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Chapter 4 Borrow Areas

4-1. General

In the past borrow areas were selected largely on the basis of material types and quantities and haul distances. Today, borrow areas receive much more attention and must be carefully planned and designed, because of considerations such as environmental aspects, increasing land values, and greater recognition of the effects of borrow areas with respect to underseepage, uplift pressures, overall levee stability, and erosion. The following paragraphs discuss some factors involved in locating and using borrow areas.

4-2. Available Borrow Material

a. Material type. Almost any soil is suitable for constructing levees, except very wet, fine-grained soils or highly organic soils. In some cases, though, even these soils may be considered for portions of levees. Accessibility and proximity are often controlling factors in selecting borrow areas, although the availability of better borrow materials involving somewhat longer haul distances may sometimes lead to the rejection of poorer but more readily available borrow.

b. Natural water content. Where compacted levees are planned, it is necessary to obtain borrow material with water content low enough to allow placement and adequate compaction. The cost of drying borrow material to suitable water contents can be very high, in many cases exceeding the cost of longer haul distances to obtain material that can be placed without drying. Borrow soils undergo seasonal water content variations; hence water content data should be based on samples obtained from borrow areas in that season of the year when levee construction is planned. Possible variation of water contents during the construction season should also be considered.

4-3. General Layout

Generally, the most economical borrow scheme is to establish pits parallel and adjacent to the levee. If a levee is adjacent to required channel excavation, levee construction can often utilize material from channel excavation. Large centralized borrow areas are normally established only for the construction of urban levees, where adjacent borrow areas are unavailable. Long, shallow borrow areas along the levee alignment are more suitable, not only because of the shorter haul distance involved, but also because they better satisfy environmental considerations.

a. Location. Where possible, borrow area locations on the river side of a levee are preferable as borrow pits. Borrow area locations within the protected area are less desirable environmentally, as well as generally being more expensive. Riverside borrow locations in some areas will be filled eventually by siltation, thereby obliterating the man-made changes in the landscape. While riverside borrow is generally preferable, required landside borrow from ponding areas, ditches, and other excavations should be used wherever possible. A berm should be left in place between the levee toe and the near edge of the borrow area. The berm width depends primarily on foundation conditions, levee height, and amount of land available. Its width should be established by seepage analyses where pervious foundation material is close to the bottom of the borrow pit and by stability analyses where the excavation slope is near the levee. Minimum berm widths used frequently in the past are 12.2 m (40 ft) riverside and 30.5 m (100 ft) landside, but berm widths should be the maximum practicable since borrow areas may increase the severity of underseepage effects. In borrow area excavation, an adequate thickness of impervious cover should be left over underlying

pervious material. For riverside pits a minimum of 0.91 m (3 ft) of cover should be left in place, and for landside pits the cover thickness should be adequate to prevent the formation of boils under expected hydraulic heads. Topsoil from borrow and levee foundation stripping can be stockpiled and spread over the excavated area after borrow excavation has been completed. This reinforces the impervious cover and provides a good base for vegetative growth.

b. Size and shape. It is generally preferable to have riverside borrow areas “wide and shallow” as opposed to “narrow and deep.” While this may require extra right-of-way and a longer haul distance, the benefits derived from improved underseepage, hydraulic, and environmental conditions usually outweigh the extra cost. In computing required fill quantities, a shrinkage factor of at least 25 percent should be applied (i.e., borrow area volumes should be at least 125 percent of the levee cross-section volume). This will allow for material shrinkage, and hauling and other losses. Right-of-way requirements should be established about 4.6 to 6.1 m (15 to 20 ft) beyond the top of the planned outer slope of the borrow pit. This extra right-of-way will allow for flattening or caving of the borrow slopes, and can provide maintenance borrow if needed later.

4-4. Design and Utilization

a. Slopes. Excavation slopes of borrow areas should be designed to assure stability. This is particularly important for slopes adjacent to the levee but could also be important for any slope whose top is near the right-of-way limits. Borrow area slopes must also be flat enough to allow mowing, if required. Also, where landside pits are to be placed back into cultivation, changes in grade must be gentle enough to allow farm equipment to operate safely. The slopes of the upstream and downstream ends of riverside pits should be flat enough to avoid erosion when subjected to flow at high water stages.

b. Depths. Depths to which borrow areas are excavated will depend upon factors such as (1) groundwater elevation, (2) changes at depth to undesirable material, (3) preservation of adequate thickness of riverside blanket, and (4) environmental considerations.

c. Foreshore. The foreshore is that area between the riverside edge of the borrow area and the riverbank as shown in Figure 4-1. If a foreshore is specified (i.e., the borrow excavation is not to be cut into the riverbank), it should have a substantial width, say 61 m (200 ft) or more, to help prevent migration of the river channel into the borrow area.

d. Traverse. A traverse is an unexcavated zone left in place at intervals across the borrow area (Figure 4-1). Traverses provide roadways across the borrow area, provide foundations for transmission towers and utility lines, prevent less than bank-full flows from coursing unchecked through the borrow area, and encourage material deposition in the borrow area during high water. Experience has shown that when traverses are overtopped or breached, severe scour damage can result unless proper measures are taken in their design. Traverse heights should be kept as low as possible above the bottom of the pit when they will be used primarily as haul roads. In all cases, flat downstream slopes (on the order of 1V and 6H to 10H) should be specified to minimize scour from overtopping. If the traverse carries a utility line or a public road, even flatter slopes and possibly stone protection should be considered.

e. Drainage. Riverside borrow areas should be so located and excavated that they will fill slowly on a rising river and drain fully on a falling river. This will minimize scour in the pit when overbank river stages occur, promote the growth of vegetation, and encourage silting where reclamation is possible. The bottom of riverside pits should be sloped to drain away from the levee. Culvert pipes should be provided through traverses, and foreshore areas should be ditched through to the river as needed for proper drainage. Landside pits should be sloped to drain away from or parallel to the levee with ditches provided as necessary to outlet

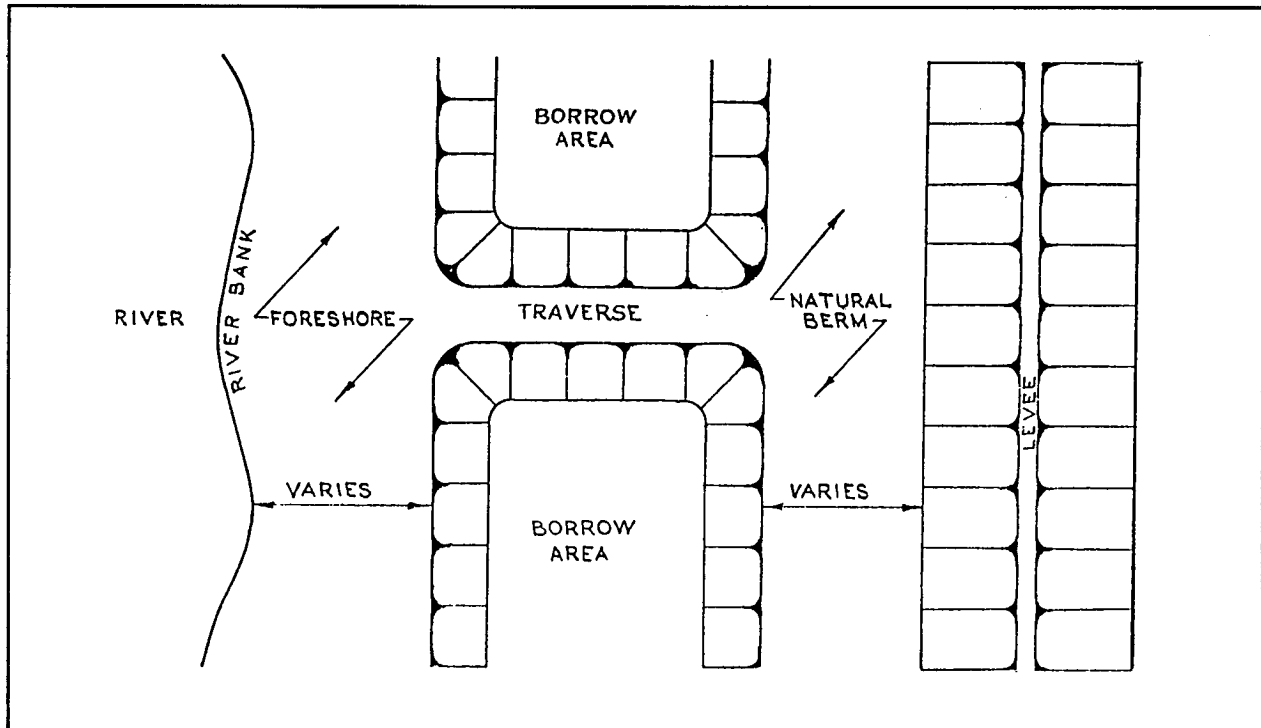


Figure 4-1. Plan of typical levee and borrow areas with traverse and foreshore

points. Gravity outlets or pump stations should be located so as to minimize lengths of flow paths within the pit area.

f. Flow conditions. To avoid damage from confined or restricted flow through the riverside borrow areas, obstructions or impediments to smooth and uniform flow should be removed if possible, or else protective measures must be taken. Riverside borrow areas should be made as uniform in width and grade as possible, avoiding abrupt changes. Removal of obstructions that could cause concentrated flow includes degradation of old levee remnants and of narrow high ground ridges beyond the borrow area, as well as removal of timber from traverses and from foreshore areas immediately adjacent to the borrow area. Obstructions to flow that cannot be removed include transmission towers, bridge piers, and other permanent structures near the levee. In such areas, stone protection should be provided for the levee or borrow area slopes if scour damage is considered probable.

g. Environmental aspects. The treatment of borrow areas after excavation to satisfy aesthetic and environmental considerations has become standard practice. The extent of treatment will vary according to the type and location of a project. Generally, projects near urban areas or where recreational areas are to be developed will require more elaborate treatment than those in sparsely populated agricultural areas. Minimum treatment should include proper drainage, topographic smoothing, and the promotion of conditions conducive to vegetative growth. Insofar as practicable, borrow areas should be planted to conform to the surrounding landscape. Stands of trees should be left remaining on landside borrow areas if at all possible, and excavation procedures should not leave holes, trenches, or abrupt slopes. Restoration of vegetative growth is important for both landside and riverside pits as it is not only pleasing aesthetically but serves as protection against erosion. Willow trees can aid considerably in drying out boggy areas. Riverside pits should not be excavated so deep that restored grass cover will be drowned out by long submergence.

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Agencies responsible for maintenance of completed levees should be encouraged to plant and maintain vegetation, including timber, in the borrow areas. It is desirable that riverside borrow pits be filled in by natural processes, and frequent cultivation of these areas should be discouraged or prohibited, if possible, until this has been achieved. Guidelines for landscape planting are given in EM 1110-2-301.

h. Clearing, grubbing, and stripping. Borrow areas should be cleared and grubbed to the extent needed to obtain fill material free of objectionable matter, such as trees, brush, vegetation, stumps, and roots. Subareas within borrow areas may be specified to remain untouched to preserve standing trees and existing vegetation. Topsoil with low vegetative cover may be stripped and stockpiled for later placement on outer landside slopes of levees and seepage berms.