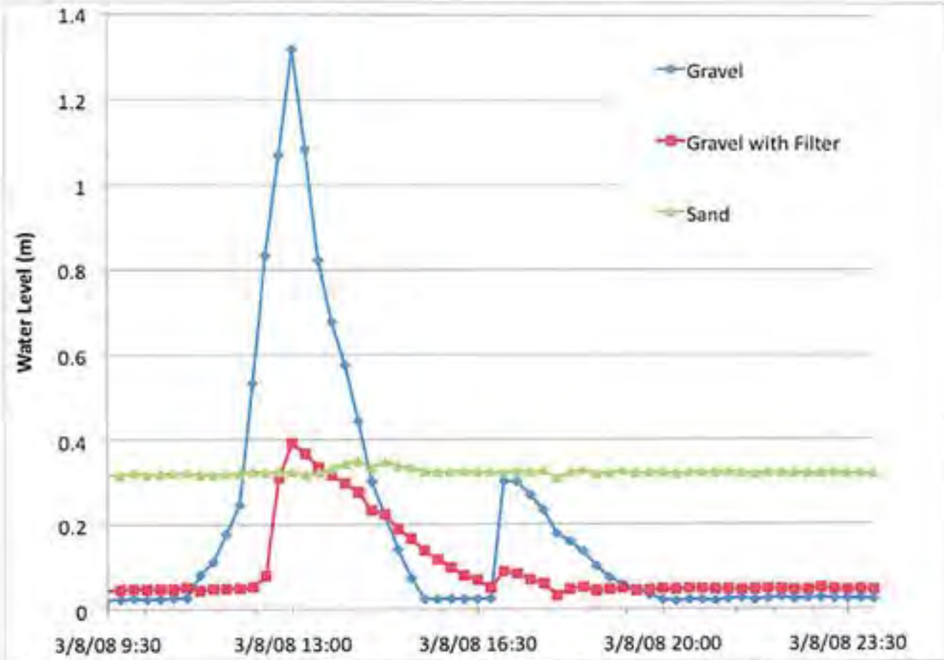

Figure 3-26. Water level data for all 3 trenches from March 8-9, 2008 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

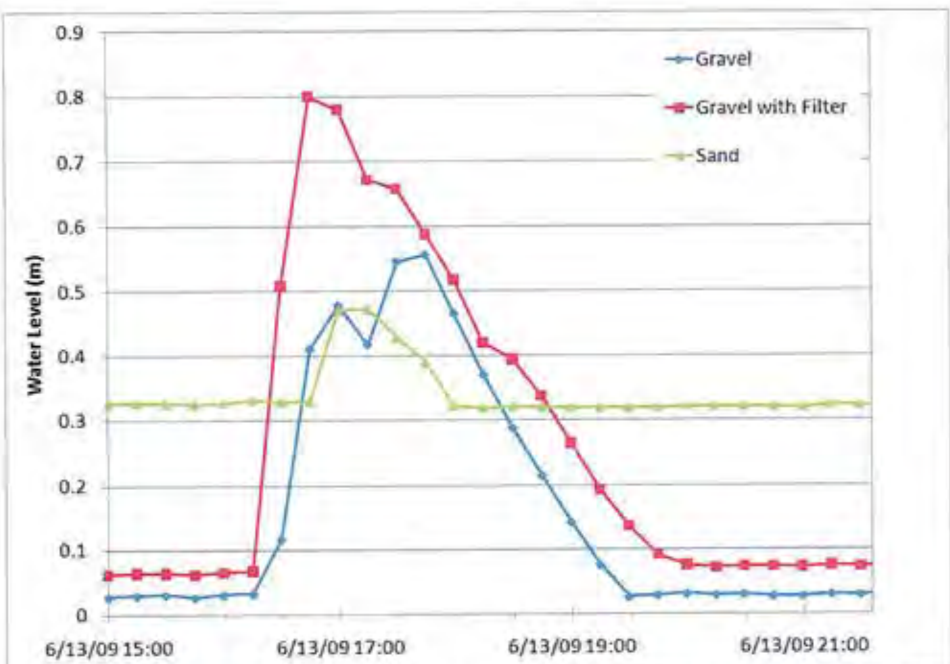

Figure 3-27. Water level data for all 3 trenches from June 13, 2009 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

The July 19, 2007 storm results in the highest recorded water level of 0.5 m in the sand trench (Figure 3-28). The response is very unusual because there was no response in the center gravel with filter trench. Other storms that resulted in a higher response in the sand trench than in the gravel trench also created a response in the gravel with filter trench. The gravel trench's maximum water level is less than half that of the sand trench. The sand trench experienced a very high drainage rate; however, the bottom 0.3 m of the recession curve is not observable due to the transducer offset.

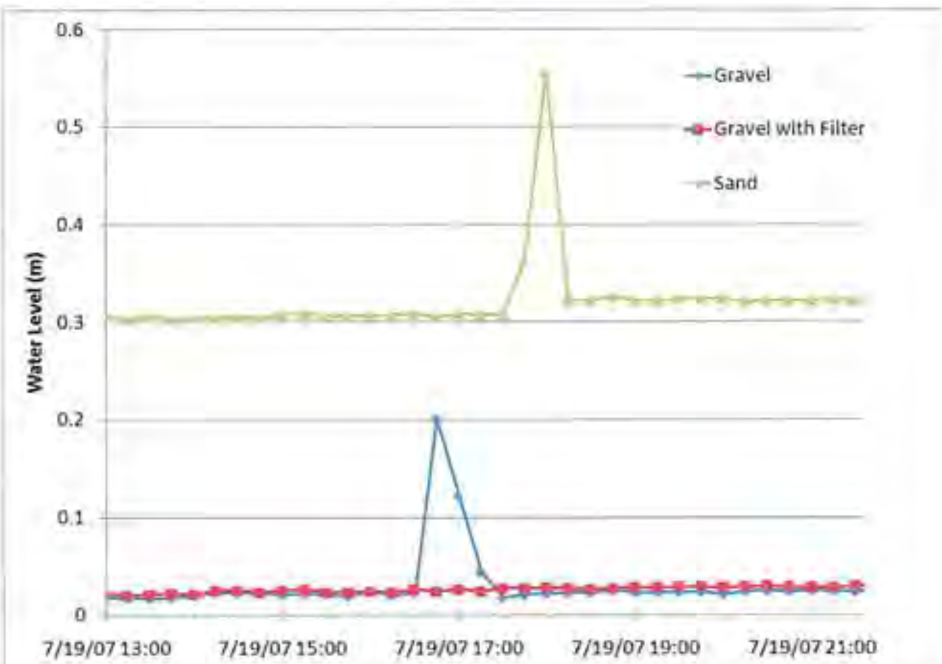

Figure 3-28. Water level data for all 3 trenches from July 19, 2007 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

The storm event that resulted in the longest duration of drainage on record occurred over April 15-16, 2007 (Figure 3-29). The gravel trench water level was significantly higher than the water levels in the other two trenches. At water levels over

0.2 m, the gravel trench emptied very quickly compared to the other two trenches which had slower drainage and did not empty. The large quantity and long duration of rainfall resulted in an extended drainage period afterward. The sand trench took the most time to drain. All of the trenches experienced very low drainage rates at the end of the event when the water levels decreased to 0.1 m.

This is one of the few good examples of sand trench behavior on record. The entire depth of the trench is observable only prior to July 2007 when the monitoring well was replanted. In spite of the very high rate of rainfall and response in the gravel trench, the sand trench barely reached 0.3 m, the lowest water level detectable after the well replanting. This helps explain why it is rare to see a significant sand trench peak after that offset.

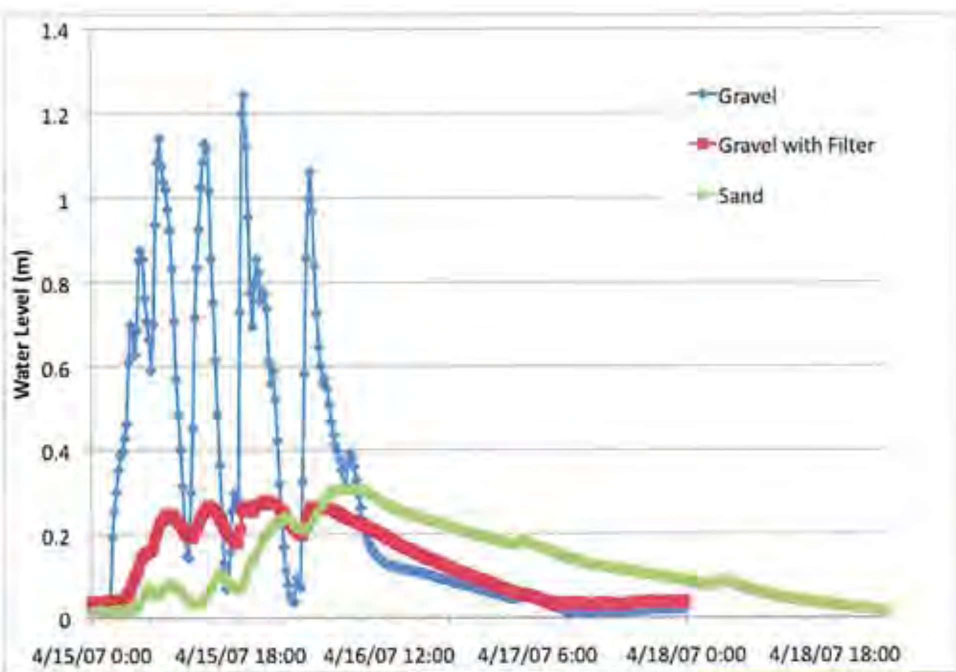

Figure 3-29. Water level data for all 3 trenches from April 15-16, 2007 storm event.

3.5.2 Examples of Other Behavior

The storm on March 2, 2007 is an early example of the drainage behavior of all 3 trenches (Figure 3-30). This graph illustrates the high drainage rate in the sand trench similar to that observed during the experiments. Since there is a shorter data set for the sand trench due to the replanting of the monitoring well 0.3 m above the trench bottom, this is one of the few observations of the 3 trench peaks being within 0.1 m of each other.

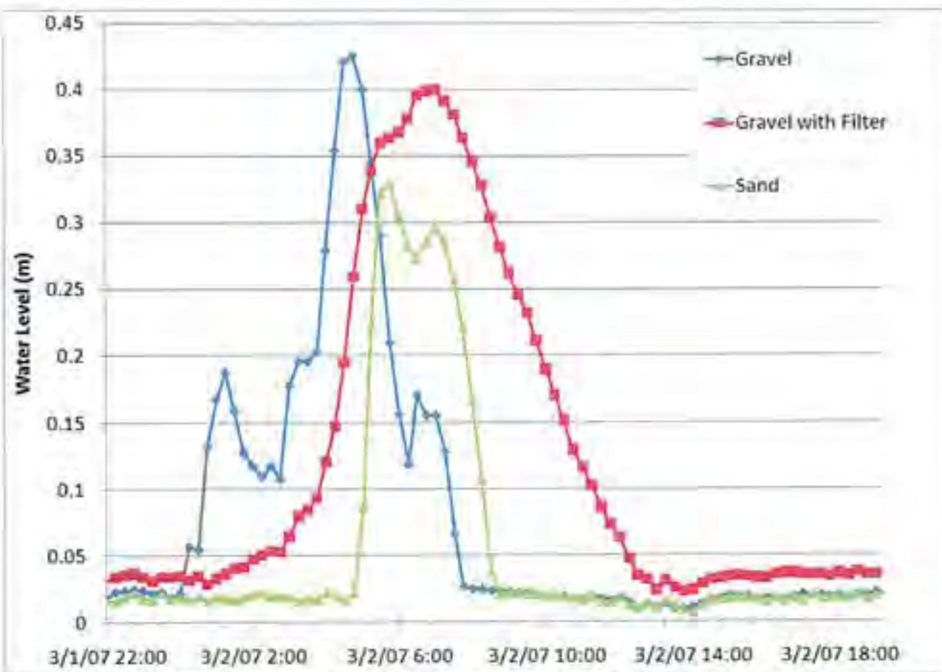

Figure 3-30. Water level data for all 3 trenches from March 2, 2007 storm event.

The October 27, 2007 storm is an example of an early storm in which the variation in drainage rate between trenches was recorded over multiple peaks (Figure 3-31). The gravel and gravel with filter trenches still matched up fairly well in responding to pulses of rain that created multiple peaks. The peaks of the gravel with filter trench were consistently lower than those in the gravel trench during this storm event. Since the

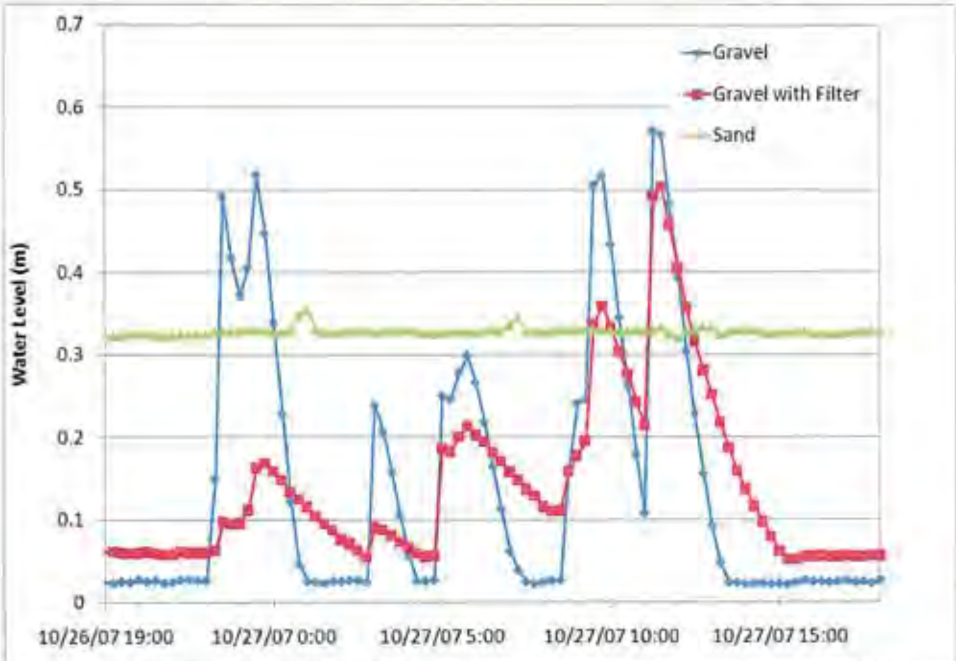

Figure 3-31. Water level data for all 3 trenches from October 27, 2007 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

gravel with filter trench drainage rate was lower as shown by the shallower slope of the recession curve; this implies that the lower peak in the gravel with filter trench was not caused by the water draining faster as it entered the trench. The most likely explanation for the lower peak is that less water was reaching the center gravel with filter trench. The drainage rates of the gravel and gravel with filter trenches were similar only when the water level was above 0.4 m.

The presence of small peaks in the sand trench implies a response to storm events, but their interpretation is complicated by the sensor being raised 0.3 m from the bottom of the trench. The water level peaks in the sand trench do not correlate in time with the peaks of the two gravel trenches. The peaks typically occurred after those in the other two trenches, following the response timing offset that was observed in the sand trench during other storms. This implies a delay of water reaching the bottom of the trench possibly caused by pooling of water on the surface of the sand and delayed infiltration. However, this explanation does not account for the lack of corresponding water level peaks in the sand trench for the highest water level peaks recorded in the other two trenches.

The storm on December 16, 2007 is an example of the most common type of trench behavior: gravel trench highest, gravel with filter trench significantly lower, and sand trench lowest or not detectable (Figure 3-32). The gravel with filter water level peak was less than one fourth of the gravel peak. There was a barely detectable peak in the sand trench. This type of behavior had occurred since 2007, which implies that the uneven delivery of water had been an issue since then.

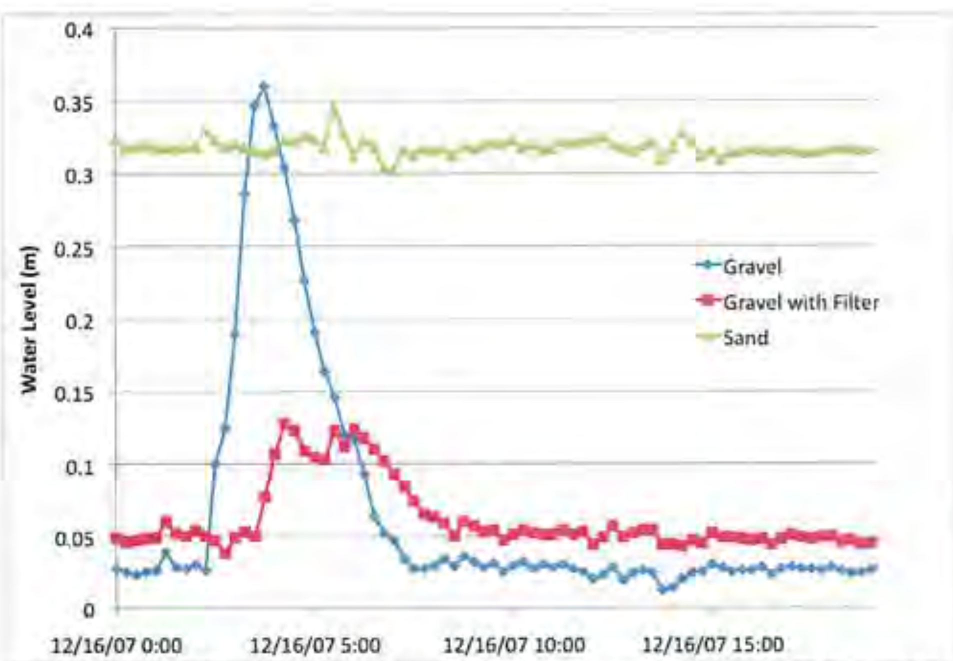

Figure 3-32. Water level data for all 3 trenches from December 16, 2007 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

For several storms, the highest water level was in the gravel trench, but the other two trenches did not respond at all. During the June 4, 2008 storm and the January 7, 2009 storm (Figure 3-33 and 3-34), only the gravel trench experienced an increase in water level. These two storms showed no response in the sand and gravel with filter trenches in spite of a 0.3 m or greater water level in the gravel trench. It is interesting to note that these results were observed during different seasons 7 months apart with different trench behavior observed between these two events. This association t to variation in water delivery, antecedent conditions, or rain behavior rather than a change in the trench due to degradation.

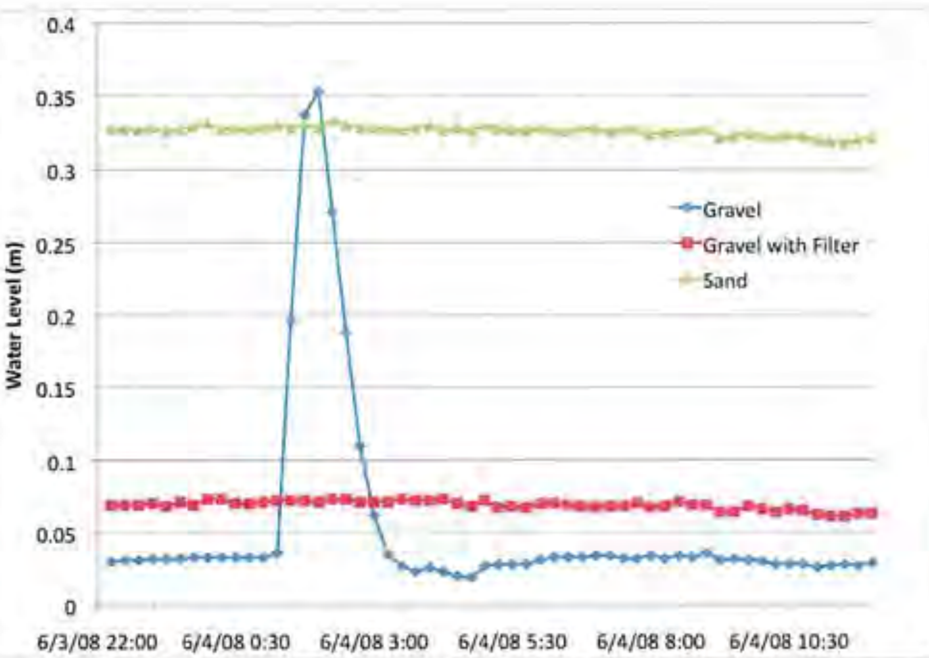

Figure 3-33. Water level data for all 3 trenches from June 4, 2008 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

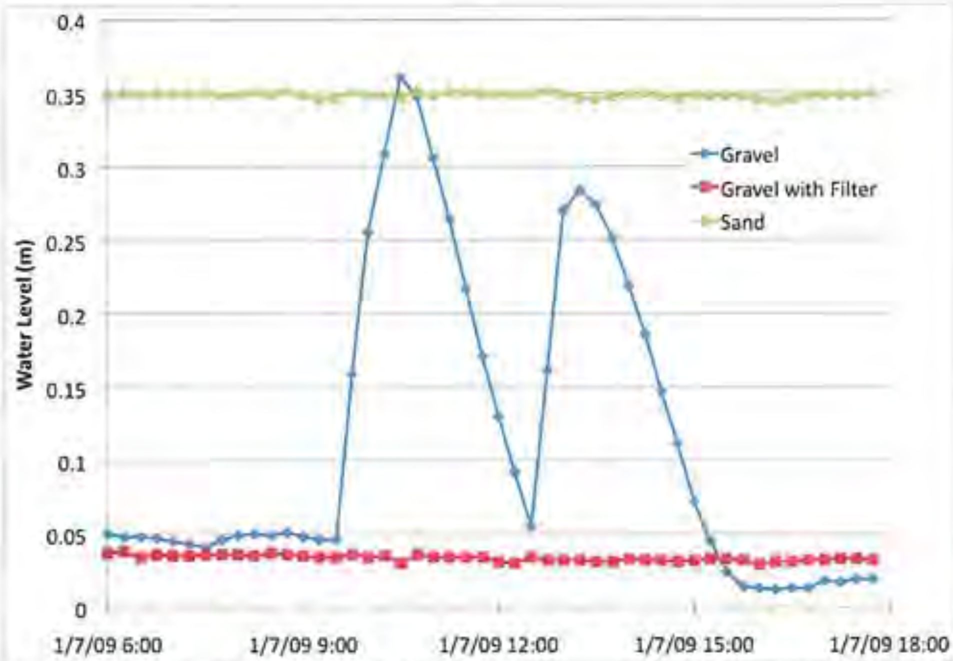

Figure 3-34. Plot of January 7, 2009 storm water levels for all 3 trenches. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

The October 9, 2007 storm is an example of a very high response in the gravel trench with limited responses in the other two trenches (Figure 3-35). The response in the sand trench was barely detectable. The response in the gravel with filter trench was only about 1/7th of that in the gravel trench. As before, this is consistent with more water reaching the gravel trench. This behavior is similar to the June 4, 2008 and January 7, 2009 trench storm responses (Figure 3-33 and 3-34). Compared with those two storms, the gravel trench water level was almost twice as high on October 9, 2007.

The May 20, 2008 storm is unusual because the gravel trench had the lowest water level (Figure 3-36). The response in the sand trench was unusually high. During this storm, I visited the study site. I observed water flowing from the black pipe at a higher rate than the water flowing from the usual water delivery pipe. Since the black pipe is located between the sand and gravel with filter trenches, it could have created this result.

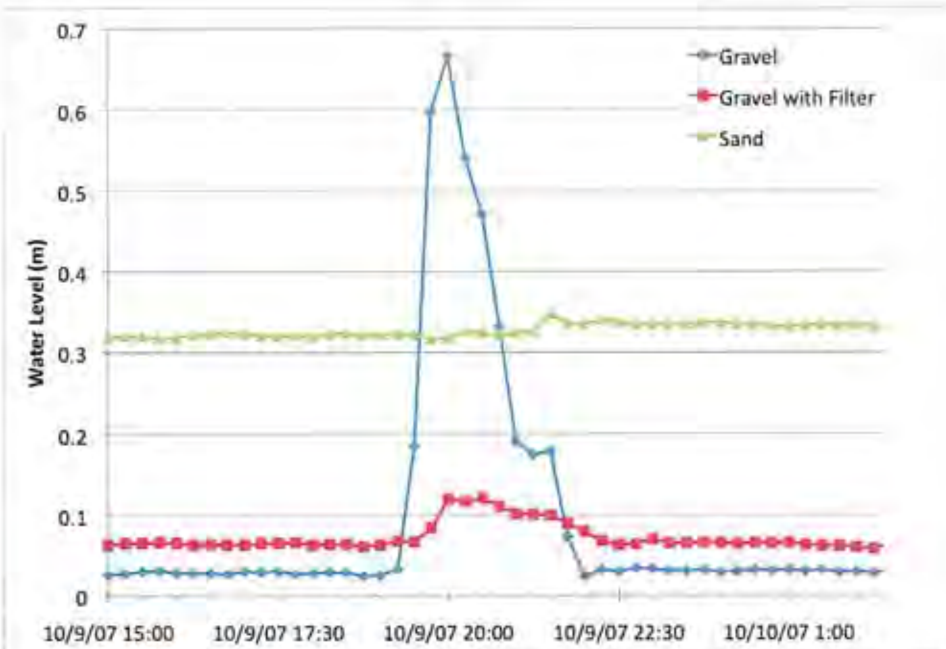

Figure 3-35. Water level data for all 3 trenches from October 9, 2007 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

In the same season on May 16, 2008 storm is another example of a rare type of storm response where the sand trench had the highest water level of the 3 trenches (Figure 3-37). This storm resulted in the second highest observed peak in the sand trench at 0.5 m from base level. Also unusual is that the sand trench response was not delayed. The sand trench peak was highest during the July 19, 2007 storm (Figure 3-28); however, that storm did not create a peak in the gravel with filter center trench at all.

The interpretation of variations in trench behavior during storms was limited by an inability to control or measure variables that influence the water levels and drainage rates of the trenches. It was difficult to meaningfully quantify variations in antecedent

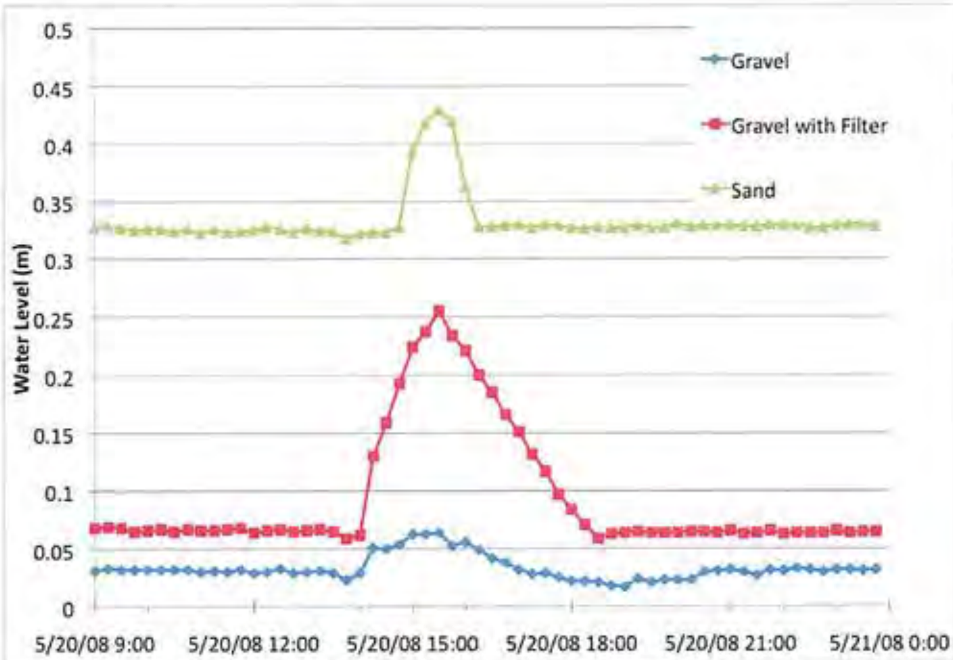

Figure 3-36. Water level data for all 3 trenches from May 20, 2008 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

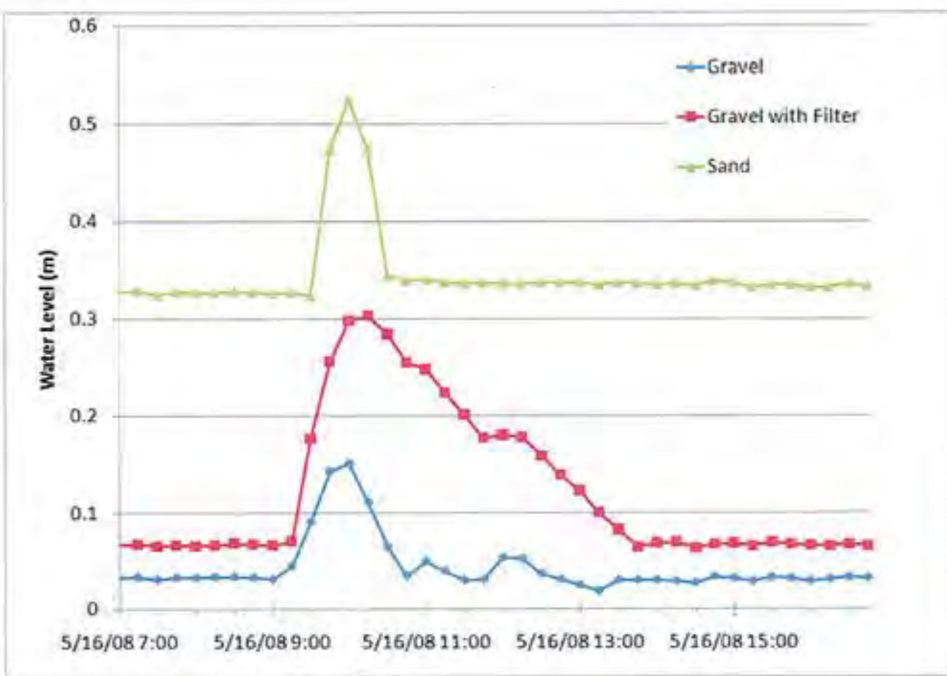

Figure 3-37. Water level data for all 3 trenches from May 16, 2008 storm. Note that the transducer in the sand-filled trench is 30 cm above the trench floor.

conditions. Similarly, rain events were difficult to categorize due to rapid changes in rain rates and dissimilar antecedent conditions.

At the site, I observed steady rains that resulted in no water flowing through the main delivery pipe. In addition, I observed abrupt changes in flow rate resulting from barely perceptible variations in rain rate. The uneven and unmeasured delivery of water to the trenches prevents in-depth comparison among the 3 trenches during storm events. More detailed comparison is reserved for the controlled injection experiments discussed earlier.

CHAPTER 4

DISCUSSION AND CONCLUSIONS

4.1 Discussion of Infiltration Trench Behavior

Although the trenches behaved differently, the behavior can be attributed to at least 3 factors, the first of which is the intentional variation in the original design. The additional differences considered are unintentional construction variation and delivery of water to the trenches. Finally, aging of the trenches is considered in relation to response times.

4.1.1 Design Differences

Design differences refer to the 3 different setups of the trenches including variations in fill material and presence of a leaf filter. The most readily observable difference between the sand filled trench and the gravel filled trenches is that water pools on the surface of the sand trench prior to infiltrating. With the gravel trenches, the water immediately percolates through the gravel to the bottom of the trench. It is possible that at a high flow rate, the stormwater could overflow the slightly raised perimeter of the sand trench and run off instead of infiltrate, but unlike the other behaviors, this was not been observed during field visits.

The controlled experiments data demonstrate the sand trench drains the fastest of the 3 trenches (Figure 3-2). However, interpreting the sand trench behavior is the most uncertain because there is no water level data recorded for the bottom 0.3 m of the trench after July 2007. Furthermore, the apparently faster rate could just result from measuring the rate at the peak only, not from the top to the bottom of the trench. Sediment coring and surface scraping in the sand trench suggests that one of the possible reasons for the sand trench draining quickly is less clogging at the bottom of the trench as compared to the top (Figure 3-4 and 3-5). Based on coring and sieving, the sand trench does accumulate fines at the surface of the trench. Fines collected at the surface of the sand and did not appear to reach below the top 1 cm of the trench, based on a 40 cm core collected in March 2008. Thus, it does not appear that fine sediment had reached the base of the trench, and reduction in recession rate after storms is not expected.

The gravel trench had higher peaks and drained at a faster rate than did the gravel with filter trench. It is possible that a portion of the gravel trench was clogged but the portion with the well was not clogged, therefore it would take less water to increase the water level in the well. During the experiments, the amount of water was nearly the same in all 3 trenches and the level of response was similar, so volume reduction seems unlikely. Instead, delivery seems to be the controlling factor for the large response in the right side gravel trench.

Initially, one goal of the study was to compare a gravel-filled infiltration trench equipped with a device that filtered out leaves to one that did not to simulate what happens when a trench is not maintained. The leaf filter prevents leaves and other large organic debris from potentially clogging the pipe and being deposited on top of the trench. Once on top of the trench, the leaves will break down and possibly contribute to trench clogging. This assumes that fine organic debris, not only silt and clay, causes clogging. An alternate possibility is that the presence of leaves on top of the trench helps prevent clogging by blocking fines from infiltrating. However, at this time, there is no evidence to support this hypothesis.

The gravel trench with the leaf filter showed no statistically significant change in recession rate, suggesting that the leaf filter does not seem to prevent or cause clogging. In fact, the highest recession rate for this trench, 0.39 cm/min, was recorded during the final season of monitoring. Prior to June 2009, the recession rate values did not range above 0.20 cm/min. However, this is only a tentative result since the trench with the leaf filter has had a slower recession rate from the beginning.

In summary, the differences in design did not result in apparent changes in behavior between the two gravel trenches. With time and more degradation, the differences in material may become evident.

4.1.2 Construction

Various aspects of the construction process could have resulted in differences of behavior among the 3 infiltration trenches. Issues caused by construction include smearing of sediment along the walls of the trenches, compaction of the base of the trenches, and errors in size and leveling. Subtle differences might not lead to measurable variation in drainage behavior among the trenches. However, some differences in construction can lead to inequalities between the trenches that obscure any deliberate design variations.

The infiltration trenches were designed to be identical except for the type of fill material and presence of leaf filter. Specifically, they were all constructed at same time, designed to be the same size, lined with the same geotextile filter material, situated in a row (assumed same infiltration rate), and provided with the same diameter inlet pipe. In spite of these similarities, there was some unavoidable variation among the trenches. From the beginning, percolation tests showed that the soil near the left-side sand trench had a higher infiltration rate than the soil near the right-side gravel trench. The percolation test results had an average value of 1.3 cm/min for the sand (left) trench, and during experiments where water was introduced using a hose, this trench also drained at a rate of 1.3 cm/min. In contrast, the right side percolation test had a drainage rate of 0.6 cm/min and the experiment showed drainage on this side to be 0.75 cm/min. In addition, possible anisotropy in the north-sonth direction (parallel to the long side of the trench) would make the fact that the center trench cannot drain in those directions a significant limitation.

During the excavation process, there could have been a number of now unverifiable variations between the right gravel trench and center gravel with filter trench construction. Since early seasonal data also shows difference in response, this suggests clogging is not the main cause of the different drainage rates. The gravel with filter trench possibly had more smearing of sediments during construction, which would have created a low permeability layer. If there were any differences in the degree of compaction of the trench bottoms, this would have taken place during the construction process. For example, one trench could have been walked in more than the other two. An unlikely possibility is that the trench bottoms are not level.

4.1.3 Delivery of Water

The stormwater pipe, swale, and berm distributed stormwater unevenly and contributed to sediment in the trenches. Differences in trench behavior due to uneven delivery of stormwater to the trenches were evident during storms when site visits occurred. Also the water level responses of the different trenches provided evidence of uneven water delivery. One additional consequence of uneven water delivery is that the trenches experienced uneven rates of "aging". A trench that received a larger volume of water over time would be considered older than one that had received less water, and this difference could affect interpretatioo of future behavior.

Another problem with uneven water delivery was the flow to each trench could not be measured. This uncertainty in distribution leads to speculation about observed water level behavior. For example, the black pipe delivered water to the center and right side of the trench. Based on storm observations, the black pipe does not flow regularly. Water from this source could explain irregularities in the pattern of trench behavior. These differences are not tied to seasons, aging, or rainfall rate. When the left or center trenches experienced higher water levels than the right trench, this was most likely caused by water delivery by the black pipe, but the occurrence could not be measured with available equipment.

In general, the right gravel trench received more water over the course of the monitoring period due to its position below the upper inlet pipe. Instead of spreading across the swale, the water flowed directly to the gravel trench. More water led to erosion above the trench and faster aging of trench (more clogging). A higher water level in the gravel trench allowed water more surface area above the clogged portion through which to drain.

In this system, the erosion led to berm failure above the gravel trench. A horizontal hole was eroded through the berm, which eventually collapsed. This left a gap in the berm through which water would flow before being spread across the swale to the other trenches. The hole explains the lack of signal in the other two trenches during storms in winter and early spring 2009. The stormwater flowed directly from the pipe at the top of the hill to the right trench. If signals appeared in all 3 trenches after the hole in the berm was created, this might be explained by flow in the black pipe located closer to the other two trenches or extremely heavy rainfall that would collect in the swale.

4.1.4 Degradation

The water level data did not provide conclusive evidence of degradation over time. However, visual observation of berm erosion suggests that the gravel trench had collected fine sediment over time. In spite of this accumulation of fines, the trench continued to operate without overflowing or holding water for more than 72 hours. Observation of changes over time was complicated by uneven delivery of water and difficulty of comparing rain events to each other.

As stated in the previous section, the right gravel trench received the most water of the 3 trenches. As a result, more clogging would be expected in the gravel trench because more water equals more sediment being delivered to the trench. Water level data in this trench did not show slower drainage which would be evidence of clogging. Clogging on the sand trench would occur at the surface. Water level was somewhat limited for the sand trench, but did not conclusively show delayed infiltration over time, which would be evidence of surface clogging. However, sediment sampling from the trench surface showed physical evidence of accumulation of fines at the surface of the trench, which would decrease the hydraulic conductivity of the sand. One infiltration trench study showed temperature reduces drainage rates (Emerson, 2008), but the seasonal water levels observed in the PERT BMP showed no trend; instead temporal differences here seems to be related to water delivery.

4.2 Lessons Learned from Trench Demonstration

4.2.1 Monitoring

To ensure that an infiltration trench is functioning, a monitoring well is sufficient because water level data indicate whether the trench is exceeding capacity and whether the trench is draining within a designated amount of time (e. g. 72 hours). It is very difficult to construct trenches with identical characteristics in the field. For a comparison study, monitoring should begin as soon as the trenches are installed so that any differences due to construction can be observed. For research purposes, it would be useful to quantify inflow to be able to draw more conclusions about clogging and to compare trenches.

4.2.2 Construction

One lesson learned is that a dirt swale and berm might not be most suitable for infiltration BMPs. Specifically, the water delivery setup did not lend itself to a comparison study because the stormwater runoff tended to flow toward one side. In addition, the dirt slope, swale, and berm were prone to erosion since a full cover of vegetation was never established. Prior to construction, the system should be observed during several storms to account for controlling factors that would not be predicted other ways. For example, it was not anticipated that the black pipe was still receiving water. This may not have been entirely preventable since it was thought to have been disconnected during the installation process. If the goal was for the water to spread evenly and for the trenches to have the same lifespan (not clog at different rates except due to deliberate variation), the inflow pipe should have been designed differently. Perhaps initially the water spread more evenly due to the swale, but this did not last. If the even spread of water was important to this setup, a more reliable means of achieving this should have been devised. The redesign of the delivery system (see the next section) likely resolved the water distribution issue; however it did nothing to decrease the erosion of the slope and berm.

It could have been predicted that an earthen system would erode quickly and contribute to clogging. Sediment from berms will continue to clog the trenches, contributing to their loss of effectiveness. Berm erosion could leed to more clogging than that caused by sediment carried by stormwater. It is probable that the bare slope experienced the highest rate of erosion immediately following construction if no sediment controls were emplaced. The sediment would have settled at the bottom of the gravel trenches prior to the start of monitoring. Later, seasonal plantings and leaf cover provided some slope stability. If a system is designed to have sediment control provided by vegetation, care must be taken that vegetation is indeed established.

Sediment control is very important. However, a simple leaf filter does not appear to have a significant impact on the trench. The results of the comparison study were obscured by early differences between the trenches, but visual observations suggest that the leaf filter had limited impact. The leaves that gathered around the leaf filter could degrade and enter the trench eventually. In this study, the purpose of the leaf filter was to simulate the leaves being regularly removed from the trench surface. It is inconclusive whether removing leaves from the surface of an infiltration trench as part of a maintenance plan extends the longevity of the structure.

4.2.3 Future Work

In August 2009, underground pipes were installed to replace the earthen berm and swale that had been designed to spread water among the trenches (Figure 4-1). The berm above the right-side gravel trench had experienced significant erosion including a hole forming in the berm. The delivery system redesign was intended to address the issues of erosion and uneven distribution of water. The swale that had distributed flow was replaced by a level PVC pipe with 3 elbow joints leading to the trenches. The runoff that flows into the upper pipe by the parking lot is now piped underground instead of flowing over the vegetated slope. The pressure transducers housed in the monitoring wells continue to record water level data. Preliminary observations of the sediment buildup inside the new pipes suggest that sediment control is still an issue, although the sediment source is in the parking lot area. One idea for a future study is comparison of the effectiveness of the infiltration trenches before and after the new delivery system.

Figure 4-1. Photograph of infiltration trench delivery system redesigned August 2009.

Another idea for future study is to examine the distribution and type of sediment accumulation. When the trenches fail or require maintenance, the sediment trapped in the trenches could be characterized. Upon excavation, observations could be made of clogging at regular depths, sediment could be sampled, geotextile removed, and cores could be taken of the bottom and sides of trenches. Lab studies show that clogging occurs at interface between the filter media and the native soil (Siriwardene et al., 2007) and this could be confirmed by field study with excavation.

The trench infiltration experiments could be repeated to look for changes over time and to test the evenness of the new delivery system. Repeating the 3-trench experiment could provide evidence of degradation cause by clogging if the drainage rates decreased. To test the distribution, water could be added at the inflow pipe and flow rate could be measured at the individual trench pipes. The results would aid in the interpretation of the storm water levels in the trenches.

4.3 Summary

Successful stormwater Best Management Practices require proper design, monitoring to evaluate effectiveness, and maintenance in response to monitoring. To study stormwater runoff mitigation techniqnes, BMPs were installed in the Pennypack Preserve located in the Pennypack Creek watershed in Montgomery County, PA.

The constructed BMPs include a row of 3 infiltration trenches constructed in July 2006. The right and center of the trench is filled with gravel, and the left trench is filled with sand. The center trench had a leaf filter. We instituted a water level monitoring program after the construction of BMPs. Monitoring wells in the infiltration trenches allowed for observation of gradual loss of effectiveness and comparison of different trench designs. Water level data were collected from December 2006 through June 30, 2009. In addition, controlled infiltration experiments were conducted in the 3 sections of the infiltration trench.

Typically, the gravel trench received water during more storms than did the other two trenches. The gravel trench tended to have the highest peaks and responded to more storms followed by the gravel with filter trench. The sand trench responded less, but in part this is attributed to higher placement of the transducer for most of the monitoring. These differences were related to uneven water delivery, based on field observations, controlled experiments, and irregular response.

Water in the trenches drained at different rates in the different sections. Looking at the seasonal storm data, the right gravel trench had the highest recession rates (maximum= 0.86 cm/min), which was a result of having the highest water levels (maximum= 1.29 m). The center gravel trench showed slow drainage from the beginning of monitoring (maximum= 0.39 cm/min), thus any effect of the leaf filter was obscured. The sand trench had a maximum recession rate of 0.41 cm/min. Water levels below 30 cm were not observable in the sand trench due to the well being replanted on July 7, 2007. Recession rate was shown to increase as water level increased. During controlled experiments, the sand trench showed the fastest recession rate of 1.3 cm/min. The right gravel trench drained at 0.75 cm/min and the center gravel trench drained at 0.16 cm/min.

The percentage of storm events that resulted in water in the trenches decreased over time, but this does not indicate change in trench behavior because the trenches did not experience an observable change in recession rate over time. Uneven water delivery to the 3 trenches prevented comparison of the effectiveness of the 3 setups over time. In spite of visual observation of heavy erosion, the drainage rates of the trenches did not decrease significantly over time. At the end of the study, water level data showed that the trenches continued to receive stormwater without overflowing and drain within 72 hours (PA DEP, 2006).

This study showed why monitoring both before and after construction is the key to planning successful implementation and maintenance of stormwater BMPs. Before construction, the water delivery pathways need to be carefully observed especially when replacing an older system. After construction, visible degradation of the structural components of the system as well as water levels inside the infiltration trenches should be monitored to ensure that the BMP functions as designed. Using these observations to plan maintenance and correct design oversights can extend the lifespan of a stormwater BMP.

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