Fill Placement Optimization Process

Introduction and Background

Purpose, Objectives and Applicability

An objective and well-defined method for determining post-mining land configuration is necessary to assure compliance with applicable laws, provide an opportunity for early coordinated regulatory review allow for meaningful and timely public input, and facilitate transparent decision-making.

The "Fill Placement Optimization Process" outlined in this document shall be undertaken for all proposed steep slope surface coal mining applications. Steep slope operations are all operations where the natural slopes exceed twenty (20) degrees.

This process does not apply to surface activities solely associated with underground mining or coal refuse facilities. 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 by ensuring compliance with environmental performance standards imposed by Kentucky Division of Mine Permits (KYDMP).

This method accomplishes the following objectives:

- Provides a process for achieving AOC while ensuring stability of backfill material and minimization of stream impact.
- Determines a reasonable quantity of excess spoil that may be placed in excess spoil disposal sites such as valley fills and head of hollow fills.
- Optimizes the placement of spoil to reduce watershed impacts.
- Provide a structured process for use in permit reviews as well as field inspections.
- Maintain the flexibility necessary for the operator to address site-specific mining and reclamation conditions.
- Establishes a permit area tolerance linked to triggers, reducing over-permitting and consequently preserving stream impact minimization throughout the life of the mine.

In the event KYDMP determines the applicant has exceeded the maximum stream impact, the applicant shall provide detailed plans and calculations clearly stating why the proposed permit configuration does not conform to the "Fill Placement Optimization Process". The permit face will state if the application conforms to the "Fill Placement Optimization Process". The burden of proof will remain on the applicant to justify its proposal.

AOC and Excess Spoil Quantity Relationship

Elements of AOC Definition

The following terms are necessary for development of the process:

A. Configuration: - Configuration relates to the shape of the regraded or reclaimed area. In addition to complying with the definition of AOC the reclaimed configuration must comply with performance standards, such as ensuring stability, controlling drainage, and preventing stream sedimentation.

B. Stability: - Stability relates to the placement of material in the regraded or reclaimed area in the manner that achieves a minimum long-term static safety factor, prevents slides, and minimizes erosion.

C. Drainage: - Drainage relates to moving water from and within the regraded or reclaimed area. Reclaimed drainage configurations must comply with performance standards, such as minimizing sedimentation, and restoring water quality and quantity.

Introduction of "Fill Placement Optimization Process" Concept

The process includes the development of a volumetric model referred to as the AOC Model. This volumetric model provides a definitive and reproducible means to calculate the volumes of material that can be backfilled or placed in excess spoil disposal areas. The volumes obtained from the AOC Model are used as a volumetric basis for the actual mine configuration. The actual configuration of the final mine plan may vary from the AOC Model except as described below.

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

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

SR Backfill volume displaced due to compliance with **S**tability **R**equirements.

DRBackfill volume displaced due to compliance with **D**rainage control **R**equirements.

SCR Backfill volume displaced due to compliance with **S**ediment **C**ontrol **R**equirements.

ARBackfill volume displaced due to compliance with **A**ccess / maintenance **R**equirements.

AOC Volume of backfilled spoil and configuration required to satisfy the definition of **A**pproximate **O**riginal **C**ontour.

This document uses the above acronyms for illustrative purposes only and they 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. The use of the AOC Model results in a theoretical reclamation configuration that can be quantified.

Fill Placement Optimization Steps

Step 1 – Determination of Overburden/Interburden Quantity

A) Identify the boundary of each coal seam being mined in the proposed permit application.

B) Identify the lowest seam being mined in the proposed permit application.

C) Clearly define the extent of mining. The total extent of each seam to be removed and the mining method must be clearly reflected in the form of contour drawings and/or sets of cross sections.

D) Using USGS contour mapping as reference, calculate the total quantity of overburden, interburden and coal to be disturbed, and include basis for volumetric calculations. Whenever available, aerial mapping will be used in place of USGS mapping.

E) Subtract the coal volume from the total volume.

F) Identify the predominant mining method(s) that will be used in each watershed, or sub-watershed. The mining methods shall be defined either as "area" or "contour". "Area" shall be defined as any area of a seam proposed for mining, which is included within an area constructed by two lines drawn perpendicular from the outcrop. (Reference Figure 1)

G) The mining method for each watershed shall be based on the sum of the coal volume of each type of mining by seam, the method with over 50% shall be predominant.

Step 2 – Determination of anticipated Swell Factor

A) Define the swell factor for overburden / interburden types being disturbed.

B) If swell factor is other than 25%, documentation must be provided to support values.

C) Calculate total swelled overburden volume.

Step 3 – Initial Backfill

A) Define setbacks from the outcrop of lowest seam at no less than 35 feet to allow for drainage, natural berms and access roads.

B) The berm shall be offset from the outcrop of the lowest seam to be mined by 15 feet.

C) Perimeter access road width shall be fixed at 20 feet.

D) Drainage control/design shall be calculated based on the acreage of the mined area multiplied by 0.125 to calculate the acre/feet of structure. The width of the structure shall be calculated by dividing the required acre/feet by the perimeter of the mining area at the outcrop and an assumed depth of 3 feet (including 0.5 feet freeboard), with 2H:1V side slopes.

E) Backfill calculations and cross-sections shall be prepared using a 2.4H: 1V slope configuration.

F) Backfill elevations shall not exceed pre-mining elevations along the pre-mining watershed boundary, within each watershed. (Reference Figure 2)

G) For contour or point removal operation the backfill must eliminate any highwall even if the slopes are steeper than 2H: 1V.

H) Using standard template calculate the initial volume of backfill.

I) Prepare drawings to illustrate the contours of initial backfill.

Step 4 – Determination of the Excess Spoil Volume

A) Calculate excess spoil volume by subtracting initial backfill from total swelled overburden volume.

Step 5 – Excess Spoil Disposal Locations

A) Identify all excess spoil fill locations that are contiguous to the mined area.

B) For each potential excess spoil fill location identify any constraints applicable to the site such as gas lines or wells that cannot be moved, property ownership issues and protected structures such as cemeteries.

C) Determine the possible "maximum downstream toe location" for each potential valley fill. Environmental factors, statutes, rules, property rights, operational issues, and other factors could influence this location.

D) Identify the limits of each potential valley fill site on a drawing.

E) Determine the possible "maximum upstream toe location" for each potential valley fill site. The toe location should be based on the slope of the valley floor.

Step 6 – Valley Fill Volumetrics – Non Optimized

A) For each potential fill identified in Step 5 define the initial fill segment. This first segment is that area directly up-slope of the "maximum upstream toe location", and is the most upstream location of the fill toe that can meet the geotechnical safety factor.

B) Calculate the volume of the initial fill segment using the original ground combined with the initial backfill configuration defined in Step 3, and the valley fill front slope. For this optimization model only, assume a constant valley fill front face slope for all valley fills and all "segments" of 2.4h:1v.

C) The remaining available length of the valley fill, from the "maximum upstream location" to the "maximum downstream toe location" shall be divided into 200 foot segments, with any remaining uneven length (less than 200 foot) allocated to the most downstream slice.

D) Set the top of the valley fill crest at the elevation of the lowest coal seam to be mined for both "area" and "contour".

E) Calculate the volume of each fill segment using the slope of the original ground combined with the valley fill front slope. For this optimization model only, assume a constant valley fill front face slope for all valley fills and all "segments" of 2.4h:1v.

F) Develop a matrix that illustrates the excess spoil disposal volume for the "Initial Segment" and each additional "segments" for every valley fill under consideration.

G) Complete the analysis for all of the potential excess spoil fills.

H) For each initial segment and all subsequent segments calculate the total length of stream that is impacted. The stream shall include all jurisdictional waters. Include a factor of volume per stream reach foot.

I) Prepare a volume matrix per segment and stream length.

J) The goal is to determine the fill configuration that contains the target ES volume while affecting the minimum feet of stream affected. The following is a method to approximate this configuration: Utilizing the Excess Spoil calculated in step 4, subtract the volumes of each segment starting with the initial segment that contains the highest ratio of spoil volume per stream reach. The second segment shall be either the next highest initial slice or the subsequent slice in a fill where the initial slice has been selected. The process continues based on the selection of the highest ratio segments.

K) After adequate segments have been selected to satisfy the excess spoil requirement, the sum of the stream length impacted shall be the "SMCRA Stream Impact".

L) Utilizing the stream quality index, calculate the EIU for the identified non optimized stream segments that constitute the "SMCRA Stream Impact". This value shall be defined as the "*SMCRA EIU impact*".

Step 7 – Identification of off-site disposal options

A) Review all potential excess disposal sites within ½ mile of the coal extraction area located within the permit. Potential sites shall include abandoned mine sites, previously constructed excess spoil or waste disposal locations and previously mined areas. A narrative shall be prepared for each fill site identifying the potential excess spoil disposal volume and any constraints affecting its use.

B) As an incentive to use previously disturbed areas, the quantity of material disposed of off-site shall be deducted from the Total Spoil Material. This will result in a reduction in the Excess Spoil. The allocation of this volume shall be based on the ratio of Excess Spoil to Total Spoil.

C) The value for the Adjusted Excess Spoil volume shall be defined as:

$$\mathbf{ES_N = ES - (OSDV \times (ES/TSM))}$$

Step 8a – Adjusted Fill Deck Elevation ("area")

A) For each watershed in which a potential fill is proposed, calculate the average difference in elevation from the ridgeline to the lowest seam to be mined.

B) This average difference in elevation shall be calculated by taking a profile along the watershed boundary using equally spaced stations at a maximum spacing of 100 ft or other appropriate engineering method.

C) The average elevation of the lowest coal seam to be mined shall be taken along the outcrop of the seam within the watershed using equally spaced stations at a maximum spacing of 100 ft or other appropriate engineering method.

D) The value for the adjusted fill deck elevation shall be the average elevation of the ridgeline minus the average elevation of the lowest coal seam multiplied by the swell factor defined in Step 2, plus the average elevation of the lowest coal seam.

Step 8b – Adjusted Fill Deck Elevation ("contour")

A) Identify the highest coal seam to be mined as being the highest stratagraphic coal seam proposed for mining, except that the uppermost seam can be ignored if the total swelled overburden for that seam is less than 10% of the total overburden identified in Step 2.

B) For every watershed in which a potential fill is proposed, calculate the average elevation at the top of the highwall above the highest seam to be mined.

C) This average elevation of the highwall shall be calculated by taking a profile along the top of the proposed highwall within the watershed boundary, using equally spaced stations at a maximum spacing of 100 ft.

D) The average elevation of the highest coal seam to be mined (ignoring the uppermost seam if applicable) shall be taken along the outcrop of the seam within the watershed using equally spaced stations at a maximum spacing of 100 ft.

E) The value for the adjusted fill deck elevation shall be the average elevation of the highwall minus the average elevation of the highest coal seam, multiplied by the swell factor defined in Step 2 plus the average elevation of the highest coal seam.

F) For contour mining operations that are mining a single seam, combined with highwall miner / auger operations the swell factor in the previous step shall be reduced by 0.5% for each 1% of the total recovered coal is obtained from the highwall miner / auger portion of the operation.

G) In no case shall the fill deck elevation be required to be higher than 50% of the difference between the average elevation of the highwall and the average elevation of the lowest coal seam being mined. In no case shall the fill deck be lower than the lowest seam being mined.

H) If the average elevation of the highwall is less than 120 ft, then the fill deck elevation shall be at least the difference between the average elevation of the highwall and the average elevation of the lowest coal seam multiplied by the swell factor defined in Step 2, plus the average elevation of the lowest coal seam. In no case shall the fill deck be lower than the lowest seam being mined.

I) If there are multiple seams being mined by contour mining, and the top of the highwall of the lower seam does not intersect the outcrop of the next higher seam, then they shall be analyzed as separate fills.

<u>Step 9 – Valley Fill Volumetrics</u>

A) For each potential fill identified in Step 5 define the initial segment/slice. This segment is the area up slope from the "maximum upstream toe location", and is the most upstream location of the fill toe that can meet the geotechnical safety factor.

B) Calculate the volume of the initial segment/slice using the original ground combined with the initial backfill configuration defined in Step 3, plus the Adjusted Fill Deck Elevation (applicable to that watershed) and the valley fill front slope. For this optimization model only, assume a constant valley fill front face slope for all valley fills and all "slices" of 2.4h:1v.

D) The remaining available length of the valley fill, from the "maximum upstream location" to the "maximum downstream toe location" shall be divided into 200 foot segments, with any remaining uneven length (less than 200foot) allocated to the most downstream segment.

E) Calculate the volume of each segment/slice using the original ground combined with the initial backfill configuration defined in Step 3, plus the Adjusted Fill Deck Elevation (applicable to that watershed) and the valley fill front slope. For this optimization model only, assume a constant valley fill front face slope for all valley fills and all "segments/slices" of 2.4h:1v.

F) The volume of each segment/slice shall include the additional backfill quantity that is achieved by moving the toe of the backfill to a location vertically above the outcrop of either the highest contour seam or the lowest "area" seam to be mined. This toe shall be offset by 20 feet plus the distance required to allow for drainage control (this shall be the same distance calculated in Step 3).

G) Backfill elevation shall not exceed the pre-mining elevation along the pre-mining watershed boundary, within each watershed.

H) Develop a matrix indicating the volume of excess spoil disposal volume for the "Initial Segment/Slice" and each of the "segments/slices" for each valley fill under consideration.

I) Complete the analysis for all of the potential fills.

<u>Step 10 – Valley Fill Selection</u>

A) For each initial segment/slice, and all subsequent segment/slices, calculate the length of stream that is impacted. The stream shall include all jurisdictional waters. Include a factor of volume per stream reach foot.

B) Prepare a matrix of volume per segment/slice and stream length.

C) Utilizing the Excess Spoil, or Adjusted Excess Spoil, as calculated in step 4 (or Step 7 if off site disposal areas are used) subtract the volume of each segment/slice starting with the initial slice that has the highest ratio of spoil volume per stream reach.

D) The second segment/slice shall be either the next highest initial slice or the subsequent slice in a fill there the initial slice has been selected. The process continues based on the selection of the highest ratio segments.

E) After adequate segment/slices have been selected to satisfy the excess spoil requirement, the sum of the stream total length impacted shall be the "Maximum Stream Impact".

F) For the segments/slices selected, calculate the volume of excess spoil placed outside of the mined area, this is referred to as the "Target Fill Volume".

G) Utilizing the stream quality index calculate the EIU for the identified stream segments that constitute the "Maximum Stream Impact". This value shall be defined as the "*optimized EIU impact*".

Step 11 – Mine Design

A) The actual mine layout can be designed in any configuration, except that the actual length of stream impacted by valley fill construction may not exceed the "Maximum Stream Impact" calculated in Step 10.

B) The volume of material to be placed in the excess spoil disposal areas in the final mine design must not exceed 110 % of the "Target Fill Volume".

C) After identifying the toe location of each proposed valley fill, utilize the stream quality index to calculate the EIU for the identified stream segments that constitute the "Actual Stream Impact". This value shall be defined as the "*actual EIU impact*".

D) If the "actual EIU impact" exceeds the "optimized EIU impact" a detailed explanation shall be provided as justification.

Step 12 – Limitations

A) If there are significant changes to the mined area boundary, the Cabinet may require a permitting action and recalculation of the fill optimization.

B) If an application for a permit is adjacent to, or contiguous with, another active permit(s) controlled or operated by that same permittee/operator, then the Cabinet shall consider the operation as one "total operation" if:

- Excess spoil disposal areas on the permit under review receives spoil from more than one permit, or
- The post mining contours at the boundary between the permits are different from the pre-mining contours. This means that if the regraded areas at the permit boundaries of the two are blended and thus continuous and different from the pre-mining elevation.

C) If a permit is determined to be a "total operation", then the application shall meet the requirements of the AOC Model for the "total operation". This includes the new permit area, and all spoil storage and mining areas within ½ mile of the amended mining area. The analysis must recalculate the fill optimization volumes as defined in Step 8 & 9 except that:

- The toes of any existing fills on the "total operation" shall be fixed for the model, and shall be used to calculate the additional backfill volumes.
- Only the area within ½ mile of the amended mining area shall be considered for spoil storage.
- The analysis shall exclude any areas that have been approved for bond release as of the date of the application.

Step 13 –Certifications

A) The applicant must submit an affidavit prior to the commencement of any construction of new valley fills (including permanent sediment pond construction and clearing/grubbing operations) in accordance to the following schedule.

- after 50% of the fills approved for the permit have been started
- after 74% of the fills have been started, and
- prior to the construction of the final fill

B) The affidavit(s) shall be signed by both an authorized agent of the company and a licensed professional engineer (PE) or licensed surveyor (LS), and will affirm that the operations remains in substantial compliance with the mining plan on which the optimization assessment was based. Substantial compliance with the approved mining plan assumes a tolerance of ten (10 %) percent by acreage of the area proposed for mining. If the affidavit states the operation exceeds the tolerance then the operation is deemed "non-optimized" and the KY DNR shall request an "optimization report", or the operator shall file a permitting action for the purpose of re-evaluating the operation under the fill optimization procedure.

C) The Kentucky DNR may request that the permittee submit an "optimization report" (certified by a Licensed Professional Engineer registered in Kentucky) that the operation is in compliance with its spoil handling plan, and that the operation will satisfy the excess spoil optimization plan as included in the permit.

D) The report will address the aerial extent of the mining; highwall heights; the aerial extent of hollow fills; the percentage of the of the total recovered coal obtained from the highwall miner / auger portion of the operation; and the top elevation of completed and active fills. If the certifying Professional Engineer cannot affirm that the originally approved excess spoil handling plan can be met, one of the following will occur:

E) The report will contain a modified material handling plan to meet the optimization standards. The modified plan will be submitted in the form of a revision. The operation is allowed to continue under the pending modified plan. No final hollow fill certification can be accepted by DMRE for any fill affected by a pending modification to the optimization plan, thereby preventing any bond release for the effective increment until the issuance of the revision.

F) The permit condition will be re-issued with a condition stating that the material handling plan has not met the standards for fill optimization (as outlined in this procedure).

Step 14 – AOC Variance

A) Any request for an AOC variance must complete the Fill Placement Optimization as defined above in order to calculate the "Maximum Stream Impact" defined.

B) The actual configuration of any AOC variance mine plan must identify the length of the actual stream impacts proposed and also calculate the EIU of the proposed stream impact.

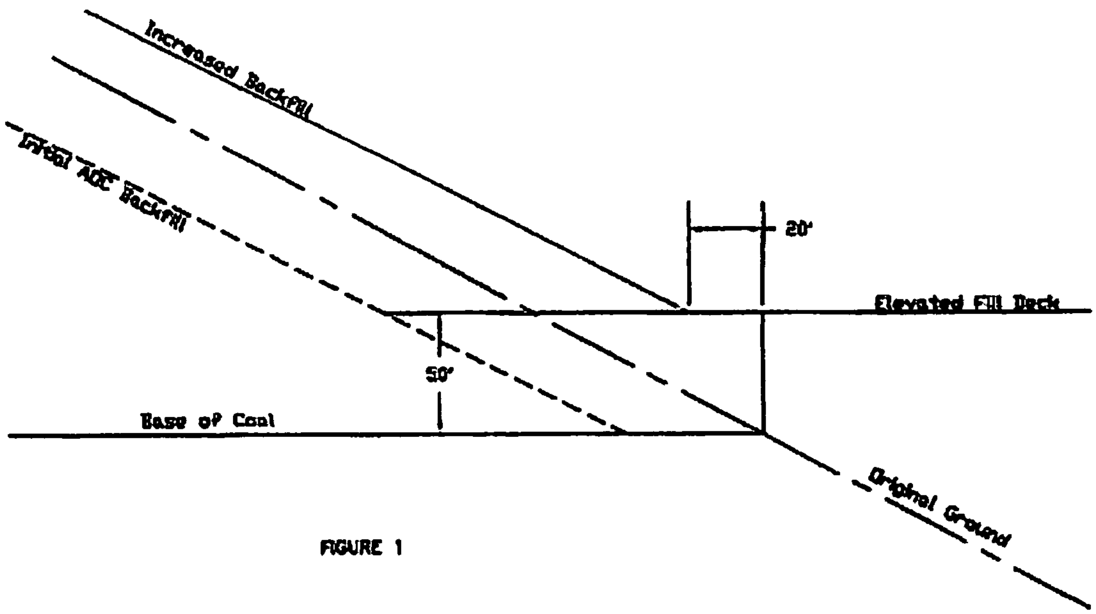

FIGURE 1

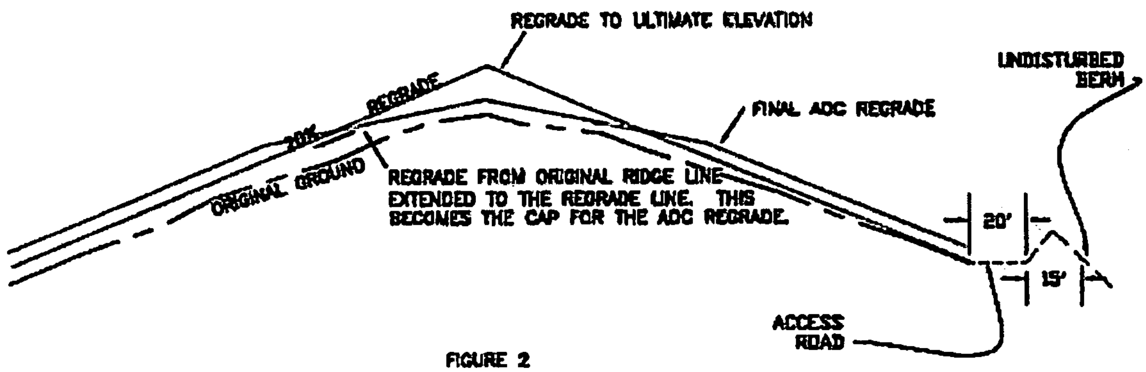

FIGURE 2