MOUNTAINTOP RECLAMATION: AOC AND EXCESS SPOIL DETERMINATIONS

To: Michael Miano, Director

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Subject: AOC/Excess Spoil Guidance

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Executive Summary

This guidance document, through the implementing regulations of the West Virginia Surface Coal Mining and Reclamation Act (WVSCMRA), provides an objective and systematic process for achieving approximate original contour (AOC) on steep-slope surface mine operations while providing a means for determining excess spoil quantities. Using this process maximizes the amount of mine spoil returned to the mined area while minimizing the amount of mine spoil placed in excess spoil disposal sites, i.e., valley fills. This, in turn, minimizes impacts to aquatic and terrestrial habitats through ensuring compliance with environmental performance standards imposed by WVSCMRA.

The definition of approximate original contour, as found in the Surface Mining and Coal Reclamation Act of 1977 (SMCRA) and WVSCMRA, requires that the final surface configuration, after backfilling and grading, closely resemble the general surface configuration of the land prior to mining while maintaining the necessary flexibility to accommodate site-specific conditions. A detailed analysis of the terms in the definition of AOC, along with additional reclamation requirements in the environmental performance standards of WVSCMRA and the promulgated rules serve to constrain what post-mining configuration is feasible. That is, a surface coal mining operation must meet not only AOC standards, but satisfy numerous other requirements including stability, access, and environmental provisions such as drainage, erosion and sediment control that influence the determination of AOC. Other factors that affect configuration are the diversity of the terrain, climate, biological, chemical and other physical conditions in the area and their impacts on fish, wildlife, and related environmental values.

The key variables found in the AOC definition, influencing AOC determination are: *configuration, backfilling and grading, disturbed area (mined area in SMCRA), terracing or access roads, closely resembles, and drainage patterns.* These variables, for analysis purposes, can be logically grouped into three focus areas: (A) configuration, (B) stability, and (C) drainage.

These focus areas are addressed through a formula-like model that portrays these variables in an objective yet flexible process for determining what post-mining surface configuration meets the AOC definition. Applying this process during mine planning will determine the amount of total spoil material that must be retained in the mined-out area. The resultant post mining

configuration should closely resemble the premining topography, thus satisfying not only the access, drainage control, sediment, and stability performance standards of WVSCMRA, but achieving approximate original contour as well. These same performance standards, applied in a similar formula-like model, determine the quantity of excess spoil that must be placed in excess spoil disposal site(s).

Using the AOC model in conjunction with the excess spoil model not only ensures compliance with the environmental performance standards of WVSCMRA, but provides an objective and feasible means for determining what constitutes compliance with the approximate original contour definition.

I. Applicable Provisions of State Law

Surface Mining Control and Reclamation Act of 1977 (SMCRA)

30 USC 1291 Section 701(2)

West Virginia Surface Coal Mining and Reclamation Act (WVSCMRA)

22-3-3(e)
22-3-13(d)(3)
22-3-13(b)(4)
22-3-13(b)(10)(B), (C), (F), (G)

West Virginia Surface Mining Reclamation Regulations (WVSMRR)

38 CSR 2-2.47
38 CSR 2-2.63
38 CSR 2-5.2, 5.3, 5.4
38 CSR 2-8, 8.a
38 CSR 2-14.5
38 CSR 2-14.8.a
38 CSR 2-14.14
38 CSR 2-14.15.a

II Objectives

This guidance document has been developed to accomplish the following objectives:

- Provide an objective process for achieving AOC while ensuring stability of backfill material and minimization of sedimentation to streams.

- Provide an objective process for minimizing the quantity of excess spoil that can be placed in excess spoil disposal sites such as valley fills.

- Minimize watershed impacts by ensuring compliance with environmental performance standards imposed by WVSCMRA.

- Minimize impacts to aquatic and terrestrial habitats.

- Provide an objective process for use in permit reviews as well as field inspections during mining and reclamation phases.

- Maintain the flexibility necessary for addressing site-specific mining and reclamation conditions that require discretion by the regulatory authority as intended by WVSCMRA and Congress.

The West Virginia Division of Environmental Protection's (WVDEP) Office of Mining and Reclamation (OMR) recognizes the need for guidance on how the various performance standards of the West Virginia Surface Mining Control and Reclamation Act (WVSCMRA) and implementing regulations, West Virginia Surface Mining Reclamation Regulations (WVSMRR), Title 38, Series 2, influence the final land configuration following coal mining and reclamation. The following guidance document delineates the amount of excavated broken rock (also called mine spoil or overburden) that WVSCMRA considers "backfill," i.e., spoil placed in the mine area to restore the approximate original contour. Further, this document determines the amount of overburden or "excess" spoil that may be placed in excess spoil disposal sites outside the mining area or "pit." In so doing, this document provides guidance, as needed for WVSCMRA program administration in steep slope terrain, for determining whether the WVSCMRA provision of "approximate original contour," or AOC, has been attained.

Chapter 22, Article 3-13(b)(3) of WVSCMRA, as well as State and Federal regulations, requires all mining operations to return the mined areas to AOC, unless an appropriate variance is granted by the appropriate regulatory authority. Chapter 22, Article 3-3(e) of WVSCMRA defines AOC to mean,

> *"that surface configuration achieved by the backfilling and grading of the disturbed areas so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated: Provided, That water impoundments may be permitted pursuant to subdivision (8), subsection (b), section thirteen of this article: Provided, however, That minor deviations may be permitted in order to minimize erosion and sedimentation, retain moisture to assist revegetation, or to direct surface runoff."*

Section 701(2) of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) uses the term *mined area* instead of *disturbed area.* SMCRA requires that the mined area be reclaimed so that the area closely resembles the general surface mining configuration of the land prior to mining. Section 14.15 of WVSMRR requires, "Spoil returned to the mined-out area shall be backfilled and graded to the approximate original contour with all highwalls eliminated." Section 2.89 of WVSMRR defines "pit" to mean "that part of the surface mining operation from which the mineral is being actively removed or where the mineral has been removed and the area has not been backfilled." Section 2.47 of the WVSMRR regulations defines excess spoil as "overburden material disposed of in a location other than the pit."

III. Elements of AOC Definition

In order to determine whether approximate original contour has been attained, processes must be developed to objectively assess what surface configuration *closely resembles the general surface configuration of the land prior to mining,* while maintaining the flexibility required to accommodate the *diversity in terrain, climate, biologic, chemical and other physical conditions in areas subject to mining operations,* as intended by Congress in Public Law 95-87 (SMCRA). To accomplish this, it is necessary to determine, and address, the variables that influence the postmining surface configuration. A detailed analysis of the terms in the definition of AOC, and additional reclamation requirements in the performance standards of WVSCMRA and the promulgated rules serve to constrain what post-mining configuration is feasible. That is, a surface coal mining operation must meet not only the AOC standards, but satisfy numerous other requirements, including stability, access, and environmental provisions such as drainage, erosion, and sediment control that influence the determination of AOC. Focusing on the collective requirements of WVSCMRA leads to an objective process for obtaining AOC.

The key variables found in the AOC definition, influencing AOC determination are: *configuration, backfilling and grading, disturbed area (mined area in SMCRA), terracing or access roads, closely resembles, and drainage patterns.* These variables logically group into the following three focus areas: (A) configuration, (B) stability, and (C) drainage.

A. Configuration: Configuration relates to the shape of regraded or reclaimed area after the reclamation phase. This shape should *closely resemble* the general pre-mining shape or surface configuration. However, final configuration, including elevation, is restricted or affected by the requirement to comply with performance standards found in WVSCMRA, such as ensuring stability, controlling drainage, and preventing stream sedimentation.

B. Stability: The second focus area, stability, concentrates on ensuring that the reclaimed configuration is stable. Section 22-3-13(b)(4) of WVSCMRA requires the mining operation, at a minimum, to "Stabilize and protect all surface areas, including spoil piles, affected by the surface mining operation to effectively control erosion and attendant air and water pollution." The WVSMRR also requires that spoil returned to the mined-out area to be backfilled and graded to achieve AOC (see 38 CSR-2-14.15.a.). The backfilling process places the spoil material in the mined-out area, while the grading process shapes and helps compact the material in a manner that ensures that the material is stable.

State regulations, *(see* 38 CSR-2-14.8.a. and 14.15.a) require the backfilled material to be placed in a manner that achieves a postmining slope necessary to achieve a minimum long-term static safety factor of 1.3, prevent slides, and minimize erosion. This is often obtained by using a combination of slopes and terraces (benches) as needed. Generally acceptable prudent engineering configurations are slopes of 2 horizontal to 1 vertical and terraces not to exceed 20 feet in width. The 2:1 slope is measured between the terraces. Compliance with these stability requirements, such as adding terraces and designed slopes, renders it virtually impossible to replicate the configuration of the land prior to mining. However, if backfilling and grading utilizes 2:1 slopes with terraces, the mine site will be reclaimed to a shape that closely resembles the pre-mining configuration.

C. Drainage: The third focus area, drainage, as referred to in the AOC definition, requires the postmining surface configuration to complement the drainage pattern of the surrounding terrain. WVSCMRA, *see* Section 22-3-13(b)(10)(B), (C), (F), and (G). WVSCMRA also requires the proposed operation "minimize the disturbances to the prevailing hydrologic balance at the mine-site and in associated offsite areas and to the quality and quantity of water in surface and groundwater systems both during and after surface mining operations and during reclamation..." Among these requirements are the prevention of stream sedimentation, construction of certified sediment structures prior to disturbance, restoration of recharge capacity of the mined area to approximate pre-mining conditions, and any other actions that the regulatory authority may require.

The State regulations, (*see* 38 CSR 2-2.63), define hydrologic balance to mean:

> *"the relationship between the quality and quantity of water inflow to, water outflow from a hydrologic unit including water stored in the unit. It encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground and surface water levels and storage capacity."*

Specific requirements for the protection of the hydrologic balance are found in 38 CSR 2-14.5; 38 CSR 2-5.2, 5.3 and 5.4. These performance measures require the minimization of disturbance to the hydrologic balance within the permit and adjacent areas as well as preventing material damage outside the permit area. The regulations provide appropriate measures for complying with these requirements through the use of designed diversions channels and appurtenant drainage conveyance structures, designed sediment control structures, and measures, such as minimizing erosion, disturbing the smallest practical area at any one time, stabilizing the backfill, and retaining sediment within the disturbed area. As with stability, compliance with these drainage control requirements makes it virtually impossible to replicate the configuration of the land prior to mining.

Other performance standards that affect the reclamation configuration of the mine site must also be taken into account. If access to the reclaimed area is necessary, the placement of a road will obviously factor into the possible post-mining landform. The more flat areas cut into backfill slopes or placed on the mined bench at the toe of backfill, the more difficult it becomes to create a reclamation "template" that parallels the land configuration prior to mining. It is an absolute necessity to provide some combinations of these flat areas in a reclaimed mine backfill for access, as well as drainage and erosion control (sediment ditches, terraces, diversion channels), to conform with the environmental performance standards.

Another consideration in designing the post-mining configuration is minimizing the adverse impacts on fish, wildlife, and related environmental values (*see* 38 CSR 2-8). While seemingly general, when put into context with the requirements of the Fish and Wildlife Coordination Act and Clean Water Act, the provisions combine to limit mine site spoil disposal disturbances to stream channels and terrestrial habitats. This results in the requirement that excess spoil disposal should be confined to the smallest practicable site. Minimizing spoil disposal fill sizes means maximizing the amount of spoil backfill on the mining bench. Maximizing backfilling on the mine bench does not circumvent the need for stable backfill slopes, adequate drainage control, access roads (where necessary), and erosion/sediment control. However, it is feasible to configure a reclaimed area to satisfy configuration, stability, drainage control and also closely resemble the land surface that existed before mining. The planning process utilized in developing a surface coal mining permit application, while complex, can and must simultaneously satisfy all of these competing performance standards.

IV AOC and Excess Spoil Determination

This guidance document applies to steep-slope surface mining operations (*see* 38 CSR 2-14.8.a), including area mines and contour mines, that remove all or a large portion of the coal seam or seams running through the upper fractions of a mountain and propose to return the site to AOC. As described in the previous sections, many variables, such as stability requirements, drainage requirements, and sediment control requirements, affect or determine what the post-mining surface configuration, or shape, of the land will be at a steep slope surface coal mining operation proposing to return the site to AOC. Incorporating compliance with these performance standards into the proposed permit application requires the applicant to carefully plan the mining and reclamation phases of the proposed surface coal mining operation. This process requires, among other requirements, plans showing: post-mining contour maps, cross-sections, and profiles; spoil volume calculations; drainage structure designs; sediment control structure designs; access road designs (if justified); spoil placement sequences; and excess spoil determinations and calculations. When these findings are integrated, the resulting surface configuration of the land should satisfy the Congressional intent, as presented in SMCRA, the Legislative intent as presented in WVSCMRA, and related regulations, of returning the land to AOC.

A. AOC Model: Portraying these performance standards as variables in a model or formula provides an objective, yet flexible, process for determining what post-mining surface configuration meets the AOC definition, while complying with the other performance standards in WVSCMRA. The following terms were developed and defined for use in the formula:

OC Pre-mining configuration, or volume of backfill material required to replicate the original contours of the undisturbed area proposed to be mined.

SR Backfill volume displaced due to compliance with stability requirements.

DR Backfill volume displaced due to compliance with drainage control requirements.

SCR Backfill volume displaced due to compliance with sediment control requirements.

AR Backfill volume displaced due to compliance with access/maintenance requirements.

AOC Volume of backfilled spoil required to satisfy the Congressional intent of SMCRA for approximate original contour.

This document uses the above acronyms for illustrative purposes only and are not intended to represent standard engineering terminology. Instead, they illustrate the AOC model process, rather than quantifying each term in the formula. While the terms can be quantified individually, this is not required by the AOC model process. Use of the model results in a reclamation configuration that can be quantified into a cumulative volume, accounting for the overall effect of the individual reclamation components which are performance standards in WVSCMRA. Volume calculations, however, are an integral requirement in order to satisfy the model.

The term "backfill volume displaced" refers not to specific volumes, but to the concept that, if not for complying with these performance standards, additional spoil or backfill material volumes could theoretically be placed in the location where these structures or slopes are proposed. (See Figure 1). In practice, however, placing additional spoil in these location will violate other performance standards.

Details of Backfill Volume Displaced When Complying with Performance Standards

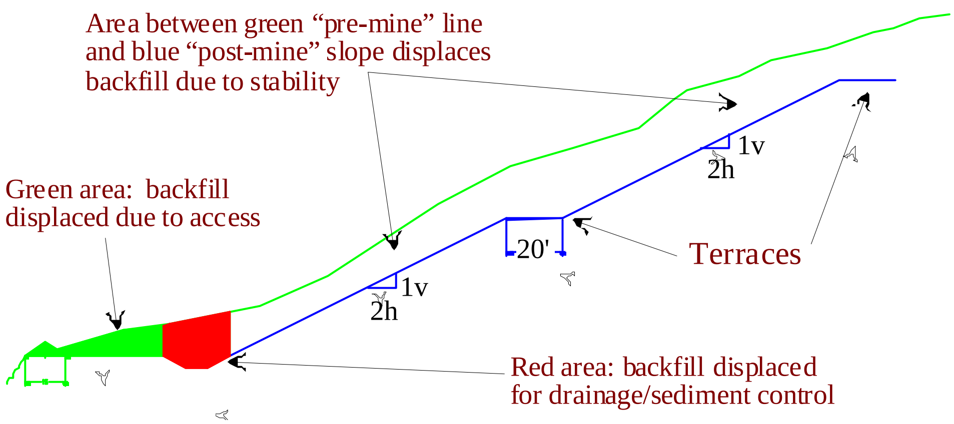


Figure 1

Based on the terms and illustrations used above, the following formula determines the amount of backfill which must be returned to the mined area to satisfy AOC.

OC - SR - DR - SCR - AR = AOC

Several of the terms must be further quantified to be used consistently in the AOC model:

<u>Total Spoil Material **(TSM)**</u> - Total spoil material is all of the overburden that must be handled as a result of the proposed mining operation. **TSM** will either be placed in the mined area or in excess spoil disposal sites (valley fill or pre-existing benches). This

value is determined by combining the overburden (**OB**) volume over the uppermost coal seam to be excavated with the interburden (**IB**) volumes between the remaining lower coal seams. These values are typically expressed as bank cubic yards (bcy).

TSM volumes are determined by using standard engineering practice, such as average-end area, stage-volume calculations, or 3-dimensional (3-D) grid subtraction methods. The regulatory authority must have adequate information submitted by the applicant to **TSM** properly evaluate **TSM** calculations. If the applicant utilizes an average-end area method, cross-sections must be supplied for a base line or lines, at an interval no less than every 500 feet–or more frequently, if the shape of the pre-mined area is highly variable between the 500-foot intervals. If the applicant utilizes a stage-storage method, planimetered areas should also be determined on a contour interval (CI) that is representative and reflects any significant changes in slope (20' CI or less recommended). If a 3-D model is used, the pre-mining contour map and, if possible, a 3-D model graphic should be provided. The grid node spacings used in generating volumetrics should be identified. If digital data is utilized by the applicant, it should be in a format and on a media acceptable to the regulatory authority.

TSM is determined by calculating the in-situ overburden and interburden volume, multiplied by a "bulking" factor **(BF)**. Bulking factors are calculated by a two-step process: 1) "swell" volume is determined from the amount of expected expansion of in-situ material through the incorporation of air-filled void spaces; 2) "shrink" volume can be calculated from the amount the swelled material compacts during placement (reducing the void spaces and, consequently, the volume). Thus, the bulking factor is the swell factor minus the shrink factor, which varies based on the overburden lithology (e.g., sandstone swells more and shrinks less than shales). **TSM** is reported in cubic yards (cy). Permit applications should contain a justification of the weighted bulking factor utilized-based not only on the weighting of individual swell factors calculated for each major rock type to be excavated that will be placed in the backfill, but on the shrinkage or compaction factor due to spoil placement methods as well. In equation form:

$$\mathbf{(OB + IB) \times BF = TSM}$$

<u>Spoil Placement Areas</u> - There are only two areas that **TSM** can be placed: 1) disturbed area (mined area in SMCRA) or backfill (**BFA**); and, 2) excess spoil disposal areas (**ESD**), i.e. valley fills.

BFA the backfill area, referred to as the mine area, is generally thought of as the area between, if viewed from a cross-section, the outcrop boundaries of the lowest coal seam being mined. (See Figure 2)

ESD excess spoil disposal sites are areas **outside of the mined area** used for placement of excess spoil. (See Figure 2)

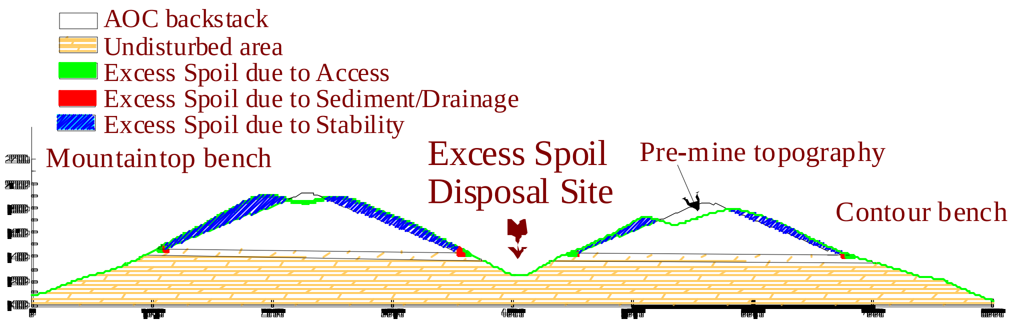
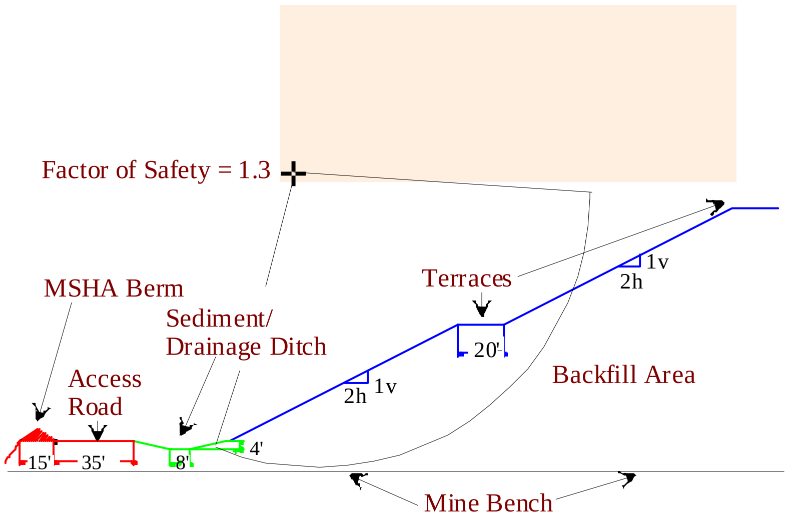


Figure 2

Original Contour (**OC**) - The original configuration of the mine area is determined from topographic maps of the proposed permit area. This configuration is developed through the use of appropriate cross-sections, slope measurements, and standard engineering procedures. Sufficiently detailed topographic maps, adequate numbers of cross-sections, or labeled 3-D model grids/graphics should be submitted that illustrate the representative pre-mine topography and slopes. Digital data should be submitted with the application in a format and on a media acceptable to the regulatory authority.

Stability Requirements (**SR**) - The concept of stability, in this model, focuses on the stability of the slopes of the spoil material placed in the backfill areas or excess spoil disposal sites. The spoil material must be placed in such a manner as to prevent slides or sudden failures of the slopes. State regulations require that slopes be designed to prevent slides and achieve a minimum, long-term static safety factor of 1.3. This safety factor should be the result of a worst-case stability analysis. There are standard engineering analytical procedures, that use unique shear strength and pore water pressure factors of the spoil material, for performing slope stability analyses. Therefore, it is the spoil strength characteristics and the water level anticipated within the backfill that determine the slope to which material can be placed and satisfy the safety factor requirement of the Federal and state counterpart regulations.

A generally acceptable practice, unless it results in a safety factor of less than 1.3, includes grading the backfill slopes (between the terraces) on a 2 horizontal to a 1 vertical ratio (2H:1V, or a 50 feet rise in 100 foot of slope length) and placing terraces where appropriate or required to control erosion or surface water runoff diversion (See Figure 3). It may be theoretically possible to place spoil on slopes steeper than 2:1, but other performance requirements may not recommend exceeding 2:1 slopes. For example, the Mine Safety and Health Administration recommends that slopes not be greater (steeper) than 2:1, because that is the maximum safe slope for operation of tracked-equipment.



Values, except 2h:1v slope, are for example only (e.g., width/depth)

Figure 3

Slopes shallower or less than 2:1, with appropriate terraces, would result in more excess spoil material and would not closely resemble pre-mining configuration. Thus, the basis for these slopes would have to be documented based on engineering practices and approved by the regulatory authority. For example, if overburden and interburden were predominantly weak shales that cannot attain a 1.3 factor of safety at 2:1 slopes, more gentle slopes could be justified. The 2:1 backfill slope, and associated terraces or drainage conveyances will determine the ultimate backfill height for the mined area. This final elevation may be lower than the pre-mining elevation, approximate the pre-mining elevation, or exceed the pre-mining elevation.

However, as can be seen in Figure 4, this reclamation technique results in a configuration or shape that closely resembles the premining configuration, when defining the "approximate original contour."

Drainage Control Requirements (**DR**) - Drainage structures are used to divert or convey surface runoff away from the disturbed area, after complying with effluent standards. These structures must be properly designed to adequately pass the designed flow. These structures are designed using standard engineering practices and theory. The purpose of these structures is to minimize the adverse impacts to the hydrologic balance (e.g., erosion, sedimentation, infiltration and contact with acid/toxic materials, etc.) within the permit area and adjacent areas, as well as prevent material damage outside the permit area while ensuring the safety of the public. The size and location of these structures vary throughout the permit area depending on factors, such as travel time, time of concentration, degree of slope, design peak runoff curve, and depth, length, and width of drainage structures. The size and location of these structures necessarily reduce backfill spoil volume because of the flat area required to properly construct effective structures and meet drainage requirements.

Sediment Control Requirements (**SCR**) - Sediment control structures, like drainage control structures, are used to minimize the adverse impacts to the hydrologic balance within the permit area and adjacent areas, as well as prevent material damage to areas outside the permit area while ensuring the safety of the public. Their primary purpose is to prevent, to the extent possible, additional contributions of sediment to stream flow or to runoff outside the permit area. Oftentimes, drainage control structures and sediment control structures are combined into a single dual-purpose structure, i.e., the sediment control structure discharges from the disturbed area. These structures must be properly designed to accommodate the required sedimentation storage capacity and are designed using standard engineering practices and theory. As with drainage structures, the size and location of these structures dictate the amount of flat area that will, consequently, displace backfill spoil storage. When reviewing the size and placement of these structures for adequacy in meeting effluent and drainage control requirements, the regulatory authority will also assess the design plans to assure the structures are no larger/wider than needed for proper design.

Access/Maintenance Roads (**AR**) - these structures are often necessary to gain access to sediment control structures for cleaning and maintenance. They may also serve to provide principal access to the mining operation and reclamation areas. The size and location of these roads or benches will vary throughout the minesite and should be based on documented need. This distinction is important, because the larger the road, the more backfill material displaced which will increase the size of the excess spoil disposal sites. The regulatory authority permit review should evaluate the necessity for roads in the final reclamation configuration and approve only those widths suited for the road purpose and equipment size.

The top of the backfill should be no wider/flatter than is necessary for safely negotiating the largest reclamation equipment utilized for the mine site (see Figure 4). Areas larger than necessary to work this equipment would need to be documented and approved by the regulatory authority. The final configuration of the top of the backfill should be graded in a manner to facilitate drainage and prevent saturation.

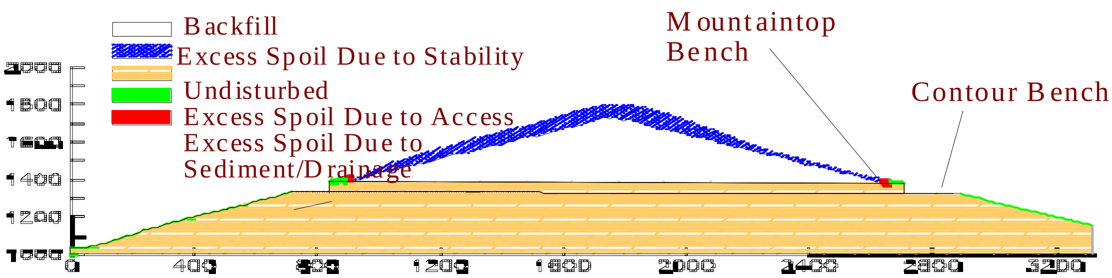
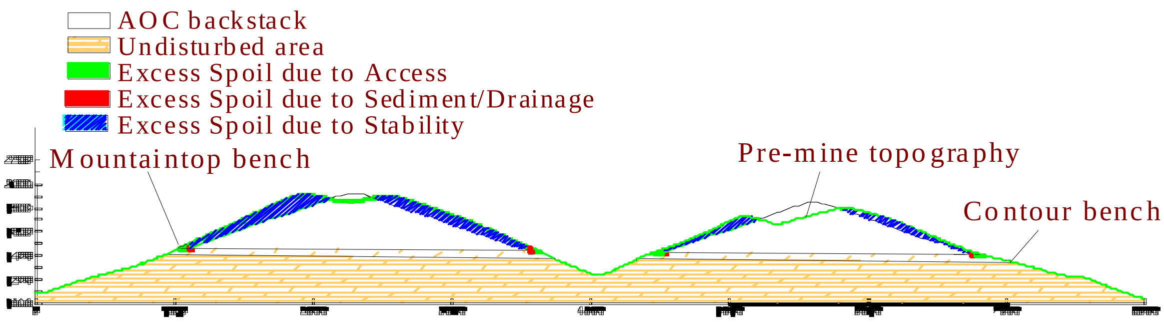


Figure 4a-results in lower elevation than pre-mining



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re 4b- results in approximately pre-mining elevation

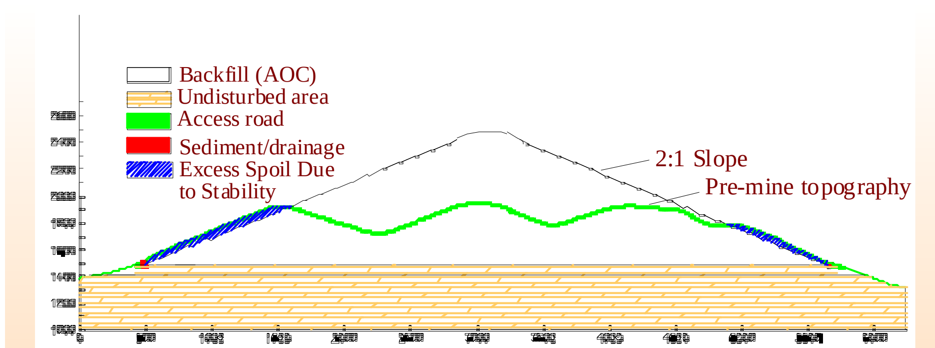

Figure 4c-results in higher elevation than pre-mining

Figure 4.
Restoring contours and meeting performance standards

B. AOC Process Determination

Applying these performance requirements in the mine planning process will determine the amount of total spoil material which must be retained in the mined-out area. The backfill material that will be placed within the mined-out area can be backfilled in a flexible configuration, in accordance with a practical mine sequencing and haulback operation. Consequently, the resultant post-mining configuration should closely resemble the pre-mining topography, thus satisfying not only the access, drainage, sediment, and stability performance standards of WVSCMRA, but AOC in addition (See Figure 4).

Summarizing the formula or process:

Formula: **OC - SR - DR - SCR - AR = AOC**

Step 1: Determine original or pre-mining configuration (Original Contour (**OC)**)

Step 2: Subtract from Original Contour:

Volume displaced due to Stability Requirements (**SR**) (based on documented plans)

Volume displaced due to Drainage Requirements (**DR**) (based on documented plans)

Volume displaced due to Sediment Control Requirements (**SCR**) (based on documented plans)

Volume displaced due to Access Requirements **(AR**) (based on documented plans)

Step 3: Evaluate results. The remaining volume is what has been termed backfill (**BKF**) or spoil material placed in mined-out area. The configuration of this backfill material will be (point where 2:1 outslopes begin) dependent on the placement of roads, sediment, and drainage control structures (see Figures 1, 3 and 4)

Step 4: This is an iterative process that is linked to the placement of excess spoil in excess spoil disposal sites.

C. Excess Spoil Determination Model: The parameters used in the formula developed for determining the quantity of backfill material also are used to develop a model or formula for determining the quantity of excess spoil. As with the backfill quantity formula, converting these variables into a model or formula provides an objective, yet flexible, process for determining what is truly excess spoil–while complying with the performance standards in WVSCMRA.

Applicable terms and concepts used in the development of the model:

TSM Total spoil material to be handled or available. This material will be classified as either backfill material (**BKF**) or excess spoil material (**ES**)

OC Pre-mining configuration, or volume of backfill material required to replicate the original contours of the undisturbed area proposed to be mined.

SR Backfill volume displaced due to compliance with stability requirements.

DR Backfill volume displaced due to compliance with drainage control requirements.

SCR Backfill volume displaced due to compliance with sediment control requirements.

AR Backfill volume displaced due to compliance with access/maintenance requirements.

AOC Volume of backfilled spoil required to satisfy the intent of WVSCMRA for approximate original contour.

BKF Volume of backfill or spoil material placed in the mined area

ES Volume of excess spoil remaining after satisfying **AOC** by backfilling and grading to meet **SR**, **DR**, **SCR**, **AR.**

The term "backfill volume displaced" refers not to specific volumes, but to the concept that, if not for complying with these performance standards, additional spoil or backfill material volumes could theoretically be placed in the location where these structures or slopes are proposed (See Figure 1). Spoil material unable to be placed in backfill area (in order to comply with all other performance standards), by default, must be excess spoil (**ES**), and placed in an approved excess spoil disposal site(s). The process for quantifying these terms is in Section IV A, above.

The **ES** quantity, as determined by the following formula, is obtained by complying with the stability (slopes) standards as well as incorporating the other performance standards such as drainage controls, sediment control, and access/maintenance requirements.

The excess spoil relationships.

ES = TSM - BKF

Since **BKF = OC - (SR + DR + SCR + AR),**

Therefore:

ES = TSM - (OC - (SR + DR + SCR + AR))

The regulatory authority should carefully evaluate the spoil balance information provided in the permit application to assure that excess spoil volumes are not inflated merely for achieving cost savings from material handling costs. Inflated excess spoil volumes would most likely occur because of wider or more numerous flat areas than required for drainage, sediment, or erosion control; access roads; or top of backfill areas. Use of backfill slopes less that 2:1 would also increase the excess spoil disposal. Permits that propose to conduct steep-slope surface mining operations, but change plans due to unanticipated field conditions (e.g., mining reduced to contour strip from area mining), should submit permit revisions containing revised volumetric calculations and excess spoil designs.

Solving this formula establishes the quantity of excess spoil material (**ES**) that must be placed in an excess spoil disposal site(s) (See Figure 2). Generally this **ES** volume, and/or mining logistics, requires more than one site. Typically, in steep-slope regions of Appalachia, excess spoil is placed in adjacent valleys. In areas where extensive "pre-law" mining (prior to passage of SMCRA, or August 3, 1977) has occurred, pre-existing benches are commonplace. Sometimes, operations utilize adjacent pre-existing benches (without coal removal occurring) as part of the permitted area for excess spoil disposal–if in close proximity to the operation. More often, pre-existing benches are part of the mined area, and provide for storage of additional backfill material–ultimately reducing the volume of excess spoil. Performance standards for excess spoil disposal areas are found in 38 CSR 2-14.14.

The most common site selected to place excess spoil is in the adjacent valleys. Site selection is typically made by calculating a stage-storage-volume curve for each valley adjacent to the mining operation. This stage-storage relationship changes, dependent on the point in the valley from which the downstream limits of fill is established. The permit application should contain the alternative stage-storage-volume data illustrating the various valley capacities for excess spoil storage dependent on toe location and crest elevation.

If pre-existing benches are to be used as excess spoil disposal sites, the capacity of each pre-existing bench area must be calculated. Typically these calculations utilize the average-end area method based on cross-sections representing the site configuration. After determining the capacity of these sites, the total value determined for excess spoil will be reduced by this value. The remaining quantity of excess spoil will then be placed in an adjacent valley(s), as described above.

Other factors, besides the quantity of material, that go into this **ES** site selection may include: 1) if a valley, the steepness of the valley profile (so as not to exceed 20 percent for durable rock fills or other value designated by regulatory authority relative to design changes for additional stability); 2) location in relation to mining phase; and, 3) other statutory requirements, such as the size of watershed that can be disturbed without additional permitting requirements.

Regardless of which factor(s) determine the location of the toe of the fill, the process is an iterative procedure that requires the available backfill and excess spoil material to balance, consistent with the formula developed above. After this material balance is achieved, the excess spoil disposal areas are designed to accommodate this quantity of excess spoil. If the excess spoil disposal site is a valley fill, this design will determine the height or elevation of the crest (top) of the excess spoil disposal site or fill. Once this design is complete, and top of fill elevation is determined, the next step would be to repeat or perform another iteration using the AOC model or process (See Figure 5).

If the excess spoil disposal sites are pre-existing bench areas, the sites are designed to accommodate the calculated quantity of excess spoil, while complying with the performance standards imposed by the regulatory authority's regulations.

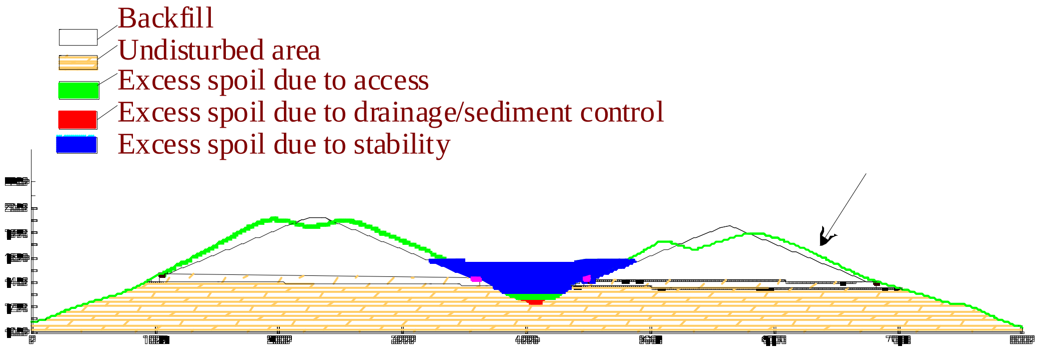

Figure 5 Pre-mine topography

D. Combining AOC Model with Excess Spoil Determination Model: The excess spoil model in Section IV B establishes the quantity of material that must be placed in an excess spoil disposal site(s). Performing a material balance, comparing the excess spoil volumes with the valley storage possibilities established the height or elevation of the fills. At least a second iteration of the AOC model must be performed to establish the final reclamation configuration. Before performing a new iteration of the AOC model (as in Section IV A), another term or concept must be introduced. The new concept determines the interface between the backfill area and the excess spoil disposal area. (See Figure 2). This demarcation can be used consistently in any steep slope mining situation, and is determined using the following process:

Locate the outcrop of the lowest seam being mined, whether contour cut only or removal of the entire seam.   (See Figure 6)

Project a vertical line upward beyond the crest of the fill and backfill elevations (See Figure 2).

The area where coal removal occurs, to one side of this line, is backfill area

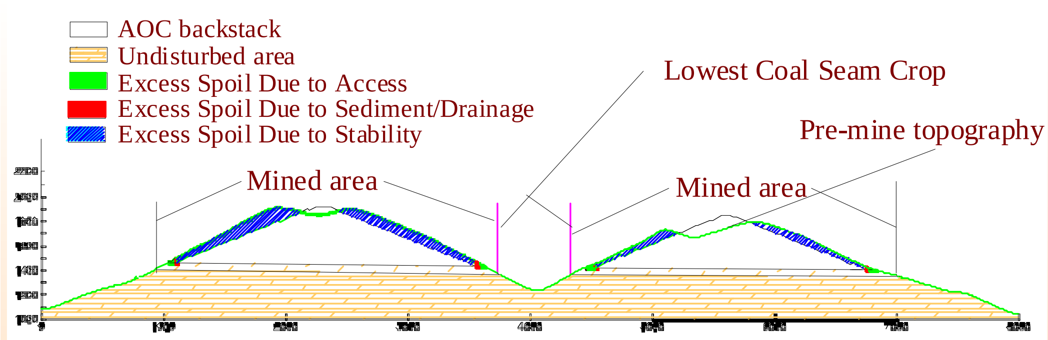

Figure 6. Lowest coal seam outcrop and mined area

(BFA); and, the area on the other side of the line, including the valley bottom, is excess spoil disposal area (see Figure 2).

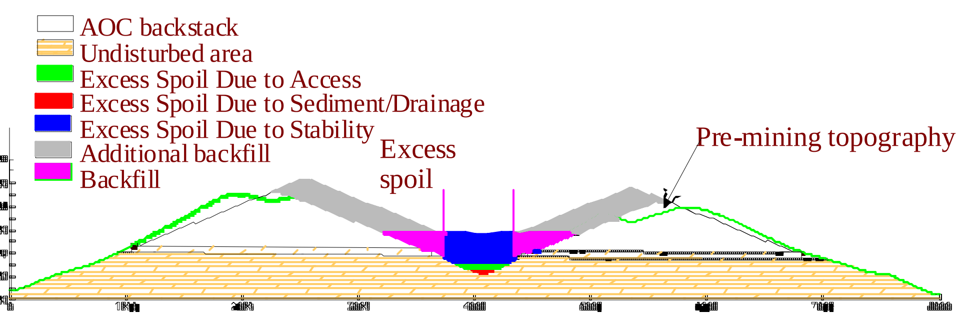

Figure 7

Establishing this boundary between excess spoil areas and backfill areas is not arbitrary. It is the same procedure used by some regulatory authorities in determining where permanent diversion ditches must be located. Also, this boundary establishes where permanent sediment control structures may be placed without being considered a violation of the prohibition of locating a permanent impoundment on an excess spoil disposal site.

This point becomes a reference line to perform the second or additional iterations of the AOC model used in Section IV A. That is, the road access, stability, drainage, sediment control analysis is applied to establish where backfilling at a 2:1 slope begins. The additional material placed on the mined area as a result of the iteration process creates the need to perform another material balance exercise, as describe above in Section IV B. This readjustment of the material balance may result in a reduction of excess spoil volume. In either case, the elevation of the fills would not be lowered, but instead the material balance would result in a reduction of length of the fills or possibly the elimination of some proposed fills (See Figures 7 and 8).

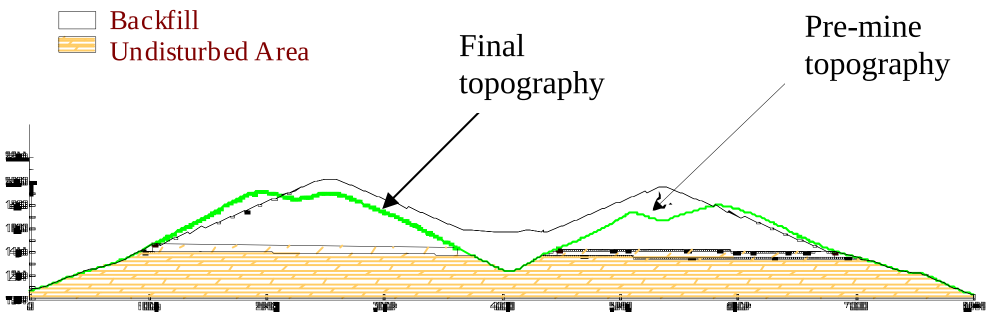

Figure 8

Reevaluation of fill designs using this second iteration becomes an important component of the permit design. Reduction in fill lengths could result in the toe of the fill being placed upon too steep of a slope–requiring additional material excavation for a keyway cut, or additional material placement for a stabilizing toe buttress.

However, this process may still result in large flat areas at the fill crest that could be used to store additional backfill. This provides the further option of storing additional excess spoil in the crest area–reducing excess spoil fill length. This option would further minimize terrestrial and aquatic impacts in the excess spoil disposal area because the toe of the fill would move upstream (See Figure 9).

E. Contour Mining Operations: Contour mining excavates only part of the mountainside, leaving undisturbed areas above and below the excavation (see Figure 10). The mining phase of a contour mine creates a cliff-like highwall and shelf-like bench on the hillside that must be restored to approximate

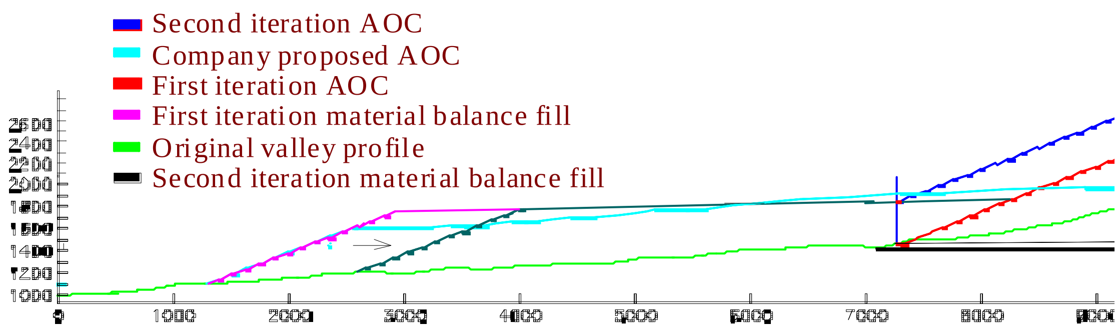

Figure 9. How the AOC process affects fill length

original contour, with the highwall completely eliminated, in the reclamation phase. The AOC/excess spoil determination models, described in IV A-C, are used to achieve AOC and determine excess spoil volumes for this type of surface mining operation as well.

For example, a contour mine typically takes one (1) contour "cut" (see Figure 10) and progresses around the coal outcrop, leaving a highwall and bench after the coal is removed. Reclaiming the site, utilizing the AOC process, would require documentation showing drainage structure designs, access road requirements, and properly designed sediment structures. The application would also require documentation demonstrating the stability of the outslope of the material placed in the backfill area. Regulations require that slopes be designed to prevent slides and achieve a minimum long-term static safety factor of 1.3. A generally acceptable practice, unless it results in a static safety factor of less than 1.3, includes grading the backfill slopes (between terraces where required) on a 2 horizontal to a 1 vertical ratio (2H:1V) (See Section IV A for details). If compliance with the other performance standards, i.e., drainage, access, and sediment control, result in backfill out-slopes being steeper than 2:1, the application should contain adequate documentation that the backfill configuration meets a 1.3 static safety factor (see Figure 10). Documentation described in Section IV A would be required if slopes flatter than 2:1 are proposed.

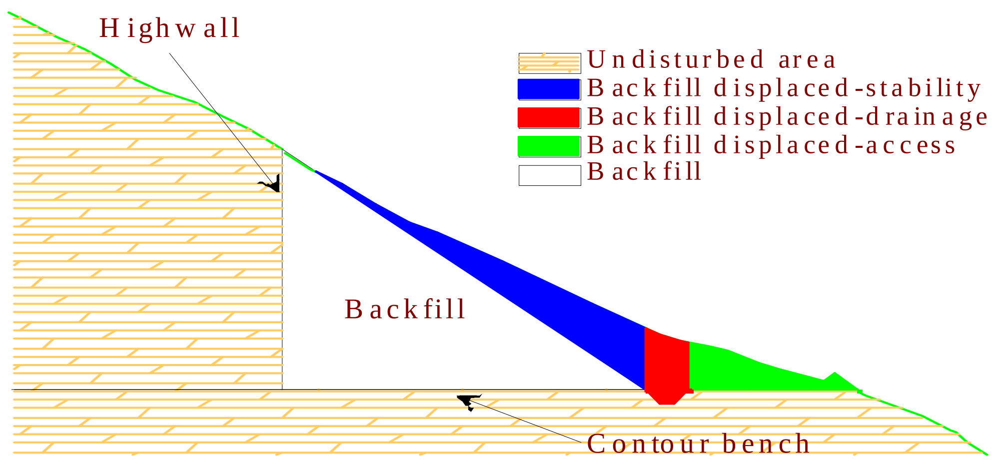

Figure 10

Oftentimes, contour mining operations encounter long, narrow ridges or points that require more than one cut to recover the coal seam(s). Although the mining phase utilizes both the contour and area mining methods when this occurs, the AOC/excess spoil determination models are used in the same way for determining AOC and excess spoil volumes. The same principles and performance standards apply–drainage, sediment control, and access requirements must be designed and documented. Also, compliance with the stability requirements for the outslopes of the backfill must be achieved and documented.

However, in order to comply with these requirements and achieve AOC, the reclamation phase of these sites must integrate two perspectives when utilizing the AOC model: 1) elimination of the highwall (perpendicular to the ridge line); and, 2) returning all spoil material that is not excess spoil to the mined area(s) (the area between the highwall and the end of the ridge line). Combining the two perspectives results in a postmining configuration that closely resembles the general configuration of the ridge or point prior to mining, while still complying with the performance standards discussed earlier in Section IV A- D.