Effects of Storm Water Regulations on Colorado Department of Transportation

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In an effort to control and reduce nonpoint source pollution, the Environmental Protection Agency has enacted National Pollutant Discharge Elimination System (NPDES) regulations for storm water discharges. The regulations require that municipalities and industries apply for and obtain permits for their storm water discharges. Applicants must also implement best management practices to control pollutants in those storm water discharges. The NPDES regulations have affected municipalities and industries throughout the country, as well as transportation agencies such as the Colorado Department of Transportation (CDOT). CDOT has evaluated the NPDES regulations and has developed a storm water program, which has kept CDOT in complete compliance. How the NPDES regulations are addressed in Colorado, what effects they have had on CDOT, and how CDOT has responded to those effects are described. CDOT's compliance program is described, and major steps associated with obtaining compliance, including outfalls identification and monitoring activities, are explained in detail. Problems encountered during the compliance program's development, and future developments, especially those that could result from reauthorization of the Clean Water Act, are included, as well as conclusions reached by CDOT during the development of its compliance program.

In accordance with section 402(p) of the Clean Water Act, on November 16, 1990, the Environmental Protection Agency (EPA) published in the Federal Register the National Pollutant Discharge Elimination System (NPDES) regulations for storm water discharges. These regulations are administered and enforced in Colorado by the Colorado Department of Public Health and Environment (CDPHE).

The NPDES regulations were issued to control an unaddressed cause of water quality impairment: nonpoint sources. The National Water Quality Inventory (NWQI), 1988 Report to Congress concluded, "Pollution from diffuse sources, such as runoff from agricultural, urban areas, construction sites, land disposal and resource extraction, is cited by the States as the leading cause of water quality impairment" (*1*). The NWQI, 1992 Report to Congress states, "Storm sewers and urban runoff have emerged as significant problems nationwide and are the second leading source of impairment in lakes and estuaries," and "sedimentation and nutrients are cited as the leading pollution problems in wetlands" (*2*).

The NPDES regulations have had a profound impact on transportation agencies across the country. CDOT operations have been affected, from construction activities to highway maintenance. The following sections summarize regulation requirements in Colorado, specific impacts to CDOT, and CDOT's response to those impacts.

MUNICIPAL DISCHARGES

This section of the NPDES regulations affects all separate municipal storm sewer systems in municipalities with populations over 100,000. In Colorado this applies to four cities: Denver, Lakewood, Aurora, and Colorado Springs. The EPA has identified CDOT and other departments of transportation (DOTs) across the nation as "Large, Medium, and Designated Municipalities (Boundaries not Defined by Census)" (*3*). In Colorado, CDOT is recognized as an "interrelated discharge" because CDOT's storm sewer system interconnects with systems in the municipalities. CDOT was therefore required by CDPHE to submit a municipal permit application for the highway system serving those four cities.

The municipal permit application was to be prepared in accordance with EPA requirements listed in the November 16, 1990, Federal Register. Items such as outfall identification, best management practices (BMPs), education programs, and financial information must be included in the permit application. The regulations also require applicants to engage in water quality monitoring efforts to characterize pollutants in storm water runoff. Results from the monitoring must be submitted with the permit application.

Following guidelines from CDPHE, CDOT prepared Part 1 and Part 2 of the municipal permit application and submitted them in May 1992 and May 1993, respectively. Two additional reports containing outfall identification information and monitoring results were submitted in December 1993. Two major components of CDOT's municipal permit application are the outfalls identification [which included the implementation of a Geographic Information System (GIS)] and the storm water monitoring (performed in 1993).

Outfalls Identification

The NPDES regulations require "the location of known municipal storm sewer system outfalls discharging to waters of the United States" (*1*) be included in the municipal permit application. In Denver, Lakewood, Aurora, and Colorado Springs, CDOT identified 119 outfalls. A GIS was created for these outfalls, and dry-weather screening to detect illicit connections was performed.

The criteria used to identify CDOT outfalls were as follows:

- The discharge point to the receiving water must be located within 305 m (1,000 ft) of CDOT's right-of-way (ROW).
- No connections with other non-CDOT storm sewer systems must exist between CDOT's ROW and the point of discharge.

Figure 1 illustrates these criteria.

A procedure to locate and identify the outfalls was also developed.

1. Using a map, identify those state highways located close to receiving waters where the potential for an outfall may exist.
2. Locate "as constructed plans" for those portions of state highways identified as possible outfall locations.

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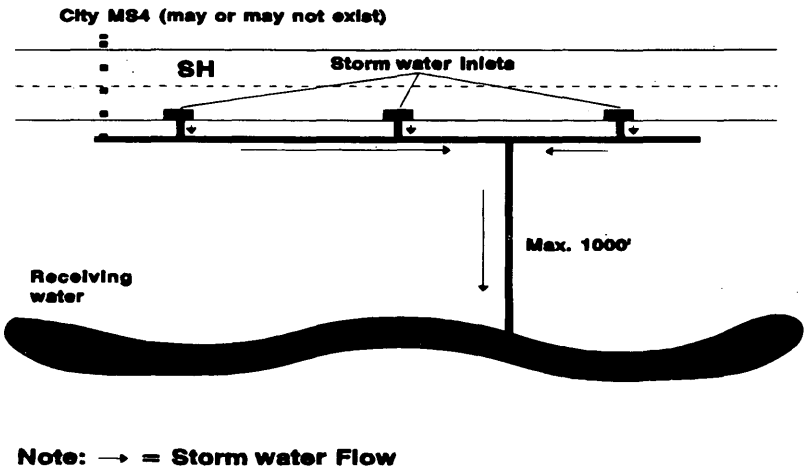

FIGURE 1 CDOT outfall definition criteria.

3. Verify in the drainage sheets of the plans the existence (or not) of outfalls to receiving waters. If an outfall is found, verify that it follows the criteria described, in which case it can be defined as a CDOT outfall, and obtain its approximate milepost location.
4. Perform a field reconnaissance and visually locate and inspect the outfalls.

Location

To obtain the location (latitudes and longitudes) of all 119 outfalls, it was decided that global positioning system (GPS) techniques would be the most efficient surveying method. CDOT decided to use GPS because of its ability to obtain an accurate position in a minimum amount of time. This allowed CDOT to optimize its resources and survey all 119 outfalls in approximately 6 days.

GPS is a state-of-the-art technique that uses satellites to obtain coordinates for a given location. According to the Federal Geodetic Control Committee, "GPS satellite surveying is a three-dimensional measurement system based on observations of the radio signals of the NAVSTAR Global Positioning System." Developed by the Department of Defense, GPS uses satellites and computers to obtain accurate coordinates of a position anywhere on earth (*4*). Coordinates are calculated by measuring the distance from the position to a group of satellites in space. The distances are measured by timing how long it takes a radio signal from a satellite to reach a receiver located at the position (*4*). This technique yields highly accurate coordinates [measurements can be made to ±1 cm (2.54 in.)] in a minimum time (under optimal conditions, coordinates can be obtained in less than 10 min).

For CDOT, surveyed positions were to be tied to the North American Datum of 1983 readjustment of 1992 (NAD 83/1992) and coordinates calculated in Geodetic, State Plane (Colorado Central Zone), and UTM (zone 13) formats. Latitudes and longitudes were to be obtained with a positional accuracy of ±1 m (3.28 ft), even though GPS technology allows higher accuracy. An accuracy of 1 m (3.28 ft) appeared satisfactory for the purposes of the outfalls location. This reduced surveying time as well as cost.

Dry-Weather Screening

A dry-weather screening to detect potential illicit connections or illegal dumping was performed by CDOT. All 119 outfalls were inspected, from which only 10 presented flow during dry periods. Those 10 outfalls were sampled and tested as required by 40 Code of Federal Regulations 122.26 (d)(1)(iv)(D), and only two presented the potential for illegal dumping.

Data Base

Using computer data base software, the data for each outfall were compiled as follows:

- Location: state highway, milepost, station (as shown in "as constructed" plans), city, receiving water, and latitude and longitude;
- Characteristics: size, material, and type; and
- Water quality: date of first visit, whether it was wet or dry, date and time it was sampled, color and odor, whether flow presented oil or surface scum, amount of flow, turbidity, pH, total chlorine, total copper, total phenol, and detergents.

Each outfall was given an identification number formed by (digits)(letter)(digits) in which (*a*) the first digits indicate the state highway number where the outfall is located, (*b*) the letter represents the possibility of several outfalls occurring at the same milepost, and (*c*) the last digits indicate the milepost where the outfall is located. The data base also includes the number assigned to the outfalls when they were surveyed.

GIS

CDOT's transportation planning section is responsible for implementing a GIS throughout the state. Much information associated with the state highway system is included in CDOT's GIS, including the data described previously. After the coordinates of each outfall were obtained, the data were introduced in CDOT's GIS, which uses "ArcInfo" from Environmental Systems Research Institute as the main software. Other data associated with each outfall were also introduced in the system.

The GIS showing CDOT's outfalls will be available to all CDOT personnel statewide. CDOT personnel will be able to (*a*) access CDOT's GIS, (*b*) locate CDOT outfalls in Denver, Lakewood, Aurora, and Colorado Springs on a computer screen, and (*c*) select a particular outfall and view all the information associated with that outfall.

TABLE 1 Highway Site Median Concentration (9)

POLLUTANT (mg/L)	ADT < 30,000	ADT > 30,000
Total suspended solids	41	142
Chemical oxygen demand	49	114
Nitrate + Nitrite	0.46	0.76
Total Kjeldahl Nitrogen	0.87	1.83
Total phosphorus	0.16	0.40
Copper	0.022	0.054
Lead	0.080	0.4
Zinc	0.080	0.329

Conclusion

Using these criteria and procedures, 119 CDOT outfalls were identified in Denver, Lakewood, Aurora, and Colorado Springs; 28 of the 119 are considered major outfalls [equal to or greater than 91.44 cm (36 in.)].

Monitoring

The intent of the NPDES regulations is to characterize pollutants present in storm water runoff. For DOTs, this translates to pollutants present in highway runoff. CDOT compiled highway storm water runoff characterization data collected in the past by FHWA. After negotiations with CDPHE, one storm water quality monitoring site was implemented. Three rain events were sampled between June 1993 and August 1993.

Background Data

Most of the existing background data characterizing highway storm water runoff is from studies performed by FHWA in the mid-1970s and 1980s (*6–9*). These studies included monitored data from 993 separate storm events, including 16 events in Denver, Colorado. A summary of the data obtained by FHWA (shown as median values for highway site median concentrations) is included in Table 1. Common sources and types of pollutants found in highway storm water runoff as defined by FHWA are listed in Table 2.

The concentration of pollutants in highway storm water runoff is affected by factors such as:

- Precipitation intensity, duration, and volume;
- Temperature;
- Surface wind speed and direction;
- Highway configuration, design, geometry, and drainage features;
- Pavement composition, condition, and quantity;
- Traffic characteristics [average daily traffic (ADT)];
- Vehicular generated inputs;
- Maintenance practices; and
- Surrounding land use (urban versus rural).

ADT was identified as one variable having a significant impact on pollutant concentrations.

Some conclusions reached by FHWA (*8*) on highway storm water runoff and its effects on receiving waters were:

TABLE 2 Sources of Common Highway Pollutants (7)

POLLUTANT	SOURCE
Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline, tire wear, lubricating oil and grease, bearing wear
Zinc	Tire wear, motor oil, grease
Iron	Autobody rust, steel highway structures, moving engine parts
Copper	Plating, bearing/bushing/brake wear, engine parts, insecticides
Cadmium	Tire wear, insecticide application
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	fuels, oils, metal plating, bushing wear, brake lining wear, asphalt
Manganese	Moving engine parts
Bromide	Exhaust
Cyanide	Anticake compound used to keep deicing salt granular
Sodium, Calcium	Deicing salts, grease
Chloride	Deicing salts
Petroleum	Spills, lubricants, antifreeze and hydraulic fluids, asphalt
P-chlorinated biphenyl	Pesticides, atmospheric deposition, PCB catalyst in synthetic tires
Pathogenic bacteria	Soil, litter, bird droppings, livestock and stockyard waste
Rubber	Tire wear
Asbestos	Clutch and brake lining wear

- Highway storm water runoff for highways with ADT < 30,000 with no curb and gutter design exerts minimal to no impact on the aquatic components of most receiving waters.
- Annual pollutant loads from highways are low relative to loads from entire watersheds.
- Of five species (mayfly, isopod, water flea, gammarid, fathead minnow) used in acute laboratory bioassays, only the gammarid exhibited a toxic response to undiluted highway runoff.

CDOT Monitoring Site Location

CDOT initially considered using the same site in Denver that had been used by FHWA, which was located on Interstate 25. This site had an ADT of 149,000 with a drainage area of 14.29 ha (35.3 acres). However, using this site was not possible because of construction work where the site used to be.

CDOT therefore evaluated several other alternatives and selected a new site for the monitoring. The site was on Interstate 225 at milepost 2.25. ADT for I-225 is 95,000. Drainage area for this outfall was 7.59 ha (18.76 acres) of CDOT's ROW, starting at milepost 2.35 east of Cherry Creek and ending at milepost 3.07 farther east. The drainage area included paved surfaces (six highway lanes plus shoulder) as well as vegetative surfaces (median and areas between the edge of oil and the ROW fence). Storm water runoff from this area empties into Cherry Creek through a 60.96 cm (24 in.) outfall.

Monitoring Site Selection Criteria

The following criteria were used to select the monitoring site:

- Location: the site should be Denver, Lakewood, or Aurora.
- Type of runoff: the drainage area had to be exclusively CDOT's ROW with minimum or no outside contributions. Also, the conveyance for the highway runoff should have no connections with conveyances draining water from areas outside CDOT's ROW.
- Safety: the site had to have an area to install the monitoring equipment that posed no safety hazards to travelers, or personnel operating and servicing the monitoring equipment.
- Accessibility: the area should have easy access to facilitate sample collection.
- Drainage area: the drainage area for the site had to be 4.05 ha (10 acres) or more.

Monitoring Equipment

The following equipment was used for the monitoring: (*a*) automatic sampler, (*b*) data logger and data storage module, (*c*) pressure transducer, and (*d*) rain gauge.

Description

Surface drainage for the monitored area is collected by inlets located in the median and in the roadway ditch and is conveyed through a storm drain running in the median on a 3 percent slope.

Sampling occurred at the last inlet located in the median at milepost 2.25, 30.48 m (100 ft) upstream from the outfall to Cherry Creek. Sampling at the outfall was not possible because of its location outside CDOT's ROW. A shelter was constructed to house the monitoring equipment and was installed about 4.57 m (15 ft) from the sampling point.

To provide flow measuring ability, a 60.96-cm (24-in.) Palmer-Bowlus flume was constructed in the storm drain. Samples were collected just downstream from the flume.

A base flow of 0.0001 m^3/sec (0.0024 ft^3/sec) existed in the storm drain, but its magnitude was so minimal it was considered negligible. It was assumed that the source of this base flow was ground water seepage into the storm drain.

CDOT contracted the U.S. Geological Survey (USGS), Water Resources Division, Colorado District Office, to perform the monitoring. Most samples were analyzed by the USGS National Water Quality Laboratory in Denver. Analysis of fecal coliform, fecal streptococcus, and specific conductance was performed by USGS field personnel. Analysis of biochemical oxygen demand was performed by the Denver Metro Wastewater Reclamation District laboratory.

Procedure

CDOT decided to follow the same procedures that had been applied by the Urban Drainage and Flood Control District (UDFCD) during its NPDES storm water monitoring in 1992.

According to the regulations, samples were to be collected from three storm events occurring at least 1 month apart and with a preceding 72-hr dry period. However, because of Colorado's climatic conditions, CDOT used (with previous approval from CDPHE) a variance in the sampling requirements which consisted of a 7 day separation between storm events and a change in the 72-hr dry period as in the following table:

Preceding Storm Depth	*Dry Period*
≤5.08 mm (0.2 in.)	24 hr
≤12.70 mm (0.5 in.)	48 hr
>12.70 mm (0.5 in.)	72 hr

Composites and grab samples were collected and analyzed for the constituents listed in the NPDES storm water regulation (*1*).

From the data collected at the I-225 monitoring site, estimates of annual pollutant loads and event mean concentrations (EMCs) were calculated for the following constituents: total suspended solids, total dissolved solids, biochemical oxygen demand, chemical oxygen demand, total nitrogen, total Kjeldahl nitrogen, nitrate plus nitrite, total phosphorus, dissolved phosphorus, cadmium, copper, lead, and zinc.

Individual EMCs were combined and a runoff-volume-weighted average EMC was calculated for each constituent. The calculated EMCs represent site-average EMCs for the I-225 monitoring site. These EMCs do not account for runoff volumes lost due to storage, infiltration, or evaporation. Because CDOT has only one land use (highway), calculated EMCs also represent the land-use average EMC.

Estimated pollutant loads from the state highway system were estimated for Denver, Lakewood, Aurora, and Colorado Springs. The pollutant loads were calculated as drainage area × rainfall × runoff coefficient × EMC. Drainage areas for the state highway system Denver, Lakewood, Aurora, and Colorado Springs were calculated based on CDOT's highway data base. This data base contains information on pavement widths and lengths. Drainage areas were calculated as pavement width × pavement length.

Information regarding median widths, or edge-of-oil-to-ROW-fence widths, was not available, and therefore was not included in the drainage area computations. Only pavement area, (from which most of the pollutants are expected to come) was used for the calculations.

By using criteria established by UDFCD for the Denver Metropolitan area and rainfall data submitted by Colorado Springs, an annual runoff producing precipitation of 327.66 mm (12.9 in.) was selected for the four cities. A runoff coefficient of 0.90, which is standard for paved highway surfaces, was selected.

Results

Table 3 includes CDOT's monitoring results for the I-225 site (only for those constituents that were detected). Table 4 includes calculated EMCs for the FHWA I-25/I-70 site and the CDOT I-225 site. For comparison, the EMCs for the I-25/I-70 site were also calculated as runoff-volume-weighted average EMCs using the same procedure as the one used to calculate the I-225 EMCs. Results in Tables 3 and 4 are shown as reported to CDPHE.

By comparing CDOT's data and FHWA's data it can be concluded that

- No major differences are observed in oxygen demand or nutrients.
- In general, a reduction in metals is observed, which could be because of improvements in refining processes, producing cleaner motor oils and greases, reduction in insecticide applications due to environmental concerns, elimination of leaded gasoline, and improvements in tire manufacturing processes.

Other Municipal Permit Components

Other aspects of the municipal permit application include

- Annual dry-weather screening for pollutants listed in the regulation at all outfalls,
- Storm water quality management procedures, which are to be applied to maintenance and construction activities,

TABLE 3 I-225 Monitoring Data

CONSTITUENT	UNITS	STORM 1	STORM 2	STORM 3
Date		07/20/93	08/05/93	08/30/93
Rainfall	mm	10.41	10.16	3.81
Storm duration	hours	2.58	0.92	0.58
Storm runoff	mm	0.63	0.64	0.34
Total Suspended Solids	mg/L	2910.00	628.00	114.00
Total Dissolved Solids	mg/L	158.00	170.00	119.00
Biochemical Oxygen Demand	mg/L	31.00	34.00	40.00
Chemical Oxygen Demand	mg/L	380.00	180.00	220.00
Total Nitrogen	mg/L	4.70	5.80	5.90
Total Kjeldahl Nitrogen	mg/L as N	3.10	4.10	4.30
Nitrate plus nitrite	mg/L as N	1.60	1.70	1.60
Phosphorus, total	mg/L as P	0.43	0.88	0.27
Cadmium, total recoverable	ug/L as Cd	3.00	1.00	N/A
Copper, total recoverable	ug/L as Cu	75.00	32.00	34.00
Lead, total recoverable	ug/L as Pb	260.00	53.00	24.00
Zinc, total recoverable	ug/L as Zn	690.00	290.00	400.00
Oil and grease	mg/L	9.00	2.00	11.00
Fecal coliforms	cols/100 ml	1680.00	1650.00	38000.00
Fecal streptococci	cols/100 ml	9200.00	10500.00	15000.00
pH	S.U.	8.10	7.90	7.70
Bis(2-ethylhexyl)phthalate	ug/L	N/A	9.00	25.00
Arsenic, total	ug/L as As	4.00	2.00	1.00
Chromium, total recoverable	ug/L as Cr	27.00	8.00	4.00
Mercury, total recoverable	ug/L as Hg	N/A	0.20	N/A
Nickel, total recoverable	ug/L as Ni	22.00	10.00	7.00
Phenols, total	ug/L	7.00	9.00	21.00
Sodium, dissolved	mg/L as Na	20.00	20.00	13.00
Potassium, dissolved	mg/L as K	3.60	7.20	2.20
Alkalinity	mg/L (CaCO3)	46.00	59.00	14.00
Sulfate, dissolved	mg/L as SO4	16.00	16.00	16.00
Chloride, dissolved	mg/L as Cl	14.00	21.00	14.00
Nitrite	mg/L as N	0.08	0.07	0.06
Ammonia	mg/L as N	1.90	1.40	3.40
Total organic carbon	mg/L as C	80.00	55.00	61.00
Specific conductance	us/cm	177.00	228.00	172.00
Magnesium, dissolved	mg/L as Mg	0.97	2.00	1.50
Calcium, dissolved	mg/L as Ca	9.50	16.00	11.00

TABLE 4 EMCs I-225 and I-25/I-70

CONSTITUENT	EMCs I-225	EMCs I-25/I-70
Total suspended solids (mg/L), TSS	1419.138	344.737
Total dissolved solids (mg/L), TDS	154.573	N/A
Biochemical oxygen demand (mg/L), BOD	34.077	33.293
Chemical oxygen demand (mg/L), COD	267.179	207.632
Total nitrogen (mg/L), TN	5.388	N/A
Total Kjeldahl nitrogen (mg/L), TKN	3.748	2.835
Nitrate plus nitrite (mg/L), NO2+NO3	1.640	N/A
Total phosphorus (mg/L), TP	0.575	0.649
Dissolved phosphorus (mg/L), DP	0.458	N/A
Cadmium, total recoverable (ug/L), Cd	1.578	17.137
Copper, total recoverable (ug/L), Cu	49.359	108.664
Lead, total recoverable (ug/L), Pb	128.462	579.323
Zinc, total recoverable (ug/L), Zn	470.653	477.256

- BMPs, which are to be applied during highway maintenance operations, and
- Education seminars for the public, CDOT personnel, private consultants, and general contractors.

Problem Statement

This section of the NPDES storm water regulation was designed and written for municipalities and not for DOTs. Many of the requirements are not applicable to DOT's and can result in excessive costs.

For example, requiring DOTs to implement monitoring programs of the same magnitude as those implemented by municipalities is a major problem, considering the high costs of monitoring (approximately $50,000/site). For DOTs, such monitoring programs result in excessive costs, duplication of previous findings by FHWA, and few benefits.

CDOT addressed this problem by negotiating with CDPHE the implementation of only one monitoring site. If it is determined in the future that more sites are needed, then CDOT will implement more sites.

INDUSTRIAL DISCHARGES—CONSTRUCTION ACTIVITIES

The regulations require an NPDES storm water permit for all construction activities [except those that disturb less than 2.02 ha (5 acres) of total land area and are not part of a larger common plan of development]. Even though the exemption for projects disturbing less than 2.02 ha (5 acres) was successfully challenged in court by the Natural Resources Defence Council (*10*) (EPA had no sufficient data to justify the exemption), this requirement so far has not been changed.

To facilitate the permit application process, CDPHE issued (under the Colorado Discharge Permit System) a General Permit for Stormwater Discharges Associated with Construction Activity. A general permit has statewide coverage and was the most appropriate method to handle the large volume of permit applications expected. To obtain coverage under and to be in compliance with this general permit applicants must prepare and implement a Storm Water Management Plan (SWMP). The SWMP must contain, among other requirements, a description of BMPs that will be used by the applicant for the control of erosion and sedimentation and for storm water quality management.

To implement this section of the NPDES regulation, which affects about 40 percent of CDOT's annual construction projects, CDOT created an NPDES Construction Task Force in July 1991. The task force includes members from different organizations within CDOT (with one member from FHWA), and its main goal was to develop a compliance program. Steps in the compliance program developed by the task force include:

- Apply for coverage under the existing CDPS general permit until CDPHE and CDOT jointly develop and issue a specific general permit for CDOT construction activities.
- Prepare the SWMP in house (or through a consultant) before advertising BMPs for erosion and sediment control, and storm water quality management are to be identified and designed during the design phase of each project. BMP details, location, and pay items must be part of the bidding documents. Some of the BMPs for erosion and sediment control considered by CDOT for use during and after construction included seeding, mulching, erosion bales, silt fences, earth berms, diversions, check dams, inlet and outlet protection, slope drains, erosion control blankets, channel linings, sediment trap, and sediment basins. BMPs considered for storm water quality management were grass swales, grass buffer strips, wetlands, extended dry detention ponds, and wet detention ponds.
- Submit permit applications only for those projects with an earth disturbance greater than 2.02 ha (5 acres). Appropriate BMPs must, however, be identified for all CDOT construction projects regardless of their area of disturbance.
- Include portions of the SWMP in CDOT's *Standard Specifications for Road and Bridge Construction.* Section 107.25 of the specifications was revised. A new erosion control section (208) was introduced. The specifications state that
  - –Chemicals will not be stored or used within 15.24 m (50 ft) of any state waters;
  - –Construction materials, waste materials, construction equipment, and fuels will not be stored within 15.24 m (50 ft) of any state waters;

–Spill prevention and containment measures will be required at all storage areas;
–Contractors will assign an erosion control supervisor for each project;
–Exposed areas of erodible earth material will be limited to 6.88 ha (17 acres) for clearing and grubbing and 6.88 additional ha (17 acres) for earthwork operations (any exposed area also requires stabilization within 7 days if construction will not occur at that area for 30 or more days);
–Cut and fill slopes will be stabilized every time 6.1 vertical m (20 ft) of their construction are completed;
–Inspections of erosion and sediment control features will be performed by the contractor and the CDOT engineer every 14 days, and
–Contractor will maintain all erosion and sediment control features during construction.

- Revise the 1978 version of CDOT's *Erosion Control Manual.* A new document was created titled *Erosion Control and Stormwater Quality Guide.* This new document was issued in a draft form in December 1992.

Construction of erosion control and storm water quality management BMPs is recognized as a major problem in the implementation of the NPDES storm water regulations. Because the NPDES regulation and its requirements are new, some contractors have not had the chance and the time to obtain the necessary training or experience in the erosion control field. The same is true for CDOT's field personnel.

Dissemination of information and guidelines for construction of BMPs is much needed at the national level. Many state government agencies have produced manuals describing criteria for the installation and construction of erosion control and storm water quality management BMPs.

CDOT has made a great effort to address this problem by (*a*) producing an *Erosion Control and Stormwater Quality Guide,* (*b*) participating with other agencies in workshops and conferences, (*c*) helping prepare an erosion control class, which is now offered at a community college in Denver, (*d*) preparing its own training and offering it to CDOT design and construction personnel across the state, and (*e*) sharing information with other DOTs. Finally, in February 1995, CDOT implemented an Erosion Control Supervisor Training program for contractors.

Education, inspection, and enforcement are needed to achieve a satisfactory and effective level in the construction of BMPs. Government agencies and private entities must continue to work together to provide a satisfactory and effective level.

INDUSTRIAL DISCHARGES— EXCLUDING CONSTRUCTION ACTIVITIES

The NPDES regulations include a list of industries for which a storm water permit must be obtained (*1*). CDPHE has addressed these industrial activities through the issuance of various general permits under which applicants must apply for coverage.

In addition to construction, the only industrial activity for which CDOT must apply for a storm water permit are for work on sand and gravel pits. CDOT also holds a permit from the Colorado Division of Minerals and Geology for this type of industrial activity. For these pits, CDOT initially chose to apply for coverage under the CDPS *General Permit for Process Water and Stormwater Discharges Associated with Sand and Gravel Mining and Processing (and other Nonmetallic Minerals Except Fuel).* This process will be used until CDPHE and CDOT develop a specific general permit for CDOT sand and gravel pits.

As for the construction permit, the main requirement of the sand and gravel general permit is that a SWMP must be prepared and implemented for each site. CDOT submitted approximately 70 permit applications and developed a general SWMP for all pits for which applications were submitted. Main points of the SWMP for sand and gravel pits can be summarized as follows:

- Chemicals will not be stored or used within 15.24 m (50 ft) of any state waters.
- Construction materials, waste materials, construction equipment, and fuels will not be stored within 15.24 m (50 ft) of any state waters.
- Spill prevention and containment measures will be required at all storage areas.
- BMPs for erosion and sediment control will be used. BMPs that will be considered by CDOT include seeding, mulching, erosion bales, silt fences, earth berms, diversions, outlet protection, sediment trap, and sediment basins.

The aspect of the storm water regulations dealing with sand and gravel mining was designed for large mining operations; these operations cover large surface areas and have a potential for causing water pollution.

By comparison, CDOT sand and gravel pits are small operations. Most of the pits are inactive and are kept only for emergency purposes (e.g., snowstorms, landslides, floods). In those pits that are active, actual mining is performed 2 to 3 weeks every year. Because CDOT does not own those pits, it has little control on the activities in them.

The potential for water pollution from any CDOT sand and gravel pit is minimal or non existent. Requiring CDOT to obtain storm water permits for those pits has caused an unnecessary administrative burden and has incurred costs with no observed benefit.

CDOT worked with CDPHE in developing a specific general permit for CDOT sand and gravel pits to facilitate the process and alleviate the administrative burden. In January 1995 CDPHE issued a *General Permit for Stormwater Discharges Associated with Sand and Gravel Production Operations within the Colorado State Highway System.* This permit became effective on March 1, 1995.

FUTURE DEVELOPMENTS

CDOT's storm water program is a continuing program that does not end when a permit application is submitted. Many issues are left pending.

In regard to monitoring, CDOT does not expect to engage in any future efforts, except for research. This is because of the existing data, the high costs, and the few benefits that are obtained from monitoring. Monitoring efforts are under way at other state DOTs, and CDOT expects to compile this data and compare it with CDOT and FHWA data in the future. After evaluating this data, CDOT will be in a better position to assess further monitoring needs. One general permit is expected to be issued in the future for CDOT construction activities. CWA reauthorization is being considered in

Congress, which could result in a noticeable impact on the regulated community.

CDOT has been following the CWA reauthorization process very closely and has provided comments as appropriate. It is expected and hoped that comments from CDOT and other agencies are considered so that a cost-effective law is produced.

CONCLUSION

CDOT has taken a pro-active approach in the implementation of the NPDES storm water regulations. New procedures have been created, old ones revised, and specifications changed. CDOT also participates in cooperative efforts with other agencies and groups to address the pressing issue of storm water and nonpoint source pollution. Some of these groups are the Colorado Nonpoint Source Task Force and the UDFCD NPDES Joint Task Force.

CDOT worked closely with CDPHE to ensure that CDOT's compliance program was developed in accordance with federal and state law. CDOT has also participated with CDPHE in training and education activities. CDOT has maintained contact with other state transportation agencies to monitor development of storm water programs. CDOT has complied with the regulations by submitting the appropriate permit applications and implementing BMPs.

Required monitoring was performed yielding new data that add more information to that already available from FHWA. However, this new data may not be representative because of the small number of events sampled. According to FHWA, "Because of the inherent variability in EMCs, a limited sampling effort consisting of only a few storm events may produce a poor estimate of site characteristics" (*8*).

In general, the NPDES regulations were not designed for transportation departments and therefore have been difficult to implement. Some of the regulatory requirements have resulted in high costs and a heavy administrative burden, with little improvement of storm water quality. Transportation and regulatory agencies are encouraged to work together to develop better regulations that will result in a more cost-effective implementation and increased benefit for water quality, the environment, and the public.

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