NEW YORK
STATE OF
OPPORTUNITY

Department of
Environmental
Conservation

April 2015

PATROLLING AND TREATING
Flood Control Projects

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Patrol Management

ROLES AND RESPONSIBILITIES

Depending upon the magnitude and circumstances of a high-water event, management, along with the roles and responsibilities of patrol participants, will vary. However, the general elements of a high-water response follow.

Patrol Coordinator - As assigned by the region, the patrol coordinator directs patrollers with specific information during a high-water event. This includes when to start or abandon a patrol. The coordinator will be involved with interpreting reports from patrollers and reviewing conditions and data with the command center. The coordinator will ensure that each patroller and patrol team have required equipment before being allowed on patrol. More than one patrol coordinator may need to be designated.

Patrol Leader - This individual is designated to lead others on patrol. He or she is primarily responsible for conveying conditions to the patrol coordinator/command center and for the overall safety of the patrol team.

Patroller - This person is assigned to patrol flood control projects during high-water conditions and will observe and inform the patrol leader of issues.

ORGANIZING A PATROL

Description - Patrols are important during high-water operations of flood control projects. Patrollers will be tasked with monitoring and conducting observations of various project segments and components to provide condition assessment reports to the patrol coordinator. The patrol coordinator will submit these reports to the command system for directing DEC assets to potential problematic areas of a project. Subsequent treatment methods may be used to arrest a developing deficiency or to resolve a problem.

The patrol team comprises two or more people with a patrol leader assigned to a certain route as directed by the patrol coordinator. The coordinator will provide the team with a map identifying the location where the patrol is to begin and end. The leader will report to the coordinator when the team starts the patrol and, when it reaches the end of the route, will then receive further instructions from the coordinator. The leader will communicate with the coordinator to report the patrol team's observations.

CALL FOR PATROLS

The need for patrols will be determined by regional management based upon direction provided by regional flood control engineers/ managers and Division of Operations supervisors. Operations will do initial work to prepare projects for anticipated high water. At some projects, local municipal staff may be involved. Work may include readying of pumping stations, positioning critical equipment and supplies, pre-high-water checks of flap gates and valves, as well as the installation of closure structures.

When patrols are required, the region will establish a command center staffed around the clock. Regions are to initially obtain patrol assistance from regional staff. The patrol coordinator along with regional flood control staff will estimate the length of time patrollers may be needed.

If additional patrollers are needed beyond a region's capabilities, a request for more support should be made to the Bureau of Flood Protection and Dam Safety. The bureau will canvass trained Central Office staff and other regions to support flood-fighting efforts.

Division of Operations staff will install stoplog closures across roads and railroads based upon expected river stages.

DIRECTION OF PATROLS

The need to patrol projects is dictated by high-water operation plans and other conditions that may be present. The patrol coordinator should determine when conditions are safe for patrollers to be out on a project.

For both effective observation and patroller safety, the coordinator should consider the advantages of using limited patrol resources during daylight hours only or during poor weather conditions, such as when it's windy and/or there's lightning. Patrolling during cold-weather months when water temperatures are frigid is particularly hazardous. At these times, patrollers should be instructed to avoid getting near flowing water and to observe from safe locations. Improving river conditions and stabilizing project performance may lessen the need for patrol frequency.

Because patrollers have first-hand knowledge of field conditions, they should halt patrols any time they believe conditions are not safe and should report these findings to the patrol coordinator immediately. The coordinator has the authority to recall patrollers at any time. Patrols may need to be stopped for many reasons, such as an extreme water stage or damage to flood works that makes a project unsound.

As a general guide, if floodwater levels are within one foot of overtopping a levee or floodwall, and forecasts indicate that levels may rise, patrols in the area should be terminated until conditions improve.

PATROL EQUIPMENT CHECKLIST

Each Person

- Personal flotation device (PFD) appropriate for conditions (required)
- Hard hat (as necessary)
- Highway safety vest (required)
- Safety boots and gloves (required)
- Patrol manual (required)
- Flashlight or lantern (as necessary)
- Raingear (as necessary)
- Ear protection and safety glasses (as necessary)
- Watch, log book, pencils, indelible marker (recommended)

Each Team

- Patrolling instructions, maps and contact numbers (required)
- Two-way radio and/or other form of communication (required)
- Throwable flotation device (required)
- Marking stakes/marking flags (recommended)
- Camera (recommended)
- Binoculars, walking staff/probe (optional)

Responding patrollers should be prepared (gear, change of clothes, etc.) in case patrols last multiple days. In addition, responding patrollers should arrange their lodging and their travel to the command center with the patrol coordinator. Patrollers also should direct any questions they have to the coordinator.

PATROL SAFETY

Patrolling floodworks during high-water events is dangerous. Nothing is more important than the safety of each team member. Avoid any unsafe locations or activities. Be aware of slippery conditions and tripping hazards.

Levees

- Patrollers should walk side by side on the crest of the levee away from the river's edge. One patroller should observe the water side as the other observes the protected side.
- If available, a third patroller should walk along the toe of the protected side.
- The team should move slowly enough to assess the levee. Probing with a stake may detect voids and scour.
- Extreme caution should be exercised when traveling on saturated, cracked, sloughed or potentially undercut areas.
- Be aware of power lines, natural gas/propane leaks, unstable structures and other hazards, including animals.
- Patrollers should be especially careful of floating objects, such as uprooted trees and limbs extending above the water. The best way to spot these objects is to face upstream when traveling the levee.

Floodwall Hazards

When patrolling floodwalls, the patrol team should not walk on top of the wall or along unguarded edges but should concentrate on potential problem areas on the protected side of the wall.

Observe the water side of floodwalls every 100 yards. In areas where the wall is more than five feet above ground level, use access ladders if present.

Do not walk on floodwalls.

Drainage Structure Hazards

Safety of patrollers during a flood event must be the top priority. Fall protection (railings) may not be adequate or even present in areas such as floodwalls, headwalls, drainage structures and bridges, where the possibility of falling into floodwaters exists.

Keep clear of these areas.

Fall hazard – no railings to guard against falls.

Watch your step; riprap is unstable.

Swift-Water Hazards

If you fall into the water, you can attempt to get out of it by doing the following:

Your PFD will provide buoyancy. Attempt to get a bearing on your location, and then try to get into a sitting position with your feet in front of you, pointing downstream.

Once in this position, try to maneuver yourself out of any swift-flowing water and look for an area along the bank that you can reach. Once you've found a spot, swim toward it. Depending on the water's velocity, you may need to try this more than once. When you reach the bank, carefully climb out of the water and get to a secure, dry place. If conditions prevent you from immediately exiting the water, try to "ride it out" until you find a safe spot.

Proper technique when in swift water: keep your arms out and legs together.

Swift-Water Hazards

DO NOT try to swim to or hold onto logs or tree limbs in flowing water. These are referred to as “sweepers and strainers,” where the current can pull you underwater and you might drown. Try to avoid this situation. If it’s unavoidable, turn around and try to swim over the limb at a low spot. Never try to swim under these obstacles.

A dislodged floating tree limb creates a typical “sweeper” in high water. Never try to swim under limbs or logs.

An instructor demonstrates where NOT to be located in this strainer. Avoid such obstacles at all times. Swim around them; never try to hold onto them.

TREATMENT METHODS

PATROL TASKS

Identify and track flood control project performance during a high-water event. Look for developing problems. Problems that may require corrective action are listed below:

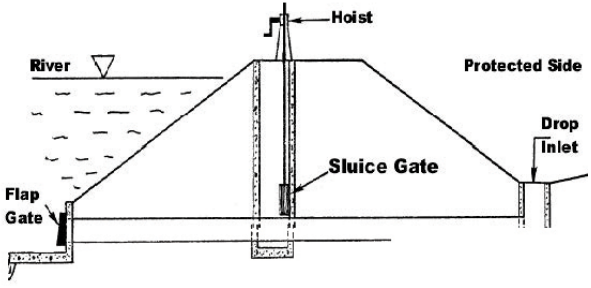
- Backflow though a drainage structure
- Sand boils
- Seepage and sloughs
- Interior ponding
- Scour
- Animal burrows
- Overtopping

Inform the patrol leader –› patrol coordinator –› command center of identified flood problems.

Flood control engineers/managers and operations supervisors will evaluate problems and perform corrective work as needed. Assistance with emergency repairs may be requested.

DRAINAGE STRUCTURES

During normal conditions, drainage structures allow stormwater to flow through a levee or floodwall from the protected side to the river. Drainage structures should be checked before, during and after a high-water event.



DRAINAGE STRUCTURES

Flap Gate

Flap gates and protected side inlets should be clear of debris before a high-water event.

Flap gates may be underwater when checked for closure. If a flap gate is not sealing, there will be backflow through the drainage structure into a ponding area or ditch. This will cause flooding of the protected side of the levee unless action is taken.

Sluice Gate

If backflow through a pipe is not controlled by a flap gate, the sluice gate should be lowered (closed). This is done from the hoist at the top of the structure. To permit drainage of ponding areas, sluice gates lowered during a high-water event must be raised after river levels subside. Flap gates should then be checked for proper operation.

Some drainage conduits do not have backup sluice gates. Backflow may be mitigated by plugging the drainage structure with sandbags, et cetera.

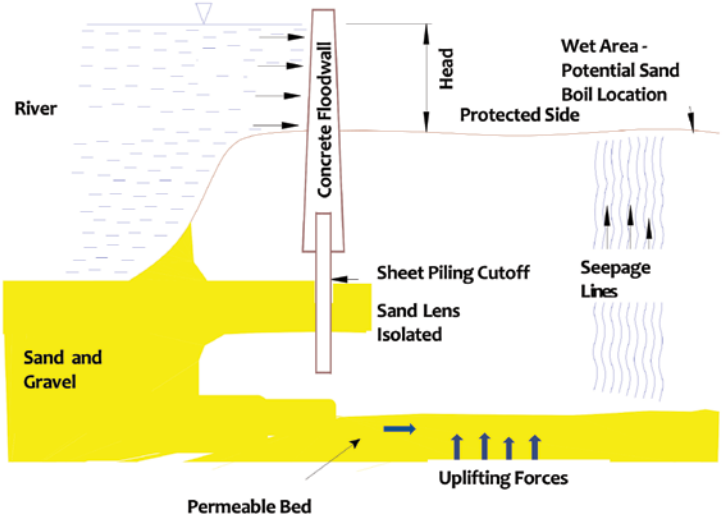
SAND BOILS

When flood waters are on a levee or floodwall, a condition may occur where muddy water is oozing or bubbling out of the ground near the levee toe. Such a condition is called a sand boil, and it's a sign that water and soils are being piped through or under the levee/floodwall to the protected side. This seriously endangers the floodworks. If the condition is bad enough, failure of the protective works can result.

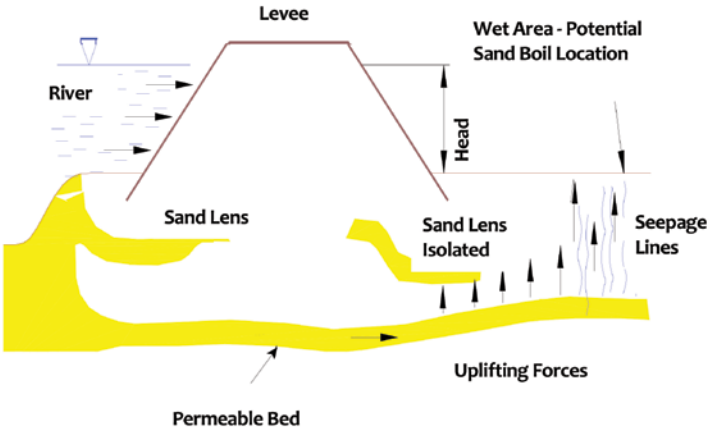
Mark sand boils with flags.

When a sand boil is observed, mark the location with a stake or flag, and record it and an estimate of the amount of flow. This will help find the sand boil upon return, perhaps under more adverse conditions. **Immediately report conditions to the patrol leader and coordinator.**

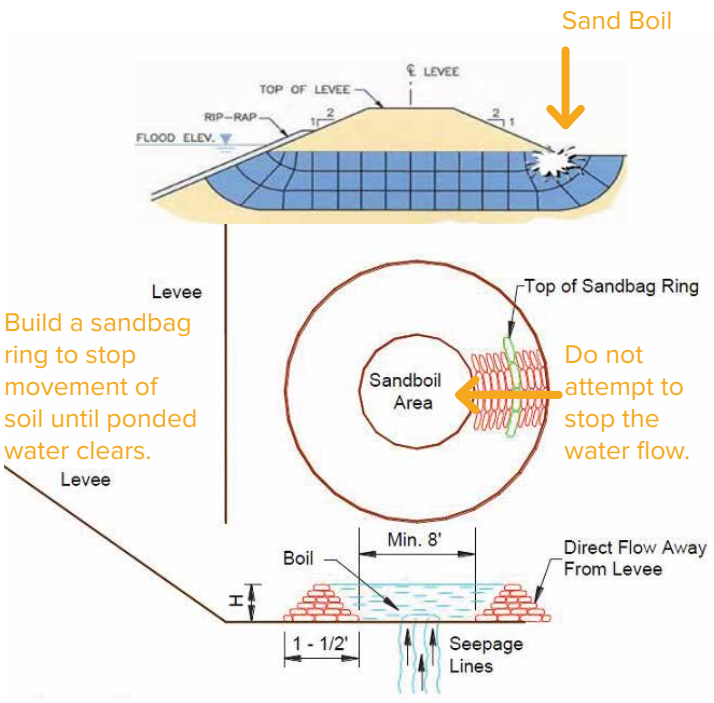
Sand Boil Mechanisms



Sand Boil Mechanisms



Possible Sand Boil Formation in Relation to a Levee



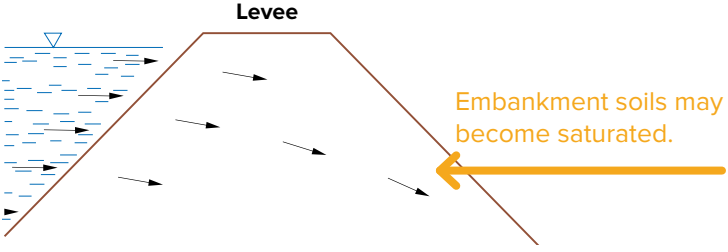
Build sandbag ring to stop movement of soil until ponded water clears.
DO NOT ATTEMPT TO STOP THE WATER FLOW!

SANDBAG CONTAINMENT RINGS

If deemed feasible, a sandbag ring may be constructed to counteract water pressure from the river. Make the sandbag ring only high enough to stop the movement of soil particles in the erupting area. The muddy water bubbling into the sandbag ring will clear when movement of soil particles ceases. **Do not attempt to stop the water flow** as other sand boils may occur outside the sandbag ring. Discharge from the sandbag ring should be diverted away from the levee or floodwall to the nearest drainage structure or ditch when practical.

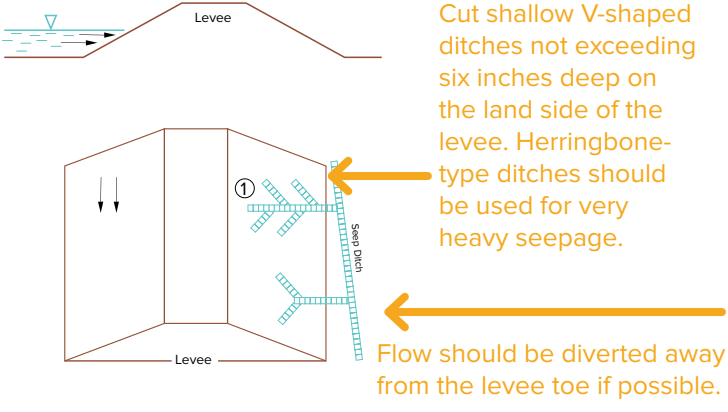
SEEPAGE AND SLOUGHS

Seepage through a levee is common as the levee becomes saturated due to an extended high-water stage. The mechanism of high-water seepage is shown below.



Mild seepage may be alleviated by using shallow drainage ditches as shown below.

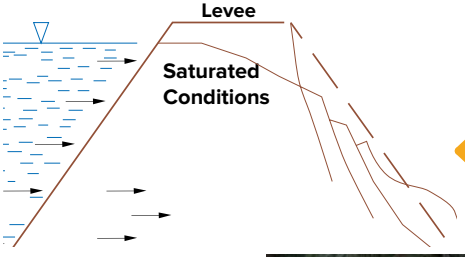
Methods of Draining Levee Slopes



SEEPAGE AND SLOUGHS

Areas of seepage should be checked often to ensure that seepage flow is not substantially increasing or beginning to carry soil particles. If the seepage saturates a levee or if longitudinal cracks begin to occur on levee slopes or the levee crown, a slough, slump, or slide of the levee embankment or turf layer may be imminent.

Increasing saturation of the levee can cause advanced sloughs and may result in levee failure if uncorrected. **Immediately report these conditions to the patrol leader/coordinator.**



Sod becomes wet and may begin to float.

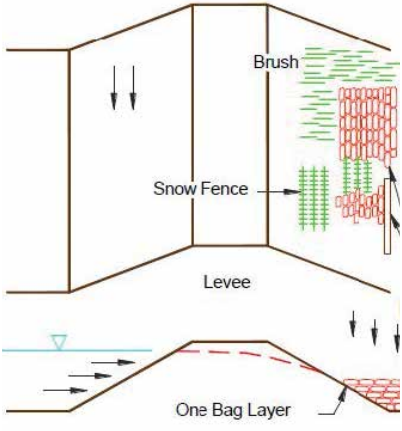
Slope failure.

SEEPAGE AND SLOUGHS

When sloughs or slides develop during a high-water event, corrective action may be needed to prevent levee failure.

Corrective actions for seepage, as shown below, may prevent sloughs and slides from developing.

Slide/Slough Preventative Measures



Cut seep drains diagonal to the slope to drain soft areas.

Place a layer of fencing, porous geotextile fabric or a single layer of brush (butts up, tops down) on the slope.

Weight the levee toe with a sandbag buttress.

Place no weight other than what is necessary to hold the brush in place.

Layer sandbags to a height of 2/3 the horizontal distance from the slough to the toe.

PORTABLE PUMPING

DEC maintains portable pumps that can be set up to pump out low-lying areas that may flood due to internal drainage. Monitor water levels adjacent to ponding areas and along levees to determine whether interior runoff is ponding and threatening to inundate developed areas.

The discharge from portable pumps is strong and can lead to erosion of levee material. Check for possible scour damage as a result of pump discharge. Communicate observations to the patrol leader/coordinator.

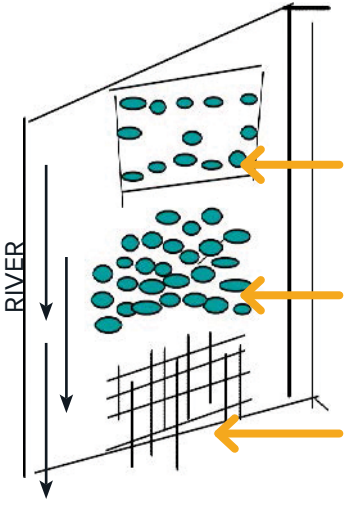
Watch for erosion.

SCOUR

Erosion of levee banks may occur as a result of the high velocity of flood waters. **Never approach the edge of an embankment that may be undercut.** Areas of scour should be reported to the patrol leader/coordinator.

Deflection dikes, plastic sheeting, snow fencing and other material may be used to arrest scour and erosion. Layers of protective materials (such as plastic sheets) should overlap in a manner similar to the placement of roofing shingles, with the edge of the upstream segment on top of the leading edge of the downstream segment.

Layers of Protective Materials



Plastic, burlap, or geotextile sheets are staked and weighted with sandbags.

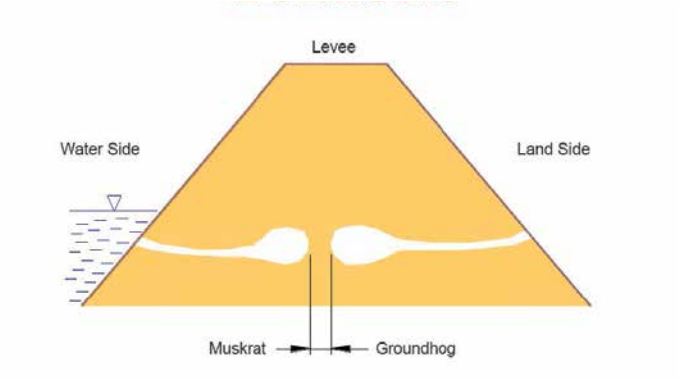
Deflection dikes are built using sandbags, stone, lumber bulkheads, etc.

Snowfence is staked and weighted with sandbags. Work should be performed downstream to upstream.

Plastic Sheeting

Plastic sheeting is weighted with sandbags. Overlap sheets "shingle style."

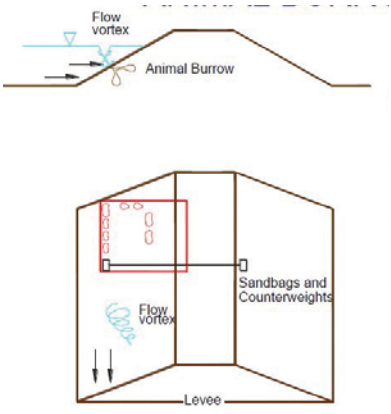
ANIMAL BURROWS



Burrow entrance holes can usually be spotted by looking for a small mound of dirt and animal paths in the vegetated cover. A collapsed burrrow may be evident by a depression in the embankment slope or crest.

Some levees may be damaged or have their structural integrity compromised when animals burrow into them. When a high-water event is imminent, check for burrows, and fill burrow holes in the levee to reduce the potential for seepage and sloughs.

Emergency Repair of Animal Burrows



Above the water line:

Fill the burrow with cement, grout, or other slurry-type material such as mud. Cover with polyethylene sheeting, and weight with sandbags.

Below the water line:

Cover the burrow with polyethylene sheeting, and weight with sandbags or counter weights.

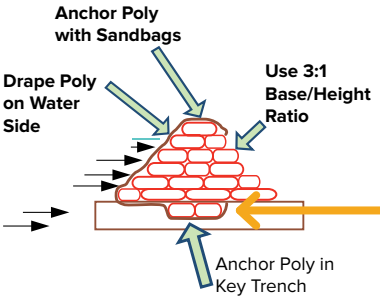
Or:

Place a mixture of manure and straw into the water at the flow vortex near the burrow entrance to fill and seal the burrow.

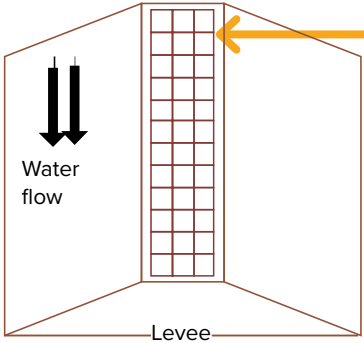
EXPEDIENT LEVEE METHODS

The following two diagrams describe how to construct an expedient levee with sandbags to raise the height of a levee or low area in case of possible overtopping.

Sandbag Expedient Levee

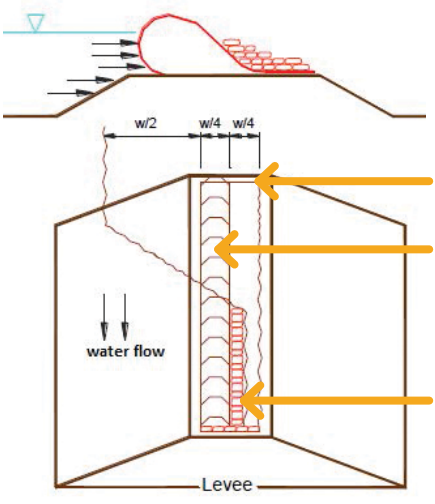


Step 1
Dig the key trench about 6" deep by 18" wide. Line it with polyethylene sheeting on the water side. Anchor the poly in the trench with sandbags.



Step 2
Stack sandbags by staggering joints. Face open ends of the bags downstream and tamp. Drape poly over the sandbags and anchor it with additional sandbags.

Earthen Embankment Polyethylene Sheeting



Step 1
Place polyethylene sheeting on the levee top with one - half of the poly sheet. (w = width of sheet)

Step 2
Embank earth or sand on one-quarter of the poly sheet.

Step 3
Drape poly sheeting over the fill, and use sandbags to anchor it.

Expedient levee constructed of poly sheeting, earth and sandbags

EXPEDIENT LEVEE METHODS

Earthen Embankment Plywood and Sand Walls

Sandbagging and reinforced plywood protective walls are possible ways to combat overtopping. These photos show constructed plywood and sandbag walls.

Sandbags Required for 100 Linear Feet of Levee	
Height of Sandbag Levee	Number of Bags
1 Foot	600*
2 Feet	2,100
3 Feet	4,500
4 Feet	7,800
*A single-width course one–foot high requires 300 bags for 100 linear feet of levee.	

HIGH-WATER ISSUES

STOPLOG CLOSURES

The operation of flood control projects will require the installation of stoplog closures, depending upon the anticipated river stage during a flood event. These closures are located across roadways, rail lines and maintenance access routes.

Some leakage through stoplogs is common.

Once installed, leakage resulting from an uneven seat under the bottom stoplog or between stoplog seals should be monitored. Leakage can be reduced with the placement of sandbags and tarps. If excessive leakage is observed and waters creep up to protected structures, portable pumps may need to be used. The public may be concerned about stoplogs leaking, but leakage is inevitable and mostly just a nuisance.

SEEPAGE RELIEF WELLS

Seepage relief wells are located on the protected side of the levee and relieve hydraulic pressure from beneath the levee system. There may be several of these wells located at the toe of a levee or floodwall. During a high-water event, it is common to observe water discharging from these wells. If relief wells are active, the patroller(s) should note which wells are discharging flow and which are not. This will identify wells that may require future investigation and rehabilitation. Seepage relief wells are commonly located where levee and floodwall foundations may be prone to uplift pressures. Levees with relief wells should be closely monitored for seepage.

Typical Relief Wells

Along this levee is a series of relief wells at the toe.

HIGH-WATER MARKS

On Levees

Establishment of high-water marks is critical in locating problem areas on flood control projects. This way, improvements can be made before another flood occurs.

Location of levee that overtopped.

As soon as practical, flag high-water lines. This evidence may show up as debris lines along levees and ponding areas. Flags should be placed into the levee at the high-water mark and spaced about 100 yards apart. If there are concrete structures along the levee, high-water marks can be preserved by painting, scratching or otherwise marking a line on the concrete at the highest water elevation.

Debris indicating high-water line.

HIGH-WATER MARKS

On Floodwalls

High-water marks on floodwalls do not remain long. When it is evident that the rise is over, a measurement should be taken from the top of the floodwall down to the wet mark at each observation point. Marking the floodwall on the land side with the observation point will help determine the location later. The observation point and the vertical measurement can be recorded in this patrol manual. When patrols are released, this information should be given to the patrol coordinator. The high-water marks will help determine where improvements are needed.

On floodwalls, the only evidence may be wet marks that last just a short time.

EVACUATION

It's always possible for a storm to overwhelm a flood control project. Evacuations may be necessary if the project will be subject to overtopping or flooding of the protected area. Evacuation decisions are a community responsibility and should be a part of a community emergency action plan. The flood control command center should keep community emergency management officials abreast of project performance.

General Information

DEFINITIONS OF TERMS

Command Center – A place established during a high-water event to provide centralized leadership and guidance during a flood response.

Drainage Structure – A structure consisting of a flap gate, sluice gate and conduit that allows interior drainage to exit through a levee or floodwall.

Flapgate – A self-operating gate located at the end of a drainage conduit. It allows interior drainage to flow to the river, while preventing the river from backing into the protected side.

Floodwall – A concrete wall that serves as a barrier to prevent a river from inundating the protected side.

Levee – A structure composed of earth fill that serves as a barrier to prevent a river from inundating the protected side.

Protected Side (Land Side) – The developed area protected from floodwaters by levees and floodwalls.

River Side (Water Side) – The unprotected side of the levee or floodwall.

Sluicegate – A manually operated gate located in a drainage structure. It generally serves as the backup check valve should a flapgate fail to seal floodwaters from the river.

Stoplog Closure – A structure erected across an opening in a levee or floodwall where a roadway or rail line passes. The structure is installed immediately prior to a high-water event based upon predetermined action levels.

EMERGENCY CONTACT INFORMATION

Patrol Coordinator _____ Phone _____

Patrol Leader _____ Phone _____

Patrol Member _____ Phone _____

Patrol Member _____ Phone _____

Radio Frequency Command Center Channel _____

Radio Frequency Patrol Team Channel _____

Command Center Contact _____ Phone _____

DEC Flood Control Project Operations Contact

Phone _____

Police _____ Phone _____ 911 _____

Fire Department _____ Phone _____ 911 _____

Notes

Notes

Notes

Notes

To obtain additional copies of this manual, contact your nearest DEC regional office or the Central Office at:

Region 3	New Paltz	914-256-3000
	White Plains	914-428-2505
Region 4	Schenectady	518-357-2045
Region 5	Raybrook	518-897-1200
Region 6	Watertown	315-785-2239
	Utica	315-793-2554
Region 7	Syracuse	315-426-7400
	Kirkwood	607-775-2545
Region 8	Avon	716-226-2466
	Elmira	607-732-2214
Region 9	Buffalo	716-851-7201

Central Office, Bureau of Flood Protection and Dam Safety

Albany 518-402-8185

Diagrams courtesy of Pennsylvania Department of Environmental Protection, Bureau of Waterways Engineering and Wetlands, Division of Project Inspection