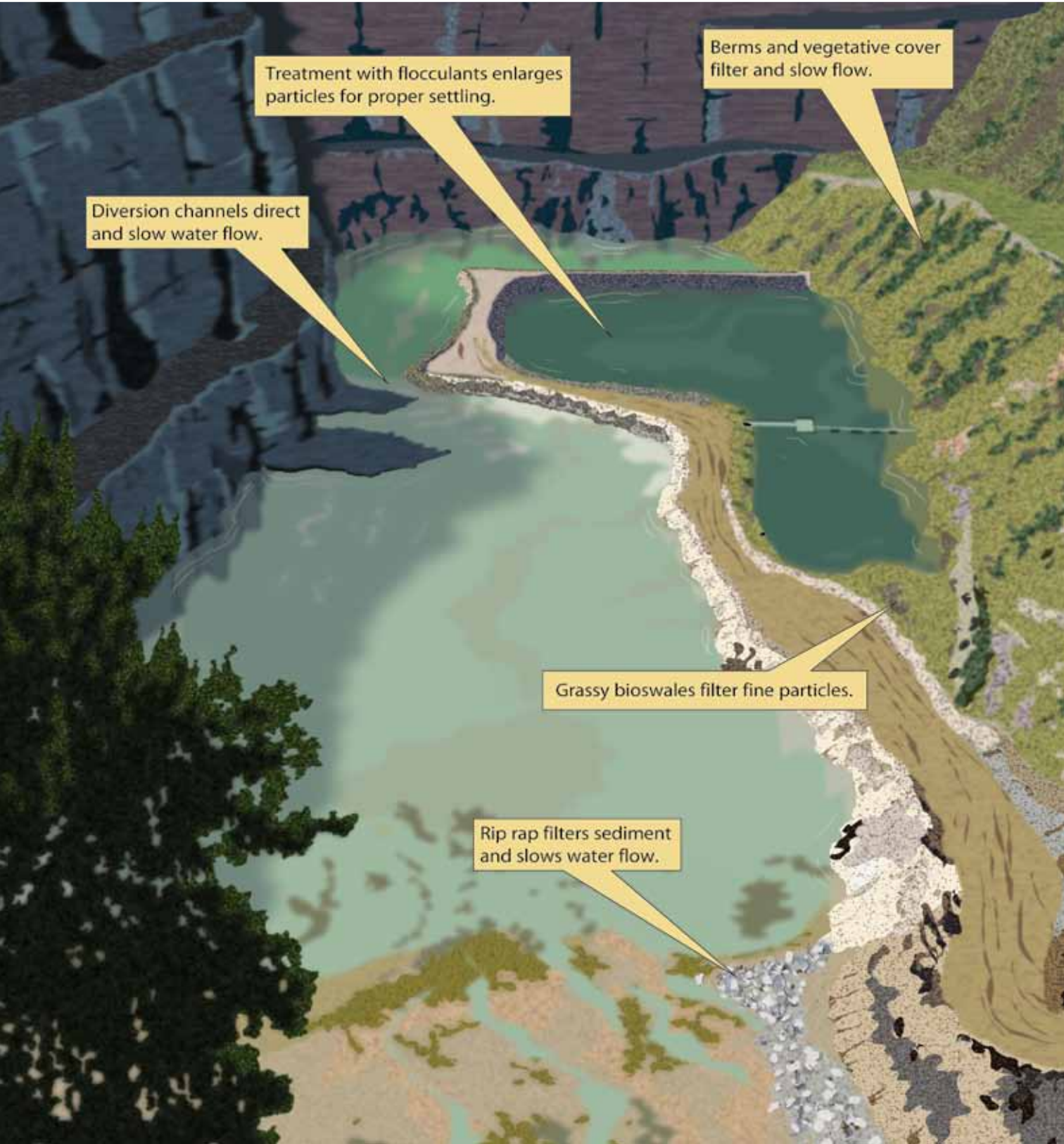


## Managing Stormwater Runoff



Treatment with flocculants enlarges particles for proper settling.

Berms and vegetative cover filter and slow flow.

Diversion channels direct and slow water flow.

Grassy bioswales filter fine particles.

Rip rap filters sediment and slows water flow.

# AGGREGATES MANAGER

## Managing Stormwater

**W**hat exactly is it about stormwater runoff that creates problems in aggregate operations? Rain isn't the problem. It's the fines the rain picks up as it runs over the stone, and the direction that runoff takes carrying the fine material — whether it remains in the aggregate mine or is discharged outside of the mine — that creates the problems.

The aggregate production process creates fines. As the stone is broken, crushed, and stored in stockpiles, the fine material is exposed to rainwater. Washing stone material also creates fines, but control of these fines is part of the process.

"Aggregate mining produces fines with high pH," notes Jay Karls, environmental consultant for GZA GeoEnvironmental, Inc. "It's the opposite of metal mining, which produces acidic runoff." In a nutshell, he says, in many areas, it boils down to fine lime sediment, which can be potentially caustic and can contaminate water sources outside the mine if it is allowed to run freely.

"Stormwater tends to be managed in settling ponds, but where the stormwater can run off outside of the ponds and escape from the site, it has to be captured and directed back to the mine, or cleaned before it's discharged off site," Karls says.

While all states within the United States must comply with Environmental Protection Agency (EPA) permitting requirements for stormwater management, most states also have authority to implement their own additional specific water pollution control regulations. According to Matt Stewart, eastern

U.S. regional director of environment for Lafarge North America's aggregate and concrete product lines, "Virtually every state we do business in has created some additional regulations over and above what the U.S. EPA requires. In addition, in October of 2007, the U.S. EPA announced that it was making stormwater impacts from crushed stone, sand, and gravel operations a 'compliance and enforcement priority.' In short, our impact from stormwater is highly regulated in the aggregate industry."

Stewart explains that sediment levels are defined through analytic tests that measure the total suspended solids (TSS) of the runoff in milligrams per liter. TSS in water will give it a milky appearance because the fine particles stay suspended in the water. Stewart adds that TSS and pH levels are the two most important limits to measure when dealing with stormwater runoff. Excessive amounts of TSS cause changes to stream channel depth, width, and flow velocity, and can have a negative impact biologically, as well.

"Because the regulations differ from state to state, it's a real challenge to make sure that individual permits match the required state or federal regulations," says Pat Clark, environmental advisor for Staker Parson Companies, which has aggregate operations in five western states.

"One thing we emphasize is that this is not a one-time deal," he says. "The stormwater plan has to be a living document, continually updated. It's critical that the mine employees buy into the plan and receive continued training on the plan to achieve effective protection of surface waters."

## OPERAT Best Management

1

### Build grassy berms



While the U.S. Environmental Protection Agency (EPA) has established general permit requirements that all states must follow, stormwater regulations tend to differ from state to state, with each state's Department of Environmental Protection providing its own additional requirements based on such variables as surface water resources. Best management practices, however, tend to be similar, and include geographic tools that intercept, divert, and filter stormwater runoff. One such tool is a vegetative or grassy berm.

4

### Direct water flow



Regulations typically differ between water that is contained on site and water that is outside the quarry or pit perimeter, with the agency measuring the amount of total suspended solids (TSS). Check dams, diversion channels, and use of rip rap can direct and slow the flow of water from higher elevations to lower areas. They also can provide outlet protection by directing water to the rock, and filtering TSS to prevent contaminants from leaving the site. Rip rap is a good tool to use in areas where the earth is disturbed, as well, so that fresh rain hits the rock, rather than the earth, minimizing erosion.

# TIONS ILLUSTRATED

## Best Practices Divert Stormwater Issues

### OUR EXPERTS

#### 2 Limit exposed surface



An overreaching goal in stormwater management is to limit the amount of earth and stone that is exposed to precipitation. A critical best management practice is to plant as much grass and other vegetation as possible. A roughened surface, achieved through “walking” the slope with a bulldozer to create channels perpendicular to the slope, catches seed to better promote growth. The practice also acts to slow water runoff and erosion until vegetation can take root. Hydroseeding — the application of a mulch, seed, and fertilizer slurry — is a very economical option that also stabilizes the slope until vegetation can sprout.

#### 3 Manage sediment and bioswales



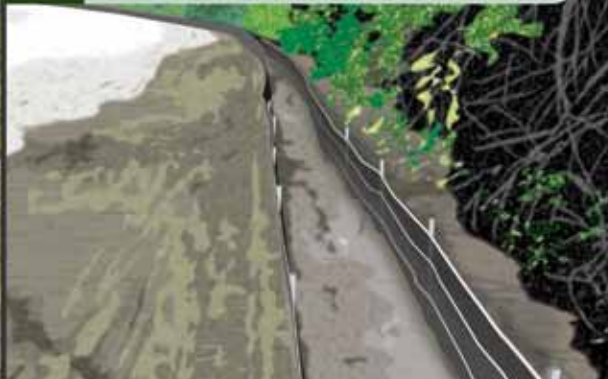
Stormwater issues in aggregate mining can stem from the high or low pH levels of fine solids created by blasting and crushing material of differing geologic makeup. As the stormwater runoff contacts the piles of aggregate material, it picks up these fines and carries them, creating pools with potentially caustic suspended solids. Practices that help manage the sediment in water runoff include vegetative resources for filtering, such as grassy bioswales, which are shallow ditches planted with grass and other vegetation to catch and filter out the fine solids. Vegetation also serves to decontaminate through absorption, deposition, and decomposition.

#### 5 Settle out fine particles



For aggregate sites that have the acreage to allow them, settlement ponds are probably the most common and cost-effective tool for settling out fine particles. The ponds must be large enough to slow the flow of water and allow the sediment to drop to the bottom. Creating a series of ponds will further slow the flow to improve settling. If particles are too fine to settle properly, however, the addition of flocculants or coagulants can help. These polymer (large organic molecules) or inorganic chemical agents work to bind smaller particles together so that they can settle more effectively.

#### 6 Keep stormwater on site



Misconceptions about stormwater runoff regulations can make water management seem daunting. Regulatory agencies realize that total elimination of discharge is sometimes not possible, so stormwater permits are designed to minimize the discharge of stormwater off site. At the same time, wherever possible, it is best to try and keep stormwater runoff on site and either filter it for groundwater or reuse it on site for washing. Diversionary structures can be erected quickly to channel stormwater runoff along desired routes. Silt fences act as a sediment filter, and they also can aid somewhat as a diversionary structure.



Jay Karls, Ph.D., environmental consultant for GZA GeoEnvironmental, Inc., has provided technical expertise on projects requiring stormwater and wastewater evaluations; environmental, multi-property due diligence assessments; health and safety assessments; environmental investigations and remedial actions; toxicological assessments and corrective actions; and litigation-support services.



Matt Stewart, director of environment for Lafarge North America's aggregate, concrete, and asphalt business in the Eastern United States, oversees management of environmental matters at approximately 220 facilities east of the Mississippi River. He has developed and implemented regulatory and environmental affairs programs for the chemical and construction industries for more than 15 years.



Patrick Clark is a regional environmental advisor for Staker Parson Companies division of Oldcastle. He is responsible for the implementation and oversight of environmental compliance activities at sites in three states. Clark has been an environmental professional for more than 11 years.

# OPERATIONS ILLUSTRATED

## Voices of Experiences

### Jay Karls

“The top concerns with stormwater runoff are the total suspended solids (TSS) and pH levels,” says Jay Karls, environmental consultant with GZA GeoEnvironmental, Inc. “If these fine particles get into, say, a cold-water stream, they can heat up the water and kill off trout and other cold water species.” Karls says TSS also will “silt up” bodies of fresh water, eventually settling and creating a mucky bottom.

“It’s important to note that there’s a difference in the type of permits you need if you are able to contain all of the stormwater on site, or if you have to discharge some off site,” Karls says. “In different parts of the country, this is a bigger issue than others, due to climate and water table height.”

The most common method for dealing with TSS in stormwater runoff is to direct the water to settling ponds. Karls says methods for capturing and filtering the runoff can include vegetative methods, such as grassy swales.

“You also have to make sure you’re actually getting settlement of the fines within the settling ponds,” Karls notes. “If you’re having trouble, you can add flocculants, which will essentially take the small particles and bind them into larger particles to give you proper settlement.”

To control pH levels, Karls says settling certainly helps, as do efforts to keep stormwater from contacting aggregate material, if possible. “The pH issue isn’t as big for aggregate producers as it is for ready-mix sites,” he says, “but if pH levels exceed permissible amounts, then acid can be added to the water to balance out the levels.”

Karls says that “to make a stormwater plan work, it takes diligence by the operators; they have to look at where the stormwater falls and where it goes. The areas that are impacted then need to be treated appropriately.”

### Matt Stewart

There are numerous options for aggregate producers to use in dealing with stormwater runoff, according to Matt Stewart, eastern U.S. regional director of environment for Lafarge North America’s aggregate and concrete product lines. He explains the main pollutant generated at aggregate mining facilities is total suspended solids (TSS). “Probably the most ‘low-tech,’ low-maintenance, and cost-effective approach is to divert the water to settling ponds on site,” he says.

A settling pond allows water flow to slow so sediment will drop to the bottom. “In urban areas, it’s sometimes not possible to create several acres of ponds, so other methods such as mechanical treatment systems and/or the use of flocculants and coagulants become necessary to remove the solids,” Stewart says. Mechanical systems must be selected with care due to high initial costs, ongoing maintenance costs, and their ability to hold up under heavy use conditions. Flocculants and coagulants must also be selected with care because of their cost and potential impact on local water bodies. In most cases, their use requires toxicity testing and advanced approval by the state/federal EPA.

The aggregate producer’s goal is to limit the amount of earth and crushed stone exposed to precipitation. This goal is managed through diversion and filtering. “Producers are urged to vegetate as much as possible,” says Stewart. “When building berms, if you roughen the surface of the earth, it creates two benefits. First, it helps the slope to catch and hold the seed. Also, it helps minimize erosion.”

Diversion methods direct the water to filtering areas and settling ponds, and can include such techniques as berms, shallow swales, diversion channels, and check dams. “Berms and diversion structures divert the stormwater so that it is not allowed to flow off site,” says Stewart.

### Patrick Clark

“We face several challenges in working with stormwater runoff,” says Patrick Clark, environmental advisor for Staker Parson Companies. According to Clark, these include the following:

1. Preparation of the stormwater regulation plan — and putting the regulations into action at each site;
2. Working with the employees on site so that everyone understands that site’s unique stormwater challenges;
3. Ensuring buy-in from the facility’s operators for day-to-day maintenance of the plan;
4. Employee training on two levels, including specific training for an on-site pollution prevention team that knows the permit and plan contents, and general training for the rest of the mine employees.

“It’s not an overnight prospective,” Clark says. “You can’t just hand a plan over to a site and expect the operators to run with it. Continued training is the key. On a specific level, you need to provide ongoing mentoring and support. And from the general standpoint, it’s good to include stormwater management training on a regular basis, at least once annually.”

Staker Parson employs two full-time environmental advisors. “It helps to keep up with changing regulations and differing state regulations,” Clark says. In addition, the two advisors can better monitor changing site conditions. “The EPA has introduced some new regulations that reduce our monitoring burden somewhat,” he says.

“The mine operation itself is constantly undergoing change,” says Clark. “And it’s critical to approach the stormwater plan as a living document, making sure it is updated continually. The operators need to understand that as their site changes, so do the documents and the methods for controlling the runoff.”