**Section 300.150 Water Impoundment Structures**

a) Dams

1) This Section establishes the minimum acceptable standards for the design and construction of water impoundment structures under the Surface Mined Land Conservation and Reclamation Act when failure of the structures would not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption to the use or service of public utilities.

2) The standards established here are applicable to structures where the vertical distance between the lowest point along the centerline of the dam and the top of the dam does not exceed thirty (30) feet. For structures in excess of this height a registered engineer in the State of Illinois shall prepare the necessary plans and specifications as required by the Department.

b) Site Conditions

 The maximum practical use of good sites shall be encouraged including the multiple use of the stored water, and possible future needs for additional water during the effective life of the structure.

1) Depth of Water – The minimum depth for impoundment water shall be in accordance with standards established by the Department of Natural Resources for fish stocking, except when such impoundments are to be used in connection with water treatment or industrial use only.

2) Foundation –

A) The soil on which an embankment is to be placed shall consist of material that has sufficient bearing strength to support the embankment without excessive consolidation. The foundation shall consist of relatively impervious material which will prevent excessive passage of water.

B) The foundation area shall be cleared of all trees, stumps, roots, brush, boulders, sod, and debris. All channel banks and sharp breaks shall be sloped to no steeper a ratio than one-to-one (1:1). All topsoil containing excessive amounts of organic matter shall be removed. The surface of the foundation area shall be thoroughly scarified, moisture adjusted to facilitate compaction and completed in accordance with the requirements for the embankment, before placement of the embankment material. Cutoff trenches shall be used except in cases which are exempt by the Department. When used, a cutoff trench shall be excavated to a more impervious material underlying the base of the embankment and shall be backfilled with suitable material as specified for earth embankment, subparagraphs (d)(5) below.

c) Design Criteria

 Site conditions shall be such that the design storm runoff, as indicated under this subsection, can be safely passed through spillways provided.

1) Principal Spillway – The following are the minimum requirements for the principal spillway:

A) Drainage area ten (10) acres or less – A minimum of a four (4) inch diameter smooth or six (6) inch diameter corrugated metal pipe shall be provided. A well vegetated earth spillway may be approved by the Department as a principal spillway provided it is properly designed to convey the peak flow to a stable grade to a minimum point ten (10) feet past the toe of the embankment.

B) Drainage area ten to thirty (10-30) acres – A pipe conduit spillway is required. The minimum pipe size shall be six (6) inch smooth or eight (8) inch corrugated metal pipe.

C) Drainage area thirty to two hundred fifty (30-250) acres and all areas having a potential of creating a hazard to life or property -- A registered engineer in the State of Illinois shall prepare the necessary plans and specifications as required by the Department.

2) Pipe Conduits and Outlets

A) The outlet pipe shall discharge the peak flow to a stable grade to a minimum point ten (10) feet past the toe of the embankment. The following pipes are acceptable: cast iron, wrought iron, steel, asphalt coated corrugated metal, and concrete. All pipe joints shall be made watertight by the use of watertight couplings or gaskets, or by welding or caulking. Concrete pipe shall meet the requirements of ASTM specification C-76 or equivalent and shall be laid in a concrete bedding or cradle. Corrugated pipe shall be at least sixteen (16) gauge and smooth steel shall be at least three-sixteenths (3/16) inch in thickness. All pipe shall be capable of withstanding the external loading.

B) The pipe conduit barrel shall be placed on a firm foundation to the lines and grades shown on the plans. Selected backfill material shall be placed around the conduit in six (6) inch layers and each layer shall be thoroughly compacted by means of hand-held tampers.

C) The flowline of the outlet and of the pipe shall be at least two (2) feet, but not more than four (4) feet, above the flowline of the outlet channel. The outlet shall be placed on an earthen berm or timber or concrete support. If the pipe diameter exceeds twelve (12) inches and the grade downstream is unstable, a timber or a concrete prop shall be provided. All pipes thirty (30) inches or larger and all pipes discharging continuous or prolonged flows shall be propped. Protection shall be provided to prevent the development of a scour hole which will undermine the pipe or its support. Stability checks, when required, shall be based on maximum pipe discharge. Although "propped" outlets are in most common usage, "standard," "flared," or "Saint Anthony Falls (SAF)" outlets are also acceptable when the grade below is stable.

3) Anti-Seep Collars

 Concrete or metal anti-seep collars shall be installed around the pipe conduit within the normal saturation zone. The anti-seep collars and their connections to the pipe shall be watertight. Sufficient collars shall be provided to increase the length of seepage along the pipe by twenty percent (20%). The length of seepage along a collar shall be taken as two (2) times the minimum projection of the collar measured perpendicular to the pipe. The upstream collar shall be placed ten to fifteen (10-15) feet from the inlet of the conduit. Additional collars shall be spaced at not greater than twenty-five (25) feet intervals.

4) Trash Guards

 Where necessary to prevent clogging of the conduit, an approved type of trash guard shall be installed at the inlet or riser.

d) Earth Embankment

1) Top Width – The minimum top width of the embankment shall be eight (8) feet for embankments less than ten (10) feet in height and twelve (12) feet for embankments between ten to twenty (10-20) feet in height. For embankments exceeding twenty (20) feet in height, a registered engineer shall prepare the plans and specifications as required by the Department.

2) Side Slopes – The upstream slope shall be no steeper than two and five-tenths (2.5) horizontal to one (1.0) vertical, and the downstream slope shall be no steeper than two (2.0) horizontal to one (1.0) vertical. The combined upstream and downstream side slopes of the settled embankment shall not be less than five (5) horizontal to one (1) vertical.

3) Freeboard – The minimum elevation of the top of the settled embankment shall be three (3.0) feet above the water surface in the reservoir with the principal spillway flowing at design depth.

4) Allowance for Settlement – Allowance for settlement shall be made throughout the design. The height of the embankment shall be increased by the amount needed to insure that the design top elevation shall be maintained after all settlement has taken place. This increase shall be not less than ten percent (10%). Ordinarily, any point on the constructed slopes should not vary from the planned slope by more than one (1) foot horizontally or six (6) inches vertically.

5) Placement of Fill –

A) The material placed in the embankment shall be free of sod, roots, frozen soil, and other objectionable material. All acid producing material must be excluded from the embankment.

B) The placing and spreading of the embankment material shall be started at the lowest point of the foundation and brought up in approximately nine (9) inch horizontal layers. Each layer shall be thoroughly compacted as required by the Department by controlled movement of equipment. The moisture content of embankment material shall be such that compaction can be obtained with the equipment used.

C) The distribution and gradation of materials throughout the embankment shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. The most impervious material shall be used in the center portion of the fill.

D) A protective cover shall be established on all exposed surfaces of the embankment, spillway, and borrow areas. It is recommended that top soil be placed on the back slope and the front slope above the water line and on the top of the fill to facilitate the establishment of vegetation. The earth fill and spillway areas will be fenced to exclude livestock unless excepted by the Director of the Department.

6) Foundation Cutoff (Core-Trench) –

A) A cutoff of relatively impervious material shall be provided under the embankment except when an impervious base such as a haulage road forms the foundation. In this case the foundation shall be adequately scarified and recompacted. The cutoff, when used, shall extend along the centerline of the embankment and its abutments as required and be deep enough to extend into a relatively impervious layer. The layer of impervious material shall be thick enough to provide stability.

B) The cutoff shall have a bottom width and side slopes adequate to accommodate the equipment used for excavation, backfill, and compaction operations. The side slopes shall not be steeper than one (1) horizontal to one (1) vertical. The cutoff shall be backfilled with suitable material. Compaction, as required by the Department, shall be obtained by controlled movement of equipment. The trench, if feasible, shall be kept free of standing water during backfill operations.

7) Embankment Drains – Where toe drains are used, they should be placed one-half (1/2) the distance from downstream toe of fill and the centerline of fill. Drains are strongly recommended when the embankment or its foundation consists of highly permeable soils and/or embankments greater than twenty (20) feet high.

e) Levees

1) Levees are constructed to confine slurry within a designated area.

A) Conditions Where Practice Applies: Areas bounded by levees shall be such that practical and economical construction, accessibility and maintenance can be obtained. Mineral soils which are stable in levee embankments shall be used for construction. The use of organic soils is not permissible.

B) Design Criteria: The design and installation shall be based on engineering surveys and investigations.

2) Height –

A) The design height of the earth levee shall be equal to the sum of the requirements for deposit of slurry, allowance for wave height, freeboard, and settlement. Estimates of wave heights shall be based on local experience, or on hydraulic studies. A pipe outlet of a size acceptable to the Department shall be installed with a minimum difference in elevation of three (3) feet between the lowest point on the rim of the levee and the invert of the outlet pipe. In no case shall the final elevation of slurry or water level on the slurry pond be closer to the lowest point on the rim than three (3) feet.

B) The allowance for settlement shall be based on consideration of the properties of the soil material and the anticipated compaction but shall be not less than ten percent (10%) of the design height.

3) Cross Section –

A) A maintenance road shall be constructed and maintained on top of all levees. The minimum requirements for the cross section of the levees shall be as follows:

|  |  |  |
| --- | --- | --- |
| Design | Minimum | Steepest |
| Slurry Height | Top Width | Side Slope |
|  |
| Feet | Feet | Feet |
|  |
| 0-10 | 12 | 2:1 |
| 10-25 | 12 | 2½:1 |
| Over 25 |  |  |

B) (A registered engineer in the State of Illinois shall prepare plans and specifications as required by the Department.) Side slopes of three-to-one (3:1) on water side and two-to-one (2:1) on land side may be used instead of two-and-one-half-to-one (2 1/2:1) for each side. The combined water side and land side, side slopes of the levee shall not be less than five (5) horizontal to one (1) vertical.

4) Ditches and Borrow Pits –

A) Minimum berm widths between the toe of the levee and the edge of an excavated channel or borrow, shall be:

|  |  |
| --- | --- |
| Fill Height | Minimum Berm Width |
|  |
| Under 6 feet | 10 feet |
| Over 6 feet | 15 feet |

B) A land-side ditch or borrow pit shall be far enough away from the levee so that a line drawn between

i) the point of intersection of the design water line with the water side of the levee, and

ii) land-side toe of the levee at the ground line

 shall not intersect its cross section.

5) Pipe Conduits and Outlets --

A) The outlet pipe shall discharge the peak flow to a stable grade to a minimum point ten (10) feet past the toe of the embankment. The following pipes are acceptable: cast iron, wrought iron, steel, asphalt coated corrugated metal, and concrete. All pipe joints shall be made watertight by the use of watertight couplings or gaskets, or by welding or caulking. Concrete pipe shall meet the requirements of ASTM Specification C-76 and shall be laid in a concrete bedding or cradle. Corrugated pipe shall be at least sixteen (16) gauge and smooth steel shall be at least three-sixteenths (3/16) inch in thickness. All pipe shall be capable of withstanding the external loading.

B) The pipe conduit barrel shall be placed on a firm foundation to the lines and grades shown on the plans. Selected backfill material shall be placed around the conduit in six (6) inch layers and each layer shall be thoroughly compacted. The flowline of the outlet end of the pipe shall be two (2) feet, but not more than four (4) feet, above the flowline of the outlet channel. The outlet shall be placed on an earthen berm or timber or concrete support. If the pipe diameter exceeds twelve (12) inches and the grade downstream is unstable, a timber or a concrete prop shall be provided. All pipes thirty (30) inches or larger and all pipes discharging continuous or prolonged flows shall be propped. Protection shall be provided to prevent the development of a scour hole which will undermine the pipe or its support. Stability checks, when required, shall be based on maximum pipe discharge. Although "propped" outlets are in most common usage, "standard," "flared," or "Saint Anthony Falls (SAF)" outlets are also acceptable when the grade below is stable.

C) All conduits through the levee below the design highwater line shall be equipped with anti-seep collars designed to increase the distance of the seepage line along the conduit by at least twenty percent (20%).

6) Core Trench – A foundation cutoff or core trench shall be installed where there are layers of permeable soils or layers creating a piping hazard through the foundation at a depth less than three-fourths (3/4) the height of the levee below natural ground level. The cutoff trench shall be of sufficient depth and width and backfilled with select soil to minimize such hazard.

7) Vegetative Cover and Riprap Construction: the soil on which a levee is to be placed shall consist of material that has sufficient bearing strength to support the levee without excessive consolidation. The foundation must consist of relatively impervious material which will prevent excess passage of water.

A) The foundation area shall be cleared of all trees, stumps, roots, brush, boulders, sod, and debris. All channel banks and sharp breaks shall be sloped to no steeper a ratio than one-to-one (1:1). All topsoil containing excessive amount of organic matter shall be removed. The surface of the foundation area shall be thoroughly scarified before placement of the levee embankment material.

B) Cutoff trenches shall be used except in cases which are exempt by the Department. When used, a cutoff trench shall be excavated to a more impervious material underlying the base of the levee embankment and shall be backfilled with suitable material in the manner specified below. The trench shall be kept free of standing water during backfill operations.

C) The material placed in the levee fill shall be free of sod, roots, frozen soil, and other objectionable material. All acid producing material must be excluded from the fill. The placing and spreading of the fill material shall be started at the lowest point of the foundation, and brought up in approximately nine (9) inch horizontal layers. Each layer shall be thoroughly compacted as required by the Department by controlled movement of equipment. If the fill material is of varying texture and gradation, the most impervious material shall be placed toward the water side of the levee.

D) A banquette shall be placed to reinforce the land-side toe where a levee crosses an old channel or where excessively porous fill or poor foundation conditions justify such reinforcement. Such banquettes shall be used if during construction the channel crossing is under water or saturated.

E) The design shall include a top width of the banquette equal to or greater than the fill height of the levee above the top of the banquette. The banquette top shall be finished to an elevation not less than a foot above normal ground level and it shall be sloped towards the land side for drainage. The land side slope of the banquette shall be not steeper than the land side slope of the levee.

F) An alternate design of the banquette may be used where design is based on detailed site investigation, laboratory analysis and adequate compaction will be obtained.