M0230003
Task ID# 4524
cc: Wayne

RECEIVED
DEC 06 2011
DIV. OF OIL, GAS & MINING

creating solutions for today's environment

December 2, 2011

Mr. Paul Baker
Division of Oil, Gas and Mining
P.O. Box 145801
Salt Lake City, Utah 84114-5801

RE: M/023/003 – Materion Resources – Surety Bond Calculations, Version 2

Dear Paul,

On behalf of Materion Resources, Inc., please find enclosed a revised version of the surety calculations first submitted on August 1, 2011. This version includes written responses to Mr. Wayne Western's comments of September 28, 2011. The bond and a few pages of text in Section 9 of the Mine and Rec. plan have been revised accordingly, with changes marked in redline-strikeout. A form MR-RE-att is attached to help us all track what pages are proposed to be replaced.

Please feel free to call me or John Wagner if you have any questions. I can be reached at the number listed in the footer. John's phone number is 435-864-2701.

Thanks for your prompt response to this submittal. We appreciate your efforts.

Sincerely,

Ms. Marit Sawyer
Permitting Specialist
JBR Environmental Consultants

encl: Surety Bond Calculations Version 2

ec: John Wagner – Brush Resources, Inc. w/ enclosure

JBR Environmental Consultants, Inc.

Corporate Headquarters
8160 S. Highland Dr.
Sandy, Utah 84093
[p] 801.943.4144
[f] 801.942.1852

www.jbrenv.com

Responses to First Review of Surety Revie for NOI for Materion Natural Resources, M/023/0003
Comments dated Sept. 28, 2011
M. Sawyer for Materion - November 22, 2011

Com-ment #	Sheet/Page/ Map/Table	DOGM Comments (re-phrased based on phone discussion w/ W. Western 11/7/11)	Response
1	First page letter	Withdrawal of South Wind Phase 1 LMU should be documented IN the NOI.	*The following statement has been added to the NOI on page 78 as a new paragraph 3: "In late 2011, it was decided that the Southwind LMU would not be developed. Bonding for this pit was eliminated. No development will take place at this LMU until an updated mine plan and bond evaluation have been completed by DOGM."*
2	Second page letter	Division is using escalation rate of 1.7% for 2011	*This escalation rate was used in our surety estimate. As discussed via phone November 7, 2011, no change is necessary.*
3	Bond Summary Sheet	Summary sheet should be inserted into NOI in Surety section. Remaining bond pages should be inserted in NOI in an Appendix	*The two summary sheets titled "Total Bond Amount – Existing Disturbance" and Total Bond Amount – New Phase 1 Disturbance" as well as the calculation worksheets, are found in Appendix 7 and 8, as stated in the NOI on page80, first full paragraph. The new, enclosed versions should be placed there, and the old text removed.*
4	Bond Worksheets	Division usually uses Blue Book rates for equipment costs. Assumption is based on contractor owning the equipment rather than renting it. Division will provide Blue Book costs on request. If another source is used please indicate the source. List rental rates under equipment costs, operating costs (fuel & lubrications). Add 10% overhead to equipment costs (not labor costs).	*The calculations used here are based on R.S. Means monthly rental rates, divided by 176 hours/month, plus hourly operating costs. A 10% overhead charge has been added to equipment costs. The explanation of how the bond was calculated, found in the NOI at Section 9.2, pages 78 to 84, has been updated and is included with this package to reflect the new bond calculation format.*
5	Earthwork	Please fill in earthwork tables like enclosed examples – show all work so worksheets are "stand-alone" docs that would be understandable to public/court of law.	*Calculation worksheets have been revised to show all work necessary to understand these calculations without having to look at the excel document on a computer.*
6	Earthwork	Include cost of ripper in ripping costs. See example & cost provided.	*Cost of ripper has been added where ripping as a reclamation task is used.*
7	Earthwork	Topsoil placement with scraper – is this self-loading type or push-pull? If the latter add cost of dozer to pull scraper while loading.	*The calculations assume use of a self-loading 633 scraper.*
8	Reveg/ Earthwork	Move application of stone mulch to Earthwork since this is done with scrapers/earthmoving equipment	*Cost to apply stone mulch has been moved to the Earthwork costs.*
9	Reveg/ Earthwork	Move use of dozer/sheepsfoot roller to Earthwork since this is earthmoving equipment	*Cost for a dozer and use of a towed sheepsfoot roller have been moved to Earthwork costs.*
10	Reveg	Seed costs should remain on the vegetation worksheet.	*Seed costs are still on the vegetation worksheet – no change here.*

END

Form MR-REV-att (DOGM – Revise/Amend Change Form)
(Revised September 14, 2005)

Application for Mineral Mine Plan Revision or Amendment

Operator: **Materion Resources.**	
Mine Name: **Topaz Mine**	File Number: M/023/0003

Provide a detailed listing of all changes to the mining and reclamation plan that will be required as a result of this change. Individually list all maps and drawings that are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise or amend the existing Mining and Reclamation Plan. **Include page, section and drawing numbers as part of the description.**

DETAILED SCHEDULE OF CHANGES TO THE MINING AND RECLAMATION PLAN
DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED

☐ Add	☒ Replace	☐ Remove	NOI Page 78-84
☐ Add	☒ Replace	☐ Remove	Appendix 7 and 8
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments and obligations, herein.

Marit Sawyer — Marit Sawyer consultant to Materion — 12/2/11
Print Name — Sign Name, Position — Date

Return to:
State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801

Phone: (801) 538-5291 Fax: (801) 359-3940

O:\FORMS\MR-REV-att.doc

FOR DOGM USE ONLY:
File #: M/ /
Approved:
Bond Adjustment: from ($) **to $**

9.1 Baseline Reclamation Liability

BRI has carefully mapped existing disturbances using 1976, 1986, and 2001 aerial photographs and topographic mapping to determine the advancement of disturbances and their areal extent. In turn, the disturbances have been classified by disturbance: pits, waste rock dumps and pit backfills, ore stockpiles, and ancillary facilities.

The current status of reclamation at the mine is summarized on the map entitled Disturbed Acres Status of Properties Existing & Released (Plate 12). Five categories are shown on the map:

- pit, dump, ore pad, mine camp and other disturbances subject to reclamation liability;
- pit and dump disturbances varianced in the 1988 revision;
- pit, dump, backfill and other disturbances released or varianced between 1988 and 2000;
- pit disturbances requested for variance in the updated revision;
- reclamation treatment test plots.

In late 2011, it was decided that the Southwind LMU would not be developed. Bonding for this pit was eliminated. No development will take place at this LMU until an updated mine plan and bond evaluation have been submitted to, and approved by, DOGM.

The disturbed areas for which there is no further reclamation liability are the following: Taurus pit and dump, Sigma Emma pit and dump, Roadside 1 and 2 pits and associated dumps, the Fluro pit and dump, the former Anaconda pit and dump located in the vicinity of the Monitor deposit, the Monitor dump, the Rainbow pit (part) and dump, the Anaconda pit and dump located adjacent to Rainbow pit, and the Blue Chalk dumps and pit backfills. Table 4.2-1 lists the dates that these pits and dumps were opened and closed. These disturbed areas have either been released from surety requirements after the Division had determined that adequate revegetation success had been achieved or were granted a variance at the time the initial MRP was approved in 1988.

Table 9.1-1 summarizes the disturbed areas having current outstanding reclamation liabilities at the Topaz mine along with their areas (acreages) and proposed disposition.

Deleted: December 2006

Table 9.1-1 Current (end 2004) Outstanding Unreclaimed Areas

Disturbance Area Designation	Disturbed Area (acres)	Disposition	Anticipated Timing
Monitor Pit Backfill Surface	27.2	Rip, topsoil, revegetate	Beginning in Phase I
Monitor Ore Pad	13.4	Rip, topsoil, revegetate	End of Monitor pit life
Dust Suppression water assembly (southwest of Monitor)	1.9	Rip, revegetate	**Post Phase I**
Roadside 2 Pit Backfill Surface	1.0	Topsoil, revegetate	Begins in Phase I
Roadside/Fluro 3 Pit Backfill Surface	16.9	Topsoil, revegetate	Begins in Phase I
Landfill	7.7	Cover, topsoil, revegetate	End of mine life
Mine Camp	8.6	Rip/scarify, revegetate	End of mine life
Laydown area on Fluro dump	4.6	Rip/scarify, topsoil, revegetate	End of mine life
Rainbow Pit 2 borrow, ore pad, ramps	21.6	Regrade, rip, topsoil, revegetate	Post Phase I
Blue Chalk North Pits	23.3	Variance from Rule **R647-4-111.7, 12, & 13** requested	Not scheduled
Blue Chalk South Pit	8.4	Variance from Rule **R647-4-111.7, 12, & 13** requested	Not scheduled
Section 16 North 1 Pit	25.7	Variance from Rule **R647-4-111.7, 12, & 13** requested	**Not scheduled**
Section 16 North 1 Dump	26.4	Rip/scarify, topsoil, revegetate	**Post Phase I**
Total Current Disturbed Area	195.7		

As part of this revised MRP, BRI is seeking a variance for reclamation of the Blue Chalk North, Blue Chalk South, and Section 16 North No. 1 open pits. These pits must remain open, as they are today, to allow access to the Blue Chalk North and South and Section 16 ore bodies in the future. These open pits will be expanded in future phases of Topaz mine operations and backfill opportunities will be determined in future phase amendments.

The surety amounts for the currently disturbed areas subject to reclamation have been calculated using the same methods used for new disturbances to be created in the initial LMUs in the first phase of mining proposed in this plan. In this way the allocation of existing surety, whether for disturbances that are bonded or for formerly proposed developments that have not yet begun, is not relevant. Rather, the existing surety amount would be adjusted as necessary to provide sufficient surety for the currently

outstanding reclamation liability as well as the reclamation liability anticipated to be accrued during the development and mining of the Phase I LMUs.

The reclamation cost estimate for the existing disturbances is provided in Appendix 7 and the reclamation cost estimate for the proposed disturbances under the Phase I LMU is in Appendix 8.

9.2 Methodology

This section describes how the Reclamation Plan Cost Estimate was accomplished. Separate estimates for reclamation of "Existing" and "Phase I LMU disturbances" are provided in Appendix 7 (Existing disturbance as of the 2006 NOI approval) and Appendix 8 (Phase 1 LMU disturbance occurring since the 2006 NOI approval). Note that this methodology is different than that used in the 2006 NOI surety bond explanation, as DOGM preferred methodology and guidance has changed. The information below explains where data originated for each of the DOGM Bonding Worksheets, and how it was utilized in the various calculations. It applies to both the Existing and Phase I LMU disturbances.

Unless otherwise noted, costs are from R.S. Means 2011 Heavy Construction Cost Data (Means 2011). Hourly Operating Costs include rental costs as well as operating costs such as fuel and maintenance, according to Means 2011, page ix, "Equipment Costs". A 10 percent equipment overhead cost has been added to Earthwork and Revegetation equipment costs, as per DOGM instruction. The Operator's Hourly Wage Rate is for laborers as defined in the bond worksheets,, and includes wages and employer costs, such as worker benefits, according to Means 2011, page ix, "Labor Costs". Volumes and haul or push distances are measured from Materion's maps, or taken from the company's yearly planning worksheets. Equipment and labor productivity assume typical conditions and take into account time for set-up, work breaks, clean-up and other work-associated activities. Generally, the number of units (e.g., cubic yards), the productivity (e.g., cubic yards/ hr), the equipment costs and labor costs are combined to determine the cost for a given item. Production rate/productivity is based on Means 2011.

Deleted: paragraph
Deleted: will
Deleted: existing
Deleted: proposed
Deleted: , comprised of five pages each (or worksheets in MS Excel),
Deleted: ces
Deleted:
Deleted: description
Deleted: . The following subsections pertain to the reclamation cost estimates for
Deleted: e
Deleted: proposed
Deleted: December 2006

9.2.1 *Summary sheet*

Deleted: *Rates*

This sheet summarizes the estimated total bond amount required to reclaim mining disturbance. It includes the subtotal of the "direct reclamation" tasks of Demolition and Removal, Backfilling and Grading, and Revegetation costs. The "indirect costs" of Mobilization/Demobilization, Contingency, Engineering Redesign, Main Office Expense, and a Project Management Fee are calculated as a percentage of the direct costs. The percentage is set by DOGM. To account for inflation over the five-year bonding period, a DOGM-set, per-year escalation factor is added. Direct, indirect, and escalation values were added together to get the final reclamation cost. More detail on Summary Sheet assumptions is found in **Section 9.2.5**.

9.2.2 Demolition Cost sheets

The plans for facilities demolition and disposal of the demolition debris are described in Section 7.2 of the NOI. The reclamation cost estimates for this component for the Existing mine and the Phase 1 LMU are included in Appendices 7 and 8.

Demolition and disposal costs are broken down by type (metal structures, foundation, etc.) and item (maintenance shop, welding shop under "metal structures"). Costs include those described in **Section 9.2** above, as well as the cost to transport materials to a landfill (in this case, landfill is on site). Size of buildings is listed. Time to complete demolition tasks is based on productivity rates listed in Means 2011.

9.2.3 Earthwork Cost sheets

Earthwork costs include Dump Top Rounding, Ripping of regraded surfaces, Topsoil replacement, Mulching, and use of a sheepsfoot roller after seed is spread to assure good seed-soil contact. These costs are then sub-divided by pit location or site area.

Additional reclamation considerations of interest, carried over from the last bond analysis, are listed below.

Deleted: December 2006

Pit Highwall Safety Berms & Fences

Pit highwall safety berms are constructed prior to beginning mining of each open pit or pit expansion; therefore they are not reclamation costs. No fences are proposed as part of the reclamation plan.

Regrading & Recontouring

Regrading and re-contouring of waste rock dumps and pit backfills, ancillary facilities sites (e.g., mine camp,), ore stockpile sites, and the landfill are discussed in Section 7.4.

Ripping

Ripping of roads is described in Section 7.3. Ripping of other hardened surfaces such as dump surfaces and ore stockpile sites is discussed in Section 7.8.

Drainage Stabilization & Restoration

Drainage and sediment control will not be required as part of Phase I reclamation. Refer to section 7.5 and also sections 3.6, 4.8, 5.7, and 6.4.

Soil Replacement

Topsoil replacement methods are described in section 7.8.

Seedbed Preparation

Seedbed preparation methods are also described in Section 7.8.

Dozing distance for dump top rounding (so that dumps blend more with the natural landscape) was assumed to be 70 feet, as per Materion's data. The average haul distance used for the scraper topsoil replacement was based on Materion's mapping, or taken from the company's yearly budgeting worksheets. All other factors on this worksheet were obtained from the Caterpillar Performance Handbook, 41th Edition, January 2011. All other quantities were listed in **Section 7.0** or measured from the associated sets of drawings.

Deleted: This worksheet tabulates first the Equipment Hourly Rates, which include all the operating, ownership, and overhead costs extracted from the Rental Rate Blue Book, last half 2006. The Labor Hourly Rates were obtained from Means Heavy Construction Cost Data, 2006

Deleted: December 2006

Rock mulch volumes and haul distances are from Materion's maps, or taken from the company's yearly budgeting worksheets.

A sheepsfoot roller is used to press seed into the ground after it has been spread. This cost is included in the Earthwork costs as per DOGM request.

9.2.4 Revegetation Cost Sheets

Revegetation methods are described in Section 7.11.

Revegetation seed cost per acre was based on the species and seed application rates listed in **Table 7.11-1**. Prices were obtained from Granite Seed Company, Lehi, UT on May 20, 2011.

9.2.5 Indirect Costs

These costs are determined by pre-set values included in the bond Summary Sheet provided by DOGM. Particulars of each cost are discussed below.

Mobilization and demobilization

Mob and demob costs are calculated at 10 percent of total direct costs. This cost was applied to both Existing and Phase 1 LMU disturbances.

Contingency

Contingency costs were calculated at 5 percent of total direct costs. This cost was applied to both Existing and Phase 1 LMU disturbances.

Escalation

An inflation cost escalation factor of 1.7 percent per year, compounded annually for 5 years, was calculated from the total direct costs. This cost was applied to both Existing and Phase 1 LMU disturbances.

Engineering Redesign

This cost was calculated at 2.5 percent of Direct Costs. These costs were added to both the Existing and Phase 1 LMU cost summaries.

Deleted: Finally, the

Deleted: S

Deleted: C

Deleted: A

Deleted: table was derived using the revegetation species and seed application rates in Table 7.11-1. The unit seed price

Deleted: 8/14/06

Deleted: ***9.2.2 Equipment*** ¶
This worksheet tabulates the calculated production rates for each of the unit operations (i.e. dump top rounding with a dozer, ripping with a dozer, seed setting with a dozer pulling the dimpler, and a scraper replacing topsoil). Dozing distance for the dump top rounding was assumed to be 70 feet per BRI. The average haul distance used for the scraper topsoil replacement productivity originated in the Quantities sheet to be explained in the next paragraph. All other factors on this worksheet were obtained from the Caterpillar Performance Handbook, 36th Edition, April 2006.¶
9.2.3 Quantities¶
This worksheet lists and summarizes the applicable quantities needed for the ensuing cost calculations by subsection number (e.g., 9.3 Facilities Demolition, 9.4 Regrading and Recontouring, etc). BRI provided building dimensions and linear feet of dump margin for dump top rounding. All other quantities were listed in Section 7.0 or measured from the associated sets of drawings. ¶
9.2.4 Costs ¶
This sheet details by paragraph how the costs are calculated. Generally the number of units (e.g., cubic yards, etc.), the productivity (e.g., cubic yards/ hr), the equipment and labor cost per hour are combined to determine the cost for a given item. In most cases, items used in this sheet are linked to the quantities, equipment, and rates sheets. When this was not the case, a reference was listed from Means Heavy Construction Cost Data, 2006 by line number; or the DOGM rate sheet. The most recent available DOGM rate sheet is dated April 18, 2005.¶
9.2.5 Cost Summary¶
This sheet lists the total cost for each reclamation component which add up to the "Reclamation Total". The standard DOGM add-ons are then determined and listed ... [1]

Deleted: *11*

Deleted: *Miscellaneous*

Deleted: *Miscellaneous costs consist of m*

Deleted: *costs*

Deleted: , which are included with the cost estimate for Phase I LMU reclamation (Appendix 8), and landfill reclamation costs, which are included in the Existing facilities ... [2]

Deleted: December 2006

Main Office Expense

Costs for main-office planning were calculated at 6.8 percent of total direct costs. These costs were applied to both Existing and Phase 1 LMU disturbances.

Project Management Fee

Cosst for project management were calculated at 2.5 percent of direct costs. This cost was added to estimates for both Existing and Phase 1 LMU disturbances.

Deleted: *9.11.1 Construction Supervision*

Deleted: Supervision of reclamation construction

Deleted: is estimated at 10 percent of the Reclamation Total cost for both existing and proposed disturbances.

Deleted: *9.11.2 Contingency and Escalation* ¶ A cost contingency factor of 10 percent of the sum of the Reclamation Total cost plus construction supervision was included with the cost estimates for both existing and proposed disturbances. A cost escalation factor of 1.6 percent per year, compounded annually for 5 years, was added to the cost estimates for reclamation of both existing and proposed disturbances

Deleted: *9.11.3 Summary of Reclamation Costs*

Deleted: The reclamation cost estimates for existing and proposed Phase I LMU disturbances, including construction supervision, contingency, and escalation are $724,600 and $637,400, respectively.

10.0 REFERENCES

Bolke, E. L. and C. T. Sumsion. 1978. Hydrologic Reconnaissance of the Fish Springs Flat Area, Tooele, Juab, and Millard Counties, Utah. *State of Utah, Department of Natural Resources Technical Publication No. 64.*

Davis, L, 1984. Beryllium Deposits in the Spor Mountain Area, Juab County, Utah, *in* Utah Geological Association Publication 13, 1984 Field Conference: Geology of Northwestern Utah, Southern, Idaho, and Northeastern Nevada.

JBR Consultants Group, 1985a. Report on Revegetation Test Plot Program, Brush Wellman, Inc.'s Topaz Mining Property. Prepared for Brush Wellman, Inc.

JBR Consultants Group, 1985b. Plant Communities on Brush Wellman, Inc.'s Topaz Mining Property. Prepared for Brush Wellman, Inc.

JBR Consultants Group, 1985c. Report on Investigations of Soils, Brush Wellman's Inc. Topaz Mining Property. Prepared for Brush Wellman, Inc.

JBR Consultants Group, 1988. Topaz Mining Property Reclamation Plan Revision. Prepared for Brush Wellman, Inc.

JBR Environmental Consultants, Inc., 1999a, Brush Wellman, Inc. Topaz Mining Property Pit Expansion Project Rainbow #2 and Section 16 South #1 Pits, Environmental Assessment EA J-01-099-042 EA. Prepared on behalf of U.S. Bureau of Land Management, Fillmore Area office.

JBR Consultants Environmental Consultants, Inc., 1999b, Assessment of Potential Impacts to Groundwater Quality from Mining, Ore Stockpiling and Overburden Placement Brush Wellman, Inc. Topaz Beryllium Mine. Prepared on behalf of Brush Wellman, Inc. for submittal to Utah Division of Water Quality.

Lindsey, David A., 1979, Miscellaneous Investigation Series Map I-1176, United States Geological Survey.

Deleted: ¶ ¶

Deleted: December 2006

Appendix 7

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	$83,649.31	
Subtotal Backfilling and Grading	$649,031.93	
Subtotal Revegetation	$119,944.11	
Direct Costs	**$852,625.35**	
Indirect Costs		
Mob/Demob	$85,263.00	10.0%
Contingency	$42,631.00	5.0%
Engineering Redesign	$21,316.00	2.5%
Main Office Expense	$57,979.00	6.8%
Project Management Fee	$21,316.00	2.5%
Subtotal Indirect Costs	**$228,505.00**	26.8%
Total Cost 2011	**$1,081,130.35**	
Number of years		5
Escalation factor		0.017
Escalation	$95,074.00	
Reclamation Cost Escalated	$1,176,204.35	
Bond Amount (rounded to nearest $1,000)	**$1,176,000.00**	
2016 Dollars		
Posted Bond	$1,362,000.00	
Difference Between Cost Estimate and Bond	-$186,000.00	
Percent Difference	-13.66%	
If new Monitor Phase 1 LMU disturbance is included:	$222,000.00	
Total Bond with Monitor Phase 1 LMU included	**$1,398,000.00**	
Difference between cost est. and bond	$36,000.00	
Percent Difference	2.64%	

Materion Resources
M/023/003

Materion 2011 Reclamation Cost Estimate
Demolition Summary

Revised 11/22/11

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Metal Structures																			18,823.20
	Frame and Tin Structures																			17,314.44
	Foundations 6" depth																			28,524.60
	Foundations 4" depth																			10,160.00
	Water Pipeline 8" removal																			7,443.33
	Liner matl removal (wtr pond, Fluro pond)																			1,383.74
	Costs for demo include equipment rental, operation, maintenance, labor crew with benefits, O & P																			
	DEMOLITION TOTAL																			**83,649.31**

Ref.	Description Demolition Detail	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Metal Structures																			
	Maintenance Shop	Steel	02 41 16.13 0020	0.31	/cf			16		2,400								38,400	cf	11,904.00
	Welding Shop	Steel	02 41 16.13 0020	0.31	/cf			10		1,152								11,520	cf	3,571.20
	Sample Storage	Steel	02 41 16.13 0020	0.31	/cf			10		880								8,800	cf	2,728.00
	Water Standpipe	Steel	02 41 16.13 0020	0.31	/cf			20		100								2,000	cf	620.00
	Subtotal																			**18,823.20**
	Frame and Tin Structures																			
	Shop Addition	Frame and/or tin	02 41 16.13 0100	0.33	/cf			14		1,078								15,092	cf	4,980.36
	Pump House	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		160								1,280	cf	422.40
	Production office	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		500								4,000	cf	1,320.00
	Engineering office	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		1,012								8,096	cf	2,671.68
	Lunch room	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		1,118								8,944	cf	2,951.52
	Core shed #1	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		240								1,920	cf	633.60
	Core shed #2	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		240								1,920	cf	633.60
	Guard quarters	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		718								5,744	cf	1,895.52
	Generator shed	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		180								1,440	cf	475.20
	Contractor office trailer	Frame and/or tin	02 41 16.13 0100	0.33	/cf			8		504								4,032	cf	1,330.56
	Subtotal																			**17,314.44**
	Foundations 6" depth																			
	Tank farm	Concrete	02 41 16.17 0420	6.90	$/sq ft					1,315								1,315	sq ft	9,073.50
	Generator pad	Concrete	02 41 16.17 0420	6.90	$/sq ft					419								419	sq ft	2,891.10
	Maintenance Shop	Concrete	02 41 16.17 0420	6.90	$/sq ft					2,400								2,400	sq ft	16,560.00
	Subtotal																			**28,524.60**
	Foundations 4" depth																			
	Welding Shop	Concrete	02 41 16.17 0280	5.00	$/sq ft					1,152								1,152	sq ft	5,760.00
	Sample building	Concrete	02 41 16.17 0280	5.00	$/sq ft					880								880	sq ft	4,400.00
	Subtotal																			**10,160.00**
	Water Pipeline 8" removal					19,500			8"											
	Equipment cost	HDPE	01 54 33.20 4360 *	113.07	$/ op hr													18	hours	2,035.23
	Operating cost		0154 33.20 4360*	97.20														18	hours	1,749.60
	Labor cost	HDPE	labor rates p. 677	67.75	$/ op hr													54	hours	3,658.50
	Assumes Monthly rental & op cost for D9 w/ operator & 2 laborers on ground to pull pipe and take to the on-site landfill.																			
	Assumes 3 people x 18 hours (54 hr total) to complete task																			
	Subtotal																			**7,443.33**
	Liner matl removal (wtr pond, Fluro pond)									19,300										
	Equipment cost	HDPE	01 54 33.20 5250 *	12.07	$/ op hr													10	hours	120.74
	Operating Cost		01 54 33.20 5250 *	21.80	$/ op hr													10	hours	218.00
	Labor cost	HDPE	labor rates p. 677	52.25	$/ op hr													20	hours	1,045.00
	Assumes Monthly rental & op cost for 1, 8-yd. dump truck & 2 driver/laborers to pull up lining material & take to the on-site landfill.																			
	Assumes 2 people x 10 hours (20 hr total) to complete task																			
	As per R.S. Means (2011), pages ix and 477, Labor costs include benefits & contractor O & P																			
	Subtotal																			**1,383.74**
	* 01 54 33.20 is found in the Equipment Rental section of RS Means, page 450, 451 (2011 version)																			
																				83,649.31

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Earthwork Summary															
Dump Top Rounding															**3,803.12**
Ripping															**56,220.46**
Topsoil Replacement															**261,261.14**
Mulching with gravel															**232,356.65**
Sheepsfoot roller to compact seeds into soil															**95,390.56**
TOTAL															**649,031.93**
ROUNDED TOTAL															**649,000**

Description	Equipment Cost 1 dozer	Hourly Operating Costs* 1 dozer	Equipment Overhead 10%	Total Equip Cost	Operator's Hourly Wage Rate*	Number of Men or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis.	Units	TOTAL Cost
Dump Top Rounding - pushing material to shape ("round") the waste dump edge with D9 dozer																
Monitor ore pad	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	2,820.00	CY	747.00	lcy/ hr			1,128.92
Rainbow borrow, ore pad, ramps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	2,870.00	CY	747.00	lcy/ hr			1,148.94
Section 16 North 1 Dump	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	3,810.00	CY	747.00	lcy/ hr			1,525.25
TOTAL										9,500.00						3,803.12

SOURCES AND NOTES:

* Equipment hourly cost = Means 01 54 33.20 4360 (dozer, 410 H.P.), based on monthly rental rate/176 hr month.

* Labor hourly cost = Means page 677, equip. operators, medium equip.

Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.

Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover

^ quantity from Materion mine planning data

^^ Productivity sheets assumed 1 scraper = 139 LCY/hr. This sheet assumes 2 scrapers operating so productivity is doubled

Description	Equipment Cost dozer	Hourly Operating Costs * dozer	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate*	Number of Workers or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis.	Units	TOTAL Cost
Ripping with D9 dozer and ripper shanks																
Monitor 3 Pit backfill surface	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	24.20	ac	0.75	ac/hr			9,649.19
Monitor Ore pad	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	12.80	ac	0.75	ac/hr			5,103.70
Dust Suppression water assembly	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	0.40	ac	0.75	ac/hr			159.49
Partially backfilled Roadside 2 pit backfill surface	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	4.90	ac	0.75	ac/hr			1,953.76
Roadside/Fluro 3 pit backfill surface	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	16.80	ac	0.75	ac/hr			6,698.61
Mine Camp	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	6.80	ac	0.75	ac/hr			2,711.34
Laydown & Ore pad on Fluro dump	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	14.10	ac	0.75	ac/hr			5,622.05
Rainbow borrow, ore pad, ramps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	18.20	ac	0.75	ac/hr			7,256.83
Rainbow Phase 1 dumps with earthwork incomplete	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	7.20	ac	0.75	ac/hr			2,870.83
Rainbow Phase 1 pit backfill surface	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	14.50	ac	0.75	ac/hr			5,781.54
Section 16 North 1 dump	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	21.10	ac	0.75	ac/hr			8,413.13
Subtotal																
SOURCES AND NOTES:																
* Equipment hourly cost = Means 01 54 33.20 4360 (dozer, 410 H.P.). based on monthly rental rate/176 hr month. Cost for ripper included in cost for Dozer, as per quote from Wheeler Machinery on 12.1.11																
. See* Labor hourly cost = Means page 677, equip. operators, medium equip.																
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																
Hourly cost for labor includes wages, worker's comp. and contractor O & P, as per RS Means (2011), pg ix and inside back cover																
^ quantity from Materion mine planning data																
^^ Production rate from productivity sheets																
										141.00						56,220.48

Wheeler Machinery quote of 12.1.11 - Their cost to rent a dozer with ripper shanks was just under the R.S. Means cost to rent dozer - presence of ripper shanks not specified.
Therefore no additional cost for ripper shanks is included in this cost estimate.

Description	Equipment Cost	Hourly Operating Costs *	Equipment Cost	Hourly Operating Costs *	Equipment Overhead	Totall Equip Cost	Operator's Hourly Wage Rate *	Number of Workers	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis.	Units	TOTAL Cost
	2 scrapers	2 Scrapers	1 Dozer	1 Dozer	10%													
Topsoil Replacement @ 3-6 inch depth using 2 self-propelled scrapers to haul, and one D-9 dozer to spread, topsoil																		
Monitor 3 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	9,769.00	CY	278.00	lcy/hr			37,303.35
Monitor ore pad	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	5,176.00	CY	278.00	lcy/hr			19,764.78
Dust Suppression water assembly	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	153.00	CY	278.00	lcy/hr			584.24
Partially backfilled roadside 2 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	1,957.00	CY	278.00	lcy/hr			7,472.69
Roadside/Fluro 3 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	6,767.00	CY	278.00	lcy/hr			25,840.08
Landfill	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	3,106.00	CY	278.00	lcy/hr			11,860.40
Rainbow phase 1 dumps w/ earthwork incomplete	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	2,898.00	CY	278.00	lcy/hr			11,066.14
Rainbow phase 1 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	5,840.00	CY	278.00	lcy/hr			22,300.29
Landfill Waste Rock Capping ^^	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	62,113.00	CY	527.20	lcy/hr			125,068.98
SOURCES AND NOTES:																		
*Equipment cost = Means 01 54 33.20 3600 (Self propelled, dual engine scraper, 31 CY capacity), Means 01 54 33.20 4360 (dozer, 410 H.P.)																		
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																		
* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.																		
Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover																		
^ quantity from Materion mine planning data																		
^^ Productivity sheets assumed 1 scraper. For **topsoil**, productivity for 1 scraper = 139 LCY/hr. For **landfill waste rock capping** productivity for 1 scraper is 263.6 LCY/hr.																		
This sheet assumes 2 scrapers operating so productivity is doubled																		
TOTAL												**97,779.00**						**261,261.14**

Description	Equipment Cost 2 scrapers	Hourly Operating Costs 2 scrapers	Equipment Cost 1 dozer	Hourly Operating Costs 1 dozer	Equipment Overhead 10%	Total Equip. Cost	Operator's Hourly Wage Rate	Number of Workers	Total Operator Cost	Total Eq. & Lab. Costs	Units	Depth inches	Area acres	Volume	Units	Production Rate	Units	TOTAL Cost
Mulching with gravel mulch, on-site source, 2" depth																		
Monitor 3 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	24.20	6,507	CY	278	lcy/hr	24,847.68
Monitor ore pad	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	12.80	3,442	CY	278	lcy/hr	13,142.58
Dust suppression water assembly	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	0.40	108	CY	278	lcy/hr	410.71
Roadside 2 Pit Backfill surf& outsl fr Fluro ph1	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	21.50	5,781	CY	278	lcy/hr	22,075.42
Partially backfilled roadside 2 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	4.90	1,318	CY	278	lcy/hr	5,031.14
Roadside/Fluro 3 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	16.80	4,517	CY	278	lcy/hr	17,249.63
Landfill	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	7.70	2,070	CY	278	lcy/hr	7,906.08
Mine Camp	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	6.80	1,828	CY	278	lcy/hr	6,981.99
Lay down & ore pad on Fluro dump	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	14.10	3,791	CY	278	lcy/hr	14,477.37
Rainbow borrow, ore pad, ramps	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	18.20	4,894	CY	278	lcy/hr	18,687.10
Rainbow phase 1 dumps w/ earthwork completed	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	52.60	14,144	CY	278	lcy/hr	54,007.78
Rainbow phase 1 dumps w/ earthwork incomplete	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	10.70	2,877	CY	278	lcy/hr	10,986.37
Rainbow phase 1 pit backfill surface	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	14.50	3,899	CY	278	lcy/hr	14,888.08
Section 16 North 1 Dump	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3.00	203.25	1,061.56	$/hr	2	21.10	5,674	CY	278	lcy/hr	21,664.72
													226.30	60,850				232,358.66

*Equipment cost = Means 01 54 33.20 3600 (Self propelled, dual engine scraper, 31 CY capacity), Means 01 54 33.20 4360 (dozer, 410 H.P.)
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.

* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.
Hourly cost for labor includes wages, worker's comp. and contractor O & P, as per RS Means (2011), pg ix and inside back cover

^ Area from Materion mine planning data

** Productivity from productivity sheets

Description	Equipment Cost	Hourly Operating Costs	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Totall Equip Cost	Operator's Hourly Wage Rate	Number of Workers	Total Operator Cost	Total Eq. & Lab. Costs	Area^	Units	Production Rate ^^	Units	TOTAL Cost
	1 dozer	1 dozer	1 sheepsfoot roller												
Seed-setting with Sheepsfoot Roller															
Monitor 3 pit backfill surface	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	24.20	ac	0.83	ac/hr	10,200.85
Monitor ore pad	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	12.80	ac	0.83	ac/hr	5,395.49
Dust suppression water assembly	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	0.40	ac	0.83	ac/hr	168.61
Roadside 2 Pit Backfill surf& outsl fr Fluro ph1	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	21.50	ac	0.83	ac/hr	9,062.74
Partially backfilled roadside 2 pit backfill surface	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	4.90	ac	0.83	ac/hr	2,065.46
Roadside/Fluro 3 pit backfill surface	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	16.80	ac	0.83	ac/hr	7,081.58
Landfill	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	7.70	ac	0.83	ac/hr	3,245.72
Mine Camp	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	6.80	ac	0.83	ac/hr	2,866.35
Lay down & ore pad on Fluro dump	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	14.10	ac	0.83	ac/hr	5,943.47
Rainbow borrow, ore pad, ramps	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	18.20	ac	0.83	ac/hr	7,671.71
Rainbow phase 1 dumps w/ earthwork completed	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	52.60	ac	0.83	ac/hr	22,172.09
Rainbow phase 1 dumps w/ earthwork incomplete	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	10.70	ac	0.83	ac/hr	4,510.29
Rainbow phase 1 pit backfill surface	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	14.50	ac	0.83	ac/hr	6,112.08
Section 16 North 1 Dump	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	21.10	ac	0.83	ac/hr	8,894.13
SOURCES AND NOTES:															
*Equipment cost = Means 01 54 33.20 4360 (dozer, 410 H.P.), Means 01 54 33.20 3150 (sheepsfoot roller, towed, 50 H.P.)															
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.															
* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.															
Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover															
^ Area from Materion mine planning data															
^^ Productivity from productivity sheets															
TOTAL											226.30				95,390.56

Revegetation Costs, Existing Mine - SUMMARY

Revised 11/22/11

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Seeding																			119,944.11
	Associated costs of mulching and using a sheepsfoot roller to press seeds into soil are found in the earthwork worksheet																			
	Reveg Total																			119,944.11
	TOTAL ROUNDED																			119,900

Ref.	Description Seeding with D9 and broadcast seeder	Mater-ials	Means Reference Number	Unit Cost*	Operatg cost	Unit	Unit Cost*	Operatg cost	Unit	Total Equip Cost	Labor Cost	Unit	TOTAL Operating Cost	Length	Width	Prod-uction Rate	units	Area	Volume	Weight	Density	Seed cost^	Unit	Quan-tity	Unit	TOTAL Cost
				Dozer			Seeder			w/ 10% Overhea																
	Monitor 3 pit backfill surface		See below	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	24.20	ac	12,826.55
	Monitor ore pad		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	12.80	ac	6,784.29
	Dust suppression water assembly		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	0.40	ac	212.01
	Roadside 2 Pit Backfill surf& outsl fr Fluro ph1		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	21.50	ac	11,395.49
	Partially backfilled roadside 2 pit backfill surface		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	4.90	ac	2,597.11
	Roadside/Fluro 3 pit backfill surface		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	16.80	ac	8,904.38
	Landfill		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	7.70	ac	4,081.17
	Mine Camp		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	6.80	ac	3,604.15
	Lay down & ore pad on Fluro dump		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	14.10	ac	7,473.32
	Rainbow borrow, ore pad, ramps		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	18.20	ac	9,646.41
	Rainbow phase 1 dumps w/ earthwork completed		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	52.60	ac	27,879.19
	Rainbow phase 1 dumps w/ earthwork incomplete		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	10.70	ac	5,671.24
	Rainbow phase 1 pit backfill surface		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	14.50	ac	7,685.33
	Section 16 North 1 Dump		"	113.07	97.20	$/op hr	21.45	24.75	$/op hr	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	21.10	ac	11,183.46
	Sources and Notes																									
	* All costs on this sheet are based on use of a D9 dozer Means (2011) (01 54 33.20 4360 (pg 480+))																									
	*Cost for range broadcast seeder is based on cost to rent/operate a 50 H.P., towed sheepsfoot roller (Means (2011) - 01 54 33.20 3150) as I could not find a separate cost for a broadcast seeder, and these two operations are similar.																									
	Unit cost assumes monthly rental @ 176 operating hours per month. Operatg cost from same line item in Means																									
	* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.																									
	Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per Means (2011), pg ix and inside back cover																									
	* Seed cost obtained from Granite Seed, May 2011																									
	Total															11.62								226.30		119,544.11

Project: Materion Mine, Existing Dist.
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 5
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE
RS Means (2011) Cost - 01 54 33.20 4360

Earthmoving Activity:

Dump Top Rounding & Topsoil spreading

Characterization of Dozer Used (type, size, etc.):

Caterpillar D-9; semi - U blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

dozing distance = 70 ft.

Productivity Calculations:

Operator Adjustment Factor = 0.75 (operator factor) x 1.00 (material factor) x 0.83 (efficiency factor) x 1.00 (grade factor) x 1.00 (weight correction factor)

x 1.00 (production method/blade factor) x 1.00 (visibility factor) x 1.00 (elevation factor) = 0.62

Net Hourly Production = 1200 (normal hourly production) LCY/hr x 0.62 (operating adjustment factor) = 747 LCY/hr

Hours Required = _____ (volume to be moved) LCY ÷ 747 (net hourly production) LCY/hr = 0.0 hr(s)

Data Source(s):

Caterpillar Performance Handbook 41st edition

Project: Materion Mine, Existing Dist.
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 6
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE - GRADING
RS Means (2011) Cost - 01 54 33.20 4360

Earthmoving Activity:

Broadcast seeding with D-9 pulling a broadcast seeder unit

Seed Setting with D-9 pulling Dimpler (after seeding)

Characterization of Dozer Used (type, size, etc.):

D-9 dozer pulling a broadcast seeder (e.g. a Truax broadcaster)

D-9 dozer with a cylindrical dimpler

Description of Dozer Use (% grade, effective blade width, operating speed, etc.):

Range broadcast seeder = 11 feet wide, 1 mi/hr operating speed, level grade

Dimpler = 11 ft width; 1 mi/hr operating speed; level grade

Productivity Calculations:

Operator Adjustment Factor = 0.75 (operator factor) x 1.00 (material factor) x 0.83 (efficiency factor) x 1.00 (grade factor) x 1.00 (weight correction factor)

x 1.00 (production method/blade factor) x 1.00 (visibility factor) x 1.00 (elevation factor) = 0.62

Hourly Production = 1.0 (average speed) mi/hr x 11.0 (effective blade width) ft x 5280 ft/mi x 1 ac

÷ 43560 ft^2 = 1.3 ac/hr

Net Hourly Production = 1.3 ac/hr x 0.62 (operating adjustment factor) = 0.83 ac/hr

Hours Required = (area to be graded) ac ÷ 0.83 (net hourly production) ac/hr = 0.0 hr(s)

Data Source(s):
Caterpillar Performance Handbook 41st edition

Project: Materion Mine,Existing dist
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 7
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE
R.S. Means 2011 01 54 33.20 4360

Ripping Activity:

Ripping of various surfaces in preparation for revegetation

Characterization of Dozer and Ripper Use:

D-9 Caterpillar

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

ripping depth = 2ft. Cut spacing = 10.5 ft. Average cut length = 433 ft.Material to be ripped is general mine waste surface material.

Efficiency = operator (0.75); job efficiency (50 min/hr or 0.83)
(0.75 x 0.83 = 0.623)

Productivity Calculations:

Cycle Time = 433 ft (cut length) ÷ 88 ft/min [speed] + 0.25 min (fixed turn time*) = 5.2 min/pass

Passes/Hour = 60 min/hr ÷ 5.2 min/pass (cycle time) x 0.623 (efficiency factor) = 7.2 passes/hr

Volume Cut/Pass = (2.0 ft (tool penetration) x 10.5 ft (cut spacing) x 433 ft (cut length)) ÷ 27 ft^3/yd^3

= 336.78 BCY/pass

Hourly Production = 336.78 BCY/pass x 7.2 passes/hr = 2434.7 BCY/hr

Hours Required = (bank volume to be ripped**) BCY ÷ 2434.7 (hourly production) BCY/hr = 0.0 hr

Acres per hour =	cut length (ft) x spacing (ft)	4546.5	from above	
	passes per hour	7.2	from above	
	Total area (ft2) covered per hr	32869.1	or 0.75	ac per hour

* Fixed turn time depends upon dozer used. 0.25 min/turn is normal.

** Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to Worksheet 5. Calculate separate dozer hauling of ripped material for each lift on that worksheet.

Data Source(s):

Caterpillar Performance Handbook 41st edition

Project: Materion Mine, Existing Dist.
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 11A-1
PRODUCTIVITY OF PUSH-PULL OR SELF-LOADING SCRAPER USE
RS Means (2011) Cost - 01 54 33.20 3600

Earthmoving Activity:

Top Soil Replacement and Applying gravel mulch

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 631 (29 cubic yard capacity, self-propelled)

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):

up 4% loaded; average haul distance 4500 ft.
Efficiency = operator (0.75) ; Job efficiency (50 min/hr or 0.83); Load Factor (0.8)
(0.75 x 0.83 x 0.8 = 0.5)

Productivity Calculations:

Cycle Time = 0.9 min (load time) + 2.8 min (loaded) + 0.7 min (maneuver and) + 1.9 min (return trip)

= 6.3 min (push-pull is)

Hourly Production = 29.0 LCY (capacity*) x 60 min/hr ÷ 6.3 min (cycle time**) x 0.50 (efficiency)

= 138.1 LCY/hr (push-pull is)

Hours Required = _____ LCY (volume to be) ÷ 138.1 LCY/hr (net hourly) = 0.0 hr

* The average of the struck and heaped capacities; use total for two scrapers for push-pull.

Data Source(s):

Caterpillar Performance Handbook 41 st edition

Project: Materion Mine, Existing Dist.
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 11A
PRODUCTIVITY OF PUSH-PULL OR SELF-LOADING SCRAPER USE
RS Means (2011) Cost - 01 54 33.20 3600

Earthmoving Activity:

Waste Rock Capping for Landfill

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 631 (29 cubic yard capacity, self propelled)

Caterpillar Performance Handbook 41st edition

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):

up 4% loaded; average haul distance = 1300 feet

Efficiency = operator (0.75); Job efficiency (50 min/hr or 0.83); Load factor (0.8)
(0.75) x 0.83 x 0.8 = 0.5)

Productivity Calculations:

Cycle Time = 0.9 min (load time (push-pull is per pair)) + 1.0 min (loaded trip time) + 0.7 min (maneuver and spread time) + 0.7 min (return trip time)

= 3.3 min (push-pull is per pair)

Hourly Production = 29.0 LCY (capacity*) x 60 min/hr ÷ 3.3 min (cycle time**) x 0.50 (efficiency factor)

= 263.6 LCY/hr (push-pull is per pair)

Hours Required = _____ LCY (volume to be handled) ÷ 263.6 LCY/hr (net hourly production) = 0.0 hr

* The average of the struck and heaped capacities; use total for two scrapers for push-pull

Data Source(s):
Caterpillar Performance Handbook 41st edition

Appendix 8

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	$0.00	included in Existing Mine
Subtotal Backfilling and Grading	$137,417.53	
Subtotal Revegetation	$23,692.01	
Subtotal Direct Costs	**$161,109.54**	

Indirect Costs		
Mob/Demob	$16,111.00	10.0%
Contingency	$8,055.00	5.0%
Engineering Redesign	$4,028.00	2.5%
Main Office Expense	$10,955.00	6.8%
Project Management **Fee**	$4,028.00	2.5%
Subtotal Indirect Costs	**$43,177.00**	26.8%

Total Cost 2011	$204,286.54	
Number of years		5
Escalation factor		0.017
Escalation	$17,965.00	
Reclamation Cost Escalated	$222,251.54	
Bond Amount (rounded to nearest $1,000) 2016 Dollars	**$222,000.00**	
Posted Bond		
Difference Between Cost Estimate and Bond	N/A	
Percent Difference		

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	TOTAL Cost
Earthwork Summary															
Dump Top Rounding															**5,488.50**
Ripping															**12,121.29**
Topsoil Replacement															**68,592.49**
Mulching															**38,400.97**
Sheepsfoot roller															**12,814.29**
Subtotal															**137,417.53**
ROUNDED TOTAL															**137,400.00**

	Equipment Cost	Hourly Operating Costs*	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate	Number of Men or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis.	Units	Cost
	1 dozer	1 dozer	10%													
Dump Top Rounding - pushing material to shape ("round") the waste dump edge with D9 dozer																
Monitor Phase 1 LMU1 dumps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	4,190.00	CY	747.00	lcy/ hr			1,677.37
Monitor Phase 1 LMU2 dumps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	4,520.00	CY	747.00	lcy/ hr			1,809.48
Monitor Phase 1 LMU3 dumps / Mon 3 pit backfill	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	5,000.00	CY	747.00	lcy/ hr			2,001.64
SOURCES AND NOTES:																
* Equipment hourly cost = Means 01 54 33.20 4360 (dozer, 410 H.P.), based on monthly rental rate/176 hr month.																
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																
* Labor hourly cost = Means page 677, equip. operators, medium equip.																
Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover																
* quantity from Materion mine planning data																
^^ Productivity sheets assumed 1 scraper = 139 LCY/hr. This sheet assumes 2 scrapers operating so productivity is doubled																
TOTAL										**13,710.00**						**5,488.50**

	Equipment Cost dozer	Hourly Operating Costs * dozer	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate*	Number of Workers or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis	Units	TOTAL Cost
Ripping with D9 dozer and ripper shanks																
Monitor Phase 1 LMU 1 dumps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	5.3	ac	0.75	ac/hr			2,113.25
Monitor Phase 1 LMU 2 dumps	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	15.5	ac	0.75	ac/hr			6,180.26
Monitor Phase 1 LMU 3 dumps / Mon3 pit backfill	113.07	97.20	1.10	231.30	67.75	1	67.75	299.05	$/hr	9.6	ac	0.75	ac/hr			3,827.78
SOURCES AND NOTES:																
* Equipment hourly cost Dozer = Means 01 54 33.20 4360 (dozer, 410 H.P.), based on monthly rental rate, divided by 176 hours																
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																
* Labor hourly cost = Means page 677, equip. operators, medium equip.																
Hourly cost for labor includes wages, worker's comp. and contractor O & P, as per RS Means (2011), pg ix and inside back cover																
^ quantity from Materion mine planning data																
^^ Production rate from productivity sheets																
TOTAL																12,121.29

Wheeler Machinery quote of 12.1.11 - Their cost to rent a dozer with ripper shanks was just under the R.S. Means cost to rent dozer - presence of ripper shanks not specified. Therefore no additional cost for ripper shanks is included in this cost estimate.

	Equipment Cost	Hourly Operating Costs *	Equipment Cost	Hourly Operating Costs *	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate *	Number of Workers	Total Operator Cost	Total Eq. & Lab. Costs	Units	Quantity ^	Units	Production Rate ^^	Units	Equip. + Labor Time/Dis.	Units	TOTAL Cost
	2 scrapers	2 Scrapers	1 Dozer	1 Dozer	10%													
Topsoil Replacement @ 3-6 inch depth using 2 self-propelled scrapers to haul, and one D-9 dozer to spread, topsoil																		
Monitor Phase 1 LMU1 dumps	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203	1,061.56	$/hr	2,132.00	CY	278	lcy/hr			8,141.13
Monitor Phase 1 LMU2 dumps	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203	1,061.56	$/hr	9,190.00	CY	278	lcy/hr			35,092.41
Monitor Phase 1 LMU3 dumps/ mon3 pit backfill	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203	1,061.56	$/hr	6,641.00	CY	278	lcy/hr			25,358.95
SOURCES AND NOTES:																		
*Equipment cost = Means 01 54 33.20 3600 (Self propelled, dual engine scraper, 31 CY capacity), Means 01 54 33.20 4360 (dozer, 410 H.P.)																		
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																		
Hourly operating cost is included in rental rate, as per R.S. Means page 477																		
* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.																		
Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover																		
^ quantity from Materion mine planning data																		
^^ Productivity sheets assumed 1 scraper. For topsoil, productivity for 1 scraper = 139 LCY/hr.																		
This sheet assumes 2 scrapers operating so productivity is doubled																		
TOTAL												**17,963.00**						**68,592.49**

Description	Equipment Cost	Hourly Operating Costs	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate	Number of Workers or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Units	Depth inches	Area acres	Volume	Units	Production Rate	Units	TOTAL Cost
	2 scrapers	2 scrapers	1 dozer	1 dozer	10%													
Mulching with gravel mulch, on-site source, 2" depth																		
Monitor Phase 1 LMU1 dumps	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	2.0	5.30	6,507	CY	278	lcy/hr	24,847.66
Monitor Phase 1 LMU2 dumps	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	2.0	15.56	3,442	CY	278	lcy/hr	13,142.56
Monitor Phase 1 LMU3 dumps/ mon3 pit backfill	265.91	304.10	113.07	97.20	1.10	858.31	67.75	3	203.25	1,061.56	$/hr	2.0	9.60	108	CY	278	lcy/hr	410.71
SOURCES AND NOTES																		
*Equipment cost = Means 01 54 33.20 3600 (Self propelled, dual engine scraper, 31 CY capacity). Means 01 54 33.20 4360 (dozer, 410 H.P.)																		
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.																		
Hourly operating cost is included in rental rate, as per R.S. Means page 477																		
* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.																		
Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per RS Means (2011), pg ix and inside back cover																		
^ Area from Materion mine planning data																		
^^ Productivity from productivity sheets																		
													30.40					38,400.97

	Equipment Cost	Hourly Operating Costs	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Total Equip Cost	Operator's Hourly Wage Rate	Number of Workers or Eq.	Total Operator Cost	Total Eq. & Lab. Costs	Area^	Units	Production Rate ^^	Units	Cost
	1 dozer	1 dozer	1 sheepsfoot roller												
Seed-setting with Sheepsfoot Roller															
Monitor Phase 1 LMU1 dumps	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	5.30	ac	0.83	ac/hr	2,234.07
Monitor Phase 1 LMU2 dumps	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	15.50	ac	0.83	ac/hr	6,533.00
Monitor Phase 1 LMU3 dumps/ mon3 pit backfill	113.07	97.20	21.45	24.75	1.10	282.11	67.75	1	67.75	349.86	9.60	ac	0.83	ac/hr	4,046.62
												ac	0.83	ac/hr	
SOURCES AND NOTES:															
*Equipment cost = Means 01 54 33.20 4360 (dozer, 410 H.P.), Means 01 54 33.20 3150 (sheepsfoot roller, towed, 50 H.P.)															
Based on monthly rental rate/176 hr month & hourly operating cost from R.S.Means 2011, pg 477.															
* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.															
Hourly cost for labor includes wages, worker's comp. and contractor O & P, as per RS Means (2011), pg ix and inside back cover															
^ Area from Materion mine planning data															
^^ Productivity from productivity sheets															
TOTAL											30.40				12,814.29

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Seeding																			23,692.01
	Associated costs of mulching and using a sheepsfoot roller to press seeds into soil are found in the earthwork worksheet																			
	Total																			23,692.01
	ROUNDED TOTAL																			23,700.00

Ref.	Description	Mater-ials	Means Reference Number	Unit Cost*	Unit	Unit Cost*	Unit	Total Equip Cost	Labor Cost	Unit	TOTAL Operating Cost	Length	Width	Prod-uction Rate	units	Area	Volume	Weight	Density	Seed cost^	Unit	Quan-tity (ac)	Unit	TOTAL Cost
	Seeding with D9 and broadcast seeder			Dozer		Seeder		w/ 10% Overhead																
	Monitor 3 pit backfill surface		See below	113.07	97.2	21.45	24.75	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	5.30		2,809.12
	Monitor ore pad		"	113.07	97.2	21.45	24.75	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	22.90		12,137.52
	Dust suppression water assembly			113.07	97.2	21.45	24.75	282.11	67.75	$/hr	349.86			0.83	ac/hr					108.50	$/ac	16.50		8,745.37
	Note: Seed cost obtained from Granite Seed May 2011																							
	Sources and Notes																							
	* All costs on this sheet are based on use of a D9 dozer Means (2011) (01 54 33.20 4360 (pg 480+))																							
	*Cost for range broacast seeder is based on cost to rent/operate a 50 H.P., towed sheepsfoot roller (Means (2011) - 01 54 33.20 3150) as I could not find a separate cost for a broadcast seeder, and these two operations are similar.																							
	Unit cost assumes monthly rental @ 176 operating hours per month, Operatg cost from same line in Means																							
	* Labor hourly cost = Means 2011, page 677, equip. operators, medium equip.																							
	Hourly cost for labor includes wages, worker's comp, and contractor O & P, as per Means (2011), pg ix and inside back cover																							
	* Seed cost obtained from Granite Seed, May 2011																							
	Total																					44.70		23,692.01

Project: Materion-Monitor Pit Ph 1 LMU
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 5
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Dump Top Rounding & Topsoil spreading

Characterization of Dozer Used (type, size, etc.):

Caterpillar D-9; semi - U blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

dozing distance = 70 ft.

Productivity Calculations:

Operator Adjustment Factor = 0.75 (operator factor) x 1.00 (material factor) x 0.83 (efficiency factor) x 1.00 (grade factor) x 1.00 (weight correction factor)

x 1.00 (production method/blade factor) x 1.00 (visibility factor) x 1.00 (elevation factor) = 0.62

Net Hourly Production = 1200 (normal hourly production) LCY/hr x 0.62 (operating adjustment factor) = 747 LCY/hr

Hours Required = (volume to be moved) LCY ÷ 747 (net hourly production) LCY/hr = 0.0 hr(s)

Data Source(s):

Caterpillar Performance Handbook 41st edition

Project: Materion-Monitor Pit Ph 1 LMU
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 6
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE - GRADING

Earthmoving Activity:

Seed Setting with D-9 pulling Dimpler and pulling seeder unit to seed for revegetation

Characterization of Dozer Used (type, size, etc.):

D-9 doer pulling a broadcast seeder (e.g. Truax broadcaster)

D-9 dozer with a cylindrical dimpler

Description of Dozer Use (% grade, effective blade width, operating speed, etc.):

Range broadcast seeder = 10.5 ft wide, 1 mi/hr operating speed, level grade

Dimpler = 11 ft width; 1 mi/hr operating speed; level grade

Productivity Calculations:

Operator Adjustment Factor = 0.75 (operator factor) x 1.00 (material factor) x 0.83 (efficiency factor) x 1.00 (grade factor) x 1.00 (weight correction factor)

x 1.00 (production method/blade factor) x 1.00 (visibility factor) x 1.00 (elevation factor) = 0.62

Hourly Production = 1.0 (average speed) mi/hr x 11.0 (effective blade width) ft x 5280 ft/mi x 1 ac

÷ 43560 ft^2 = 1.3 ac/hr

Net Hourly Production = 1.3 ac/hr x 0.62 (operating adjustment factor) = 0.83 ac/hr

Hours Required = (area to be graded) ac ÷ 0.83 (net hourly production) ac/hr = 0.0 hr(s)

Data Source(s):

Caterpillar Performance Handbook 41st edition

Project: Materion-Monitor Pit Ph1 LMU
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 7
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Ripping of various surfaces in preparation for revegetation

Characterization of Dozer and Ripper Use:

D-9 Caterpillar

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

ripping depth = 2ft. Cut spacing = 10.5 ft. Average cut length = 433 ft.Material to be ripped is general mine waste surface material.

Efficiency = operator (0.75); job efficiency (50 min/hr or 0.83)
(0.75 x 0.83 = 0.623)
2434 BCY/hr converts to 0.75 ac/hr assuming a 2ft ripper depth

Productivity Calculations:

Cycle Time = 433 ft (cut length) ÷ 88 ft/min [speed] + 0.25 min (fixed turn time*) = 5.2 min/pass

Passes/Hour = 60 min/hr ÷ 5.2 min/pass (cycle time) x 0.623 (efficiency factor) = 7.2 passes/hr

Volume Cut/Pass = (2.0 ft (tool penetration) x 10.5 ft (cut spacing) x 433 ft (cut length)) ÷ 27 ft^3/yd^3

= 336.78 BCY/pass

Hourly Production = 336.78 BCY/pass x 7.2 passes/hr = 2434.7 BCY/hr

Hours Required = (bank volume to be ripped**) BCY ÷ 2434.7 (hourly production) BCY/hr = 0.0 hr

Acres per hour =	cut length (ft) x spacing (ft)	4546.5	from above	
	passes per hour	7.2	from above	
	Total area (ft2) covered per hr	32869.1	or 0.75	ac per hour

* Fixed turn time depends upon dozer used. 0.25 min/turn is normal.

** Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to Worksheet 5. Calculate separate dozer hauling of ripped material for each lift on that worksheet.

Data Source(s):

Caterpillar Performance Handbook 41st edition

Project: Materion-Monitor Pit Ph1 LMU
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 11A (1 of 2)
PRODUCTIVITY OF PUSH-PULL OR SELF-LOADING SCRAPER USE

Earthmoving Activity:
Top Soil Replacement and Applying gravel mulch

Characterization of Scraper Used (type, capacity, etc.):
Caterpillar 631 (29 cubic yard capacity, self-propelled)

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
up 4% loaded; average haul distance 4500 ft.
Efficiency = operator (0.75) ; Job efficiency (50 min/hr or 0.83); Load Factor (0.8)
(0.75 x 0.83 x 0.8 = 0.5)

Productivity Calculations:

Cycle Time = 0.9 min (load time) + 2.8 min (loaded) + 0.7 min (maneuver and) + 1.9 min (return trip)

= 6.3 min (push-pull is)

Hourly Production = 29.0 LCY (capacity*) x 60 min/hr ÷ 6.3 min (cycle time**) x 0.50 (efficiency)

= 138.1 LCY/hr (push-pull is)

870
138.0952

Hours Required = LCY (volume to be) ÷ 138.1 LCY/hr (net hourly) = 0.0 hr

* The average of the struck and heaped capacities; use total for two scrapers for push-pull.

Data Source(s):
Caterpillar Performance Handbook 41 st edition

Project: Materion-Monitor Pit Ph1 LMU
Date: 11/10/11
Prepared by: W. W. Fuller

WORKSHEET 11A
PRODUCTIVITY OF PUSH-PULL OR SELF-LOADING SCRAPER USE

Earthmoving Activity:

Waste Rock Capping for Landfill

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 631 (29 cubic yard capacity, self-propelled)

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):

up 4% loaded; average haul distance = 1300 feet

Efficiency = operator (0.75); Job efficiency (50 min/hr or 0.83); Load factor (0.8)
(0.75) x 0.83 x 0.8 = 0.5)

Productivity Calculations:

Cycle Time = 0.9 min (load time (push-pull is per pair)) + 1.0 min (loaded trip time) + 0.7 min (maneuver and spread time) + 0.7 min (return trip time)

= 3.3 min (push-pull is per pair)

Hourly Production = 29.0 LCY (capacity*) x 60 min/hr ÷ 3.3 min (cycle time**) x 0.50 (efficiency factor)

= 263.6 LCY/hr (push-pull is per pair)

Hours Required = _____ LCY (volume to be handled) ÷ 263.6 LCY/hr (net hourly production) = 0.0 hr

* The average of the struck and heaped capacities; use total for two scrapers for push-pull

Data Source(s):
Caterpillar Performance Handbook 41st edition