# Farm Management Practices for Reclaimed Cropland

**Front Cover:** Corn growing on reclaimed land near Farmersburg, Indiana.

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Coal seam in the rock highwall (dark layer about 1/3 from the bottom).

# Team Purpose Statement

To develop and provide recommendations that ensure the protection, restoration, and management of soil resources affected by coal mining in Indiana.

# Team Goal

To promote coordination among the various government agencies, and other entities, concerned with the maintenance of prime farmland and cropland capable land resources.

# I. Introduction and Summary

Everyone who resides in the coal mining region, whether farmer or city dweller, is by default a shareholder in the future of mined land reclamation.

The purpose of this publication is to familiarize the shareholders, farmers, and landowners of reclaimed mined lands with the different aspects of farming these newly formed crop capable soils. The processes of mining and reclamation are discussed in this document to provide insight on why the management of reclaimed crop capable soils may be different from the undisturbed soils available before mining.

This document describes management techniques and available resources such as technical assistance as they apply to reclaimed crop capable soils. This document can also be used by landowners that are considering whether or not to lease their property for mining. Reclaimed crop capable soils have been proven to be as productive as un-mined cropland. In fact, it is a requirement of the mining regulations that reclaimed crop capable soil obtains yields representative of its pre-mining productivity. Management techniques and maintenance of these reclaimed areas can vary and require additional monitoring. Water and sediment control structures that may not have been needed prior to mining are sometimes required after mining to obtain optimum management of restored crop capable soils.

This document will provide farmers and landowners with the most current information and best management practices needed to obtain the highest possible yields from their restored crop capable soils and maintain the inherent value of the land.


Coal being hauled out of the active mine.


Soil being replaced as part of the reclamation process.

# II. Soils and the Mining Process

## Impacts of Mining on Soils

The recovery of coal by surface mining methods involves removal of soils and other earth materials (overburden) located above the coal. Current mining regulations require the mining operator to remove the soil (and subsoil in crop capable lands) in a separate operation before removal of the overburden.

When the soils are removed in preparation to remove the underlying overburden, a mine operator will immediately place the soil on an area where replaced overburden (spoil) has been shaped (graded) to the approximate final topography. If graded spoil is not available for soil placement, mine operators must stockpile the soil materials. Soils that must be stockpiled will tend to suffer further degradation due to the "double" handling by machinery and compaction while in the stockpile.

Soil material being replaced over graded spoil as part of the land reclamation process.

The removal of soils by mining equipment results in changes to the natural structure of the soil. The most common impacts are: loss of pore space, loss of permeability, changes in the capability of the soil material to provide moisture and air for plant growth, loss of living organisms, and reduction of organic matter. Soils reclaimed after mining are considered drastically disturbed, and these changes must be managed.

## Soil Restoration

Mining permits approved by the Indiana Department of Natural Resources discuss actions the mine operator will take to restore the soils to pre-mining yields. Methods mine operators use to restore the capability of the soil include incorporation of soil amendments (lime, fertilizer, organic matter) and deep tillage.

Topsoil being replaced on subsoil material.

# III. Soil Management Practices

Maximizing productivity of reconstructed soils is dependent upon the management practices applied.

The topography of an area that has been surface mined can change. Changes occur because the volume of the overburden increases when rock layers are shattered and relocated. At times, this can result in slopes that are steeper than they were originally. Another unavoidable result of the shattered overburden is the uneven settling that will occur over time. This settling can cause depressions that will pond water and require additional management activities.

Surface materials (topsoil and subsoil) will undergo changes brought on by moving them with large mining equipment. Changes include increased potential for erosion, reduced Available Water Capacity (AWC), decreased infiltration, reduced permeability, and loss of soil tilth and structure. These are changes that can be managed using practices that may not have been necessary before mining.

## Topography and Soil Erosion

Surface mine operators reclaim crop capable lands to gentle slopes, usually less than four percent. These gentle slopes reduce erosion, reduce surface water ponding and will not be as sensitive to the effects of uneven settling, as compared to level ground. Gentle slopes can be managed with minimal land leveling and can be deep tilled or ripped without serious erosion problems. The infiltration rate will be similar to level ground, and general farm tillage can still take place.

If the restored cropland capable lands are level ground, there is a reduced need for water control structures, equipment will have longer runs, there is a greater percentage of ground in production, and less runoff occurs.

However, level ground will require different management practices than gentle slopes. Land leveling may still be required to address differential settling across the field. Subsurface drainage may be required to remove excess water. Caution should be exercised as drainage systems can be damaged by post installation settling.

Management methods used by landowners and mine operators to control erosion of reclaimed soils include using cover crops instead of leaving a field bare during the time it is not growing row crops. Maintaining an area as a hay field for several years will build organic matter reducing the soil erodibility. Drainage control structures may be used to manage erosion on longer gentle slopes.

Most areas will have a general erosion control method. A gradual to steeper slope may require terraces or WASCOB structures to be installed to stabilize the soil. Mine soils tend to be highly erodible and may benefit from a cover crop of legumes or grasses for a few years, which also helps in maintenance of structures. Each method must be maintained and checked after large storm events.

## Compaction

Equipment usage should be minimized on reclaimed sites. Equipment traffic and tillage operations should be done when the soil is dry. Compaction avoidance techniques must be considered, since reclaimed soils are subject to mechanical re-compaction.

Working the soils when wet is not recommended as this can increase compaction problems.

## Deep Ripping

Soils reclaimed during mining operations tend to be compacted because the original soil structure is altered by the large equipment used during reclamation. Deep tillage or ripping operations, to four-foot depths, may have been used to alleviate deeper compaction created by reclamation operations.

Shallower ripping, 18 to 24 inches, can be used by landowners to alleviate compaction caused by farming operations. Caution should be taken when using ripping, because when such an area is deep tilled it may act as a sponge down to the depth of the implement's reach. This will hinder any farm tillage or the chance of plant survival.

Using a ripper to break up compaction on reclaimed land.

A grazing plan should be implemented for areas with livestock. This will ensure that vegetation remains in place to control erosion on and near the terraces.

## Residue Management

Conservation tillage in the form of minimum tillage should be implemented on reclaimed farmland. A residue ground cover of 30 to 70 percent is needed to provide maximum protection against wind and water erosion.

Minimum or reduced tillage operations should be used that would include till-plant, no-till, mulch-till and rotary-till.

## Water Management

By implementing conservation practices you can increase the benefits of precipitation during the growing season, enhancing the infiltration and movement of water in the soil. Conservation practices may be applied singly or in a combination. The purpose of their application is explained in this section. It is important to remember that root zone available water capacity (RZAWC) and the utilization of precipitation during the growing season will determine the productivity of reclaimed soils. The timeliness of precipitation during the growing season may determine the crop yield.

RZAWC is defined as the capacity of a soil to hold water in a form available to plants, usually expressed in inches of water per inch of soil multiplied by soil rooting depth. Soils that have limited RZAWC are likely to be droughty and have limitations in the kinds and amounts of crops that can be grown. RZAWC is considered a critical soil property and is important in developing water budgets, predicting droughtiness, designing drainage systems, and predicting yields.

The following table shows the RZAWC for the rooting media and land capability classes for the reclaimed soils and soils before mining, based on an Indiana study in 2004. The Land Capability Classification classifies soils according to their hazards and limitations. It includes a water criterion as follows: Class I - 9 inches or more of water; Class II - 6 to 9 inches of water; Class III - 3 to 6 inches of water; and Class IV - 3 inches or less water available for plant growth. Land Capability Classes I, II, and III are considered cropland and IV is hayland.

The eight study sites shown in the following table were reclaimed from 1982 through 1993. All sites were reclaimed using scrapers; except Daviess 001, which used shovel-truck soil replacement.

Table showing the Land Capability Classes (LCC) assigned by RZAWC for reclaimed soils and premined soils. [1/]

| County / Soil | RZAWC of Reclaimed Mined Soils (inches) | Reclaimed LCC | Premined LCC |
|---|---|---|---|
| Daviess 001 | 4. | III | I |
| Daviess 002 | 4.2 | III | II |
| Greene 015 | 2.4 | IV | II |
| Greene 025 | 2.7 | IV | II |
| Pike 001 | 1.4 | IV | II |
| Pike 002 | 4.0 | III | II |
| Warrick 001 | 2.6 | IV | II |
| Warrick 002 | 6.7 | II | II |

[1/] 2005 National Meeting of the American Society of Mining and Reclamation, Breckenridge, CO, June 19-23, 2005. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

RZAWC for the soils in the above table influences plant growth and crop yield. Many prime farmland soils before being mined have 6 to 12 inches of water, while some reclaimed soils may have no more than 1.4 inches of water. Therefore, the water within the rooting zone needs to be carefully managed to get the maximum crop yield.

During years of timely and adequate precipitation, a reduced RZAWC may not significantly reduce crop yields. However, when precipitation is not adequate, moisture stress may decrease crop yields. Moisture stress is one of the major yield limiting factors for crops grown on reclaimed mine soils as compared to crops on adjacent undisturbed land.

All other factors being equal, deep soils (whether natural or reclaimed) with no root limiting properties will have greater RZAWC than will shallow soils. One of the most essential functions of the subsoil for crop production is to store water and readily supply it to growing crops.

Since most reclaimed soils have a lower RZAWC, they will require greater precipitation during the growing season, compared to non-mined soils, to achieve similar yields. Increasing the effectiveness of precipitation can be improved by the proper use and application of conservation practices.

Contours used to control water on reclaimed land.

## Conservation Practices

Conservation Management Practices that can maintain or even increase soil moisture for plant growth are listed below.

**Residue/organic matter management:** It is important to manage the amount, orientation, and distribution of crop and other plant (cover crop) residue on the soil surface year-round. This practice may be applied as part of a conservation system to support one or more of the following:

- reduce erosion,
- maintain and improve soil organic matter content and tilth,
- conserve soil moisture,
- manage snow to increase plant available moisture,
- reduce off-site transport of sediment, nutrients or pesticides, and
- is a required management practice for highly erodable lands.

**Terracing:** The use of earth embankments, or a combination of ridges and channels constructed across the field slope are important management practices. These practices may be applied as part of a resource management system to support one or both of the following: reduce soil erosion and reduce runoff for moisture conservation.

They are applied where

- soil erosion by water is a problem,
- there is a need to conserve water for crop production,
- a suitable outlet can be provided, and
- excess runoff of water is a problem.

Terraces installed in a crop field to slow runoff and reduce erosion.

**Contouring:** The use of contour tillage; planting and other farming operations performed on or near the contour of the field slope is a powerful management practice. The purpose of this practice is to

- reduce erosion,
- reduce transport of sediment and other water-borne contaminants, and
- increase infiltration for moisture conservation.

This practice applies on sloping land where crops are grown. Contour farming is most effective on slopes between two and ten percent. This practice will be less effective in achieving the stated purpose(s) on slopes exceeding ten percent.

Contour tillage used to reduce runoff and increase water infiltration.

**Water and Sediment Control Basin (WASCOB):** These earth embankments or combinations of ridge and channel are constructed across the slope on minor watercourses. They are valuable practices to trap sediment and retain water. They may be established to

- improve farmability of sloping land,
- reduce watercourse and gully erosion,
- trap sediment,
- reduce and manage onsite and downstream runoff, and
- improve downstream water quality.

This practice applies to sites where

- the topography is generally irregular,
- watercourse or gully erosion is a problem,
- sheet and rill erosion is controlled by other conservation practices,
- runoff and sediment damage land and improvements,
- soil and conditions are suitable, and
- adequate outlets can be provided.

WASCOBs and terraces have different purposes and specifications. WASCOBs are used to control erosion in small drainage channels, and terraces are used to control water flow on slopes.

WASCOB embankment (behind riser) and riser for drainage

WASCOB embankment (right) and riser for drainage

**Conservation Tillage:** Conservation Tillage is defined to be any tillage and planting strategy or technique for establishing crops in the previous crop's residues, which are purposely left on the soil surface. Generally, conservation tillage is any tillage/planting system which leaves at least 30 percent of the field surface covered with crop residue after planting has been completed. The benefits of conservation tillage are well-known and include

- increase residue and soil organic matter,
- increase plant-available moisture,
- improve soil quality,
- increase earthworm populations,
- improve soil structure,
- increase infiltration rates, reduce

carbon dioxide ($CO_2$) losses from the soil, reduce water and wind soil erosion, and
- reduce field time.

Conservation tillage includes:

- **Mulch Till:** Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round, while growing crops where the entire field surface is tilled prior to planting. Tillage equipment used includes chisels, field cultivators, disks, sweeps and blades.

- **Ridge Till:** Managing the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops on preformed ridges alternated with furrows protected by crop residue. The soil is left undisturbed from harvest to planting except for nutrient injection. Planting is done in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges.

- **No-Till/Strip Till:** No-till and strip till systems manage the amount and distribution of crop and other plant residues on the soil surface year-round. Crops are grown in narrow tilled slots, or directly in untilled soil. The soil is left undisturbed from harvest to planting except for nutrient injection. Seeds are placed in a narrow seedbed or slot made by coulter(s), row cleaners, disk openers, in-row chisels, or rototillers, where no more than one-third of the row width is disturbed.


No-till corn growing in last years corn stubble.

Conservation tillage farming methods take several years to prove themselves, both with respect to changes in soil conditions and crop response. Anyone entering a conservation tillage system should give it a number of years and understand that changes will be necessary during that time. Moisture conservation is a benefit of conservation tillage.

**Grassed Waterway:** This is a natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation. This practice may be applied as part of a resource management system to support one or more of the following purposes:
- To convey runoff without causing erosion, flooding or ponding;
- To reduce gully erosion; and
- To protect/improve water quality.


Grassed waterway in a crop field

**Filter Strip:** A strip or area of herbaceous vegetation that removes contaminants from overland flow. This practice is used to reduce suspended solids and associated contaminants in runoff, or reduce dissolved contaminant loadings in runoff.

Filter Strip (center) used to separate the crop field (left) and wetland area (right)

In summary, these conservation practices may be applied singly and/or in a combination with each other. It is important to remember that these conservation management practices will help in the utilization of available precipitation during the growing season to maximize soil health and crop production.

Water control structures on recently reclaimed land. These include grass waterways (top right), WASCOBs (lower left and right).

# IV. CROP MANAGEMENT

## Crop Selection and Rotation

Studies have been completed that show that the effects of stress on a particular crop, on mined soils, can be minimized through crop hybrid selection and through crop rotation.

## Hybrids

It should be noted that crop hybrids with high potential on undisturbed soils does not always mean that higher yields will be found on mined soils. Corn hybrids on reclaimed soils tend to pollinate later in the season than these same hybrids do on undisturbed soils. Soybean hybrids with a longer fill season could help productivity, but carries some risk as longer season varieties could run into wetter conditions later in the season. It is best to use hybrids that are productive over a wide range of conditions and are able to cope with droughty conditions.

Corn is the most commonly grown crop in Indiana on prime farmland soils. Therefore, it is estimated that 8 to 10 inches of water must be provided for row crops from the soil itself in the growing seasons of normal rainfall. With a lower RZAWC, reclaimed soils require above normal precipitation during June, July, and August than the premined soils to get equal or higher yields. Because of this, variations in weather appear to have a more significant impact on yields on mined soils than undisturbed soils.

Consider using a hybrid that produces lots of vegetation and litter. Adding more organic matter to the soil will benefit production as mentioned below and benefits the populations of soil flora and fauna. Earthworms are scarce in mined soils and anything that will help the population growth is beneficial. Disease is less of an issue on mined soils compared to non-mined soils.

Soybeans are more tolerant to a variety of moisture conditions. Seed treatments are important considerations as soil is brought back into production. Reclaimed soils have limited sources of inoculants, and yields could be increased by adding appropriate strains at planting.

## Rotations

Crop rotations should be planned to maximize productivity but still protect the soil from the new characteristics of reclaimed soils. Rotations should account for the potentially higher erosive characteristics of mined soils and should be used to increase the organic matter and build the structure of reclaimed soils. A proper crop rotation can be used to (accelerate) improve soil organisms and soil health. Root structure of the crops in the rotation should be considered for their ability to enhance the organic matter, enhance soil development, prevent pan development, and improve soil health and structure. Most of the producers will use Corn-Bean rotations with the occasional double crops after the farming systems have been established, but this is rain dependant.

## Soil testing

Soil testing on mined soils is done the same as non-mined unless a specific problem is noticed. Then you would want to do a more detailed sample along with more varied tests. While testing for N-P-K is the norm, testing for micronutrients could prove to be beneficial on mined soils either as a soil test or as foliar testing. Producers suggest that foliar testing works best for micronutrients. Recommendations are to sample every three years for micronutrients. Foliar shows more variability than soil testing and is more accurate.

Collecting soil samples in a corn field.

## Soil pH

Soil pH affects availability of nutrients such as phosphorus and potassium. The soil pH needs to be controlled similarly to non-mined ground; but due to variability of the soil, smaller sampling areas need to be used. Use of 2.5 acre grid sampling pays off in lime application. It has similar variability as micronutrients and has the same concern for problem areas.

Lime being spread to raise the soil pH.

## Tillage

The first few years, most fields require some tillage to account for land settling and rill erosion. Timely uses of tillage implements, planters and harvesters will prevent further damage to the soil condition. See the Conservation Practices section above. After the first few years, No-till could be a viable form of management. No-till is a good system to use to reduce erosion, build soil stability and microorganisms. Implements that impact the soil the least work better by not compacting the soil and destroying soil structure.  Care should be taken to use implements that won't reverse the benefits of No-till farming.

## Nitrogen

Various types of nitrogen will respond in the same manner on mined and non-mined soils. Split applications tend to work better than single applications. Foliar feeding or side dressing could prove to be beneficial methods of application.

## Plant Population

On reclaimed soil, planting populations are often reduced slightly compared to non-mined land initially. This is to reflect the limitations of the mined land. As residue and organic matter levels are built up, populations can be increased. **Timely** planting of appropriate populations of hybrids specific to location and soil conditions will affect the outcome of crop production on reclaimed soils. Plant timing windows are smaller than non-mined. This will improve over time.

## Chemical

Rates of chemical applications and type of chemicals used may need to be adjusted for differences between native soils and reclaimed soils. Chemicals used are similar to non-mined, but the weed species may be different from what was there before the land was mined.

Applying chemicals on soybeans.

## Organic Matter

1. Cover crops

Use of cover crops will help speed the restoration process in the first few critical years. Alfalfa, annual rye and clover crops are frequently used for this purpose. Cover crops will help by:

- Absorbing the energy in raindrops preventing the sealing over of the bare soil surface which blocks oxygen from getting to plant roots, and stops infiltration of water into the soil;
- Holding the fragile soil in place;
- Supplying a food source for soil life, i.e. earthworms and bacteria that create nutrients for crop use;
- Increasing residue helps the carbon-nitrogen ratio and builds organic matter in the soil; and
- Attracting beneficial insects.

2. Crop Residue Management

Incorporation of residue can help build organic matter in the soil surface. Leaving some residue on the surface can help prevent erosion. Using hybrids and cover crops that produce abundant vegetation and leave residue such as wheat chaff will help build organic matter levels.

3. Other Sources

While crop residue is a commonly used source of organic matter, it is not the only source. Animal manure and waste vegetation are good sources of organic matter. These could be obtained locally or from commercial operations that are seeking locations to spread excess animal manure.

**Subsurface application of Animal waste**

Finally, seek information from people experienced in farming reclaimed soils. Local farmers, extension agents or University staffs are good sources of information for those starting to farm reclaimed land.

# V. Real Life Experiences

*The following section is derived from comments made by producers who own and farm mined ground. The comments made are the opinions of the producers and may not agree between them or with comments made in the text above. These experiences vary due to dates and types of mine reclamation.*

## Producer 1 from Daviess County

This farm was reclaimed using scrapers in the 1980's.

1. Use of the moldboard plow has diminished due to the fact that it tends to leave the more erosive land bare on top and, also, tends to leave a hardpan about plow depth. Use of the disc is another operation that is beginning to be questioned. A disc tends to leave a hardpan at disc depth, which can impede the movement of moisture down into the lower layers of soil, as well as impede its movement back up into the upper layers to nourish growing crops. Use of these implements can reduce the available water for crop production, as well as render the soil more erosive.

2. I am intrigued by the possibilities of deep ripping 15 – 18 inches deep. My experience tells me that the practice of deep ripping, if done under the right soil conditions, can be a great benefit to ordinary crop production. By right conditions I mean dry soil. If this practice is done each year, in the fall, in a slightly different pattern I can envision a productive zone of soil 15 – 18 inches deep free of compaction or hardpan through which moisture and nutrients can move freely. Equipment is coming into use that smoothes the soil on top but does not close the deep slots established by ripping.

3. Tile drainage should not to be done unless one can be reasonably sure further settling of the soil will be minimal. If WASCOBS are installed, it is advisable to install tile in the WASCOB channels, hooking the tile into risers at the point where the risers hook into the field drainage system. This tends to dry out the WASCOB channels as well as other parts of the field. Other tile could be installed as needed or desired keeping the above advice in mind.

4. Do not let the soil erode.

## Producer 2 from Warrick County

My experience during the first few years after total bond release:

1. Timeliness must be your top priority. When these fields are ready to prep and plant, all other activities should be put aside until completion.
2. Full width tillage may be needed for the first few years due to soil physical properties. As the soil properties allow, No-till should be implemented as this is most beneficial to

the soil.

3. Tiling could solve wetness issues but should be done after settling issues have been resolved. While it can solve the problems in a specific area, it should only be done as a last resort.
4. Crop rotation would reflect what the mine company was using at bond release. This can be changed based on the land user's goals.
5. Conservation practices, such as filters, buffers, terraces or WASCOBS, may be added as necessary; but these largely should have been installed prior to bond release. These may have to be altered based on equipment size and limitations.
6. Be aware of potential problem spots that occur. Yield monitoring, visual observation and post event observations can indicate where these areas are.

## Producer 3 from Warrick County

This farm was reclaimed using scrapers in the late 1990's and is farmed using a disc Chisel-Finisher 12" deep and ripper 18" deep.

Management practices that worked best:

No-Till
Manure incorporated using disc (Land Star finisher)
Hay – Pasture – No-till corn as a startup sequence as you get the land back out of bond

Management practices that did not seem to work:

After using a fall ripper, a wet winter or spring can cause extreme saturation
Spring chisel can cause extreme dryness

What do you do on reclaimed land that is not necessary on unmined soils?

Timely planting. The soil cannot be too wet or too heavy because the soil will crust over. If you wait too long the soil will get dry and hard.

Other Comments:

The biggest factor is moisture during the growing season when the plant needs it. With timely rains during that period the ground produces higher yields than before it was mined. In the early 2000's, corn yielded 160 –180 bushels per acre and in a dry year 12 – 60 bushels per acre. The same in beans with a yield of 45 –60 bushels per acre and in a dry year 4 –15 bushels per acre.

Another major factor is time for Mother Nature to take its course and the earthworms to get back into the soil to help compaction and create a water table to allow plant roots to go down into the soil. Cover crops of legumes and grasses for the first few years for a hay crop and so on when the ground is first reclaimed will help erosion and soil quality. But with all the above, what works one year may not work the next; it just depends on Mother Nature.

## Producer 4 from Daviess County

This farm was reclaimed using scrapers and dump trucks in the late 1990’s and is farmed using a ripper 18” deep.

Management practices that worked best:

Doing a deep ripper run, about 24” to 30” deep, the first year after the land was returned.
Use a Zone builder down to 14” to 18” and then use a Max Harrow prior to planting.

Management practices that did not seem to work:

No till without running Zone builder.
Shallow ripping, about 12” to 14”  deep, the first year.

What do you do on reclaimed land that is not necessary on unmined soils?

Deep ripping.

# VI. Available Technical and Financial Assistance

The Natural Resources Conservation Service (NRCS) is the lead agency for helping landowners to apply conservation measures to their properties. This is done using a variety of Federal programs to supply technical information for planning and design of conservation practices and cost-share funds to help finance the installation of these conservation practices. Land that has been released from performance bond can be enrolled in a variety these programs depending on landowner goals. Programs like the Conservation Reserve Program (CRP), Wildlife Habitat Incentive Program (WHIP), Environmental Quality Incentives Program (EQIP), and others can be used to protect your land.

More information is readily available by contacting NRCS at your local USDA Service Center, or on the internet at http://www.in.nrcs.usda.gov/. Click on the Programs tab for more information on individual programs. Local field offices can be found under the "Quick Access" column, click the employee directory and look for the Field Offices link.

Places to get Information:

USDA-NRCS
6013 Lakeside Blvd.
Indianapolis, Indiana 46278
Ph: 317-290-3200
Fax: 317-290-3225

## Soil Inventory

All of the soils in the state of Indiana have been mapped by soil scientists walking across the landscape, examining the physical and chemical properties of the soil and delineating soils that have similar properties. As mentioned above, the soils that now exist on the mined land are different from the soils that were mapped before the area was mined. Any mining that occurred after the initial mapping was done will not be reflected in the published soil survey book. The most up-to-date data for the soils of Indiana is stored on the Web. Tabular data, which is comprised of tables and reports covering soil properties and interpretations, can be found in the Soil Data Mart Web site (http://soildatamart.nrcs.usda.gov/). The most current soil maps can be accessed using the online program called Web Soil Survey (WSS). The address is http://websoilsurvey.nrcs.usda.gov/app/.

In WSS, navigate to the area you are interested in using either with the zoom tool or by using the quick navigation links on the left, or both. Once you locate the area you are interested in, delineate your area of interest (AOI) using the buttons with the red boxes marked "AOI". When your AOI is selected, click on the "Soil Map" to see your soil map and get a list of soils found in your AOI. Click on the "Soil Data Explorer" tab to get to the soil data for your property. Items found under the "Suitability's and Limitations for Use" tab are used to create thematic maps based on soil interpretations. The "Soil Properties and Qualities" tab items are used to create maps based on soil properties. The "Soil Reports" tab lets you create standard soils reports similar to the ones found in the published soil survey books. Any reports or maps that are generated can be added to the “Shopping Cart (Free)” and can be used to produce an electronic Soil Survey publication for the AOI selected.

Contact your local Natural Resources Conservation Service field office if you have any questions or need assistance with using Web Soil Survey.

## Other Technical Information:

Conservation Technology Information Center
1220 Potter Drive, Suite 170,
W. Lafayette, IN 47906-1383
Phone: (765) 494-9555
Fax: (765) 494-5969
www.ctic.purdue.edu

Indiana Dept. Nat. Resources
Div. of Reclamation
R.R. #2, Box 129
Jasonville, IN 47438
Phone: 812-665-2207
Fax: 812-665-5041
HTTP://www.in.gov/dnr/reclamation/

Indiana Soil and Water Conservation Districts
HTTP://iaswcd.org

Purdue Cooperative Extension Service
HTTP://www.extension.purdue.edu/index.shtml

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# VII. Glossary/Keywords

*Not all of the terms found in this Glossary are used in this document but they are useful terms to know and are commonly used in mine reclamation publications.*

**acid-forming materials:** earthen materials that contain sulfide minerals or other minerals which, if exposed to air, water, or weather processes, form acids that may create acid mine drainage.

**affected area:** any land or water upon or in which mining activities are conducted or located.

**A horizon:** the uppermost mineral layer and the part of the soil in which the organic matter is most abundant and where the leaching of soluble or suspended particles is typically the greatest.

**B horizon:** the mineral layer that is typically immediately beneath the **A horizon**. The **B horizon** commonly contains more clay, iron, or aluminum than the **A horizon** or **C horizon**.

**C horizon:** the deepest layer of the soil profile and consists of loose material or weathered rock that is relatively unaffected by biologic activity.

**compaction:** the process by which soil grains are rearranged to reduce void space and bring them into closer contact with one another, thereby increasing the bulk density.

**DNR:** Indiana Department of Natural Resources. Only occurs in email addresses

**DOR:** Division of Reclamation; one of the divisions of the **DNR**. Regulates the mining and **reclamation** activities for the extraction of coal and oversees the restoration of land mined for coal, but abandoned prior to full and complete restoration.

**graded overburden:** all of the leveled soil and rock that lies above the **coal seam**.

**land use:** specific use or management-related activity, rather than the vegetation or cover of the land. The categories of land use are cropland, developed water resource, fish and wildlife habitat, forestry, industrial/commercial, pastureland (or land occasionally cut for hay), recreation, residential, and undeveloped land. Only used as land user

**mulch:** vegetation residues or other suitable materials that aid in soil stabilization and soil moisture conservation, thus providing conditions suitable for seed germination and growth. Used only as Mulch till

**Natural Resources Commission (NRC):** a statutorily established policy making body for the **DNR**.

**Natural Resources Conservation Service:** U.S. Department of Agriculture **Natural Resources Conservation Service**. The federal agency that reviews all plans of restoration of **prime farmland**. This agency conducts all soil survey activities. Formerly known as the Soil Conservation Service.

**Office of Surface Mining, Reclamation and Enforcement (OSM):** U.S. Department of the Interior **Office of Surface Mining Reclamation and Enforcement**. The federal agency that oversees the work of the state permitting and enforcement agency. Used only in email and titles of members

**operator:** any person, partnership, or corporation engaged in coal mining who removes or intends to remove more than 250 tons of coal from the earth or from refuse piles within 12 consecutive calendar months in any one location.

**overburden:** all of the soil and rock that lie above the **coal seam**.

**pH:** a symbol for the degree of acidity or alkalinity of a solution. pH values from 0 to 6.5 indicate acidity and from 7.4 to 14 indicate alkalinity. A solution with a pH of 6.6 to 7.3 is considered neutral.

**performance bond:** surety bond, certificate of deposit, letter of credit, cash, or a combination thereof, by which a permittee assures performance of all the requirements of IC 14-34 and those of the permit and **reclamation** plan. Used as bond but not performance bond

**postmining land use**: use of the land after mining. The mined land must be reclaimed to the use approved by the DOR in the permit application and agreed upon by the landowner in the lease agreement with the operator.

**prime farmland:** lands as determined by the U.S. Secretary of Agriculture and which have historically been used for cropland.

**reclamation:** actions taken to restore mined land as required by regulations to a **postmining land use** approved by the **DOR**.

**revegetate:** the act of planting reclaimed land with grasses, trees, crops, etc..

**Root Zone Available Water Capacity (RZAWC):** The capacity of a soil to hold water in a form available to plants, usually expressed in inches of water per inch of soil multiplied by soil rooting depth. Soils that have limited RZAWC are likely to be droughty and have limitations in the kinds and amounts of crops that can be grown.

**soil amendments:** additives to the soil to enhance plant growth, such as fertilizer or agricultural lime.

**soil horizon:** each contrasting layer of soil parallel or nearly parallel to the land surface. Each soil horizon is differentiated on the basis of field characteristics and laboratory data. The three major soil horizons are the **A horizon**, the **B horizon** and the **C horizon**.

**soil productivity:** the capability of a soil for producing a specific plant or sequence of plants under a physically defined set of management practices.

**soil survey:** a field and other investigation resulting in a map showing the geographic distribution of different kinds of soils and an accompanying report that describes, classifies and interprets such soils for use. A soil survey must meet the standards of the National Cooperative Soil Survey.

**Soil and Water Conservation District (SWCD):** a governmental subdivision of the state, organized under Indiana Code 14-32 for the purposes of carrying out erosion and sediment control activities within the county. To carry out these activities, the **SWCD** works in cooperation with state and federal agencies with the consent of the land occupier.

**spoil: overburden** material removed from above the **coal seam** during surface mining.

**subsoil:** layer of soil beneath the topsoil. **B horizon**.

**topsoil:** upper layer of soil, usually darker and richer than the subsoil; surface soil. **A horizon**.

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