

Laboratory Analysis.....	600.00	
Total.....		\$1,385.00
Rattlesnake Creek		
Salary.....	735.00	
Transportation.....	50.00	
Laboratory Analysis.....	990.00	
Total.....		\$1,923.00
One half costs covered by Mountain Water Co.....		[961.00]
Total.....		\$2,346.00

Monitor item: 4-3

Activity, Practice, or Effects to be Measured: Monitor the effect of soil disturbance/ displacement on land productivity

Applicable M.A.'s: 1, 4, 5, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 20a, 21, 22, 23, 24, 25, 27

Reporting Period: Annual

Variability which would initiate further evaluation: Soil loss or compaction that reduce productivity more than 20%, or areas that are left with less than 15 tons of well distributed slash greater than 3 inches.

#1

A. Of the 12 units reviewed to determined if compaction or displacement had occurred 3 had been affected to the extent that the land productivity was reduced more than 20 percent and would stay in this condition for an extended period of time.

B. Of the tractor units visited 90 percent did not have the minimum residual slash left on site to meet the forest plan guidelines.

#2

A. In 2 of the 3 units, 35 and 50 percent of the areas involved were severely compacted. Research suggests that this kind of compaction can increase mortality and reduce height growth. In the other unit severe displacement occurred on a non-waterbarred skid trail. This situation is presently causing not only site productivity loss but road maintenance problems and sediment problems.

B. Research has very little data on the subject but what data is available shows a drop in productivity if the minimums are not met.

FOREST PLAN  
MONITORING REPORT  
SOIL PROD.  
ITEM 4-3  
1987-2001

FY 87 3/17/87

#3

A. In the 2 units that were severely compacted piling too early in the spring was the cause and this practice has been curtailed. In connection with the displacement no trend is noted.

2

B. Residual material left on site is a concern and a Forest Service Committee has been formed to look into the problem.

#4

A. This is approximately 50 percent of the tractor units done in 1986.

B. This is approximately 20 percent of all units done on the forest in 1986.

#5

A. The 3 units did not meet Forest Plan Guidelines.

B. The lack of residuals does not meet Forest Plan Guidelines.

#6

None

#7

A. Implement direction to eliminate early spring piling activities.

B. Implement the proposals of the Forest Committee.

#8

\$660

Monitor item:

5-1

Activity, Practice, or  
Effects to be Measured:

Limit off-road vehicle damage

Applicable M.A.'s:

All, but 12

Reporting Period:

2 years

Variability which would  
initiate further evaluation:

When use conflicts with management goals of  
the area

#1

Blue Mountain area was reviewed because of the present activity of the off-roaders. This area is receiving resource damage in areas that do not allow vehicle traffic.

#2

Rutting is occurring, erosion and a poorer visual quality.

F487

3/17/87

Monitor item:

4-3

Activity, Practice, or  
Effects to be Measured:

Monitor the effect of soil disturbance/  
displacement on land productivity

Applicable M.A.'s:

1, 4, 5, 7, 8, 9, 13, 14, 15, 16, 17, 18,  
19, 20, 20a, 21, 22, 23, 24, 25, 27

Reporting Period:

Annual

Variability which would  
initiate further evaluation:

Soil loss or compaction that reduce  
productivity more than 20%, or areas that are  
left with less than 15 tons of well  
distributed slash greater than 3 inches.

#1

A. Of the 14 units reviewed to determine if compaction or displacement had occurred 2 had been affected to the extent that the land productivity was reduced more than 20 percent and would stay in this condition for an extended period of time.

B. Of the tractor units visited 40 percent did not have the minimum residual slash left on site to meet the forest plan guidelines.

#2

A. In the 2 units, approximately 50 percent of the areas involved were severely compacted. Research suggests that this kind of compaction can increase mortality and reduce height growth.

B. Research has very little data on the subject but what data is available shows a drop in productivity if the minimums are not met.

#3

A. The 2 units did not meet Forest Plan Guidelines.

B. The lack of residuals does not meet Forest Plan Guidelines. The trend seems to be that the Forest is getting these problems under control and are moving to eliminate them.

#4

A. This is approximately 50 percent of the tractor units done in 1986.

B. This is approximately 20 percent of all units done on the forest in 1986.

#5

A. The 2 units did not meet Forest Plan Guidelines.

B. The lack of residuals does not meet Forest Plan Guidelines.

#6

None

FY87 10/2/87

#7

A. Implement direction to eliminate early spring piling activities.

B. Implement the proposals of the Forest Committee.

#8

\$750

Monitor item:

5-1

Activity, Practice, or  
Effects to be Measured:

Limit off-road vehicle damage

Applicable M.A.'s:

All, but 12

Reporting Period:

2 years

Variability which would  
initiate further evaluation:

When use conflicts with management goals of  
the area

#1

Blue Mountain area was reviewed because of the present activity of the off-roaders. This area is receiving resource damage in areas that do not allow vehicle traffic.

#2

Rutting is occurring, erosion and a poorer visual quality.

#3

Most of the effort has been concentrated on Blue Mtn. Need continued effort at seeking solutions.

#4

100 percent of concern area.

#5

????????

#6

None

#7

Areas with problems need to make it more difficult to gain vehicle access, need more patrolling and stronger penalties for those who will not abide.

#8

\$660

FY 87

10/7/87

above normal runoff year. Two additional stations are planned for installation in the spring of 1990.

Budget for Water Monitoring

Water Quality Studies

Benchmark and Project Watersheds

Total (See Item 4-1) ..... \$16,107.00

BPA - Randolph Creek

Salary.....\$1,680.00  
Transportation..... 760.00  
Supplies..... 6,600.00  
Data Analysis..... 1,360.00

Total.....\$10,398.00

GRAND TOTAL (Includes Item 4-1) .....\$26,505.00

-----X-----

Monitoring item: 4-3

Activity, Practice, or Effects to be Measured: Monitor the effect of soil disturbance/displacement on land productivity

Applicable M.A.'s: 1, 4, 5, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 20a, 21, 22, 23, 24, 25, 27

Reporting Period: Annual

Variability which would initiate further evaluation: Movement or compaction of soils reducing productivity more than 20%[, or areas that are left with less than 10 tons of well distributed slash greater than 3 inches. (This criterion is not in the Forest Plan.)]

Compaction: Of the units reviewed in 1989 to determine if compaction or displacement had occurred, none showed effects that were equal to or greater than 20 percent. 1989 was a somewhat dry year and, with the dry weather of the previous years, soil moistures have not recovered. Consequently, the risk of compaction has been very low. Also, better seasonal restrictions are being used for ground-based equipment.

INDIVIDUAL MONITORING ITEM REPORTS  
Fiscal Year 1989

It has been noted that the riparian areas with cattle allotments are showing extensive compaction problems on the wetter soil types. This situation exists in almost all areas that can be gotten to by cattle. This compaction is reducing the productivity of these riparian areas greater than 20 percent and therefore is outside of the Forest Plan Direction. This is a continuing problem and a difficult one to resolve. The Forest should continue to place importance on this situation.

Slash Retention: Of the tractor units reviewed in 1989, 43 percent did not have the minimal residual slash (10 tons) left on site to meet the amount recommended by research (9 out of 22 units observed on 18 sales). All districts had at least one unit that did not meet minimum amounts of biomass retained. However, the 43 percent represents a somewhat biased sample because the units observed were often pre-identified as having a questionable amount of residual slash. Residual slash is a continuing problem and emphasis should be placed on correcting the problem. The present research data show that not meeting minimum levels will reduce soil productivity.

Cost of this item was \$1,500.

-----X-----

Monitoring item:	5-1
Activity, Practice, or Effects to be Measured:	Limit off-road vehicle damage.
Applicable M.A.'s:	All
Reporting Period:	2 years
Variability which would initiate further evaluation:	When use conflicts with management goals of area.

The reporting interval for this item is two years. The item was last reported in the FY87 monitoring report. That year's report identified Blue Mountain as a problem area. Since that report, several sections of new fence have been constructed. Tree and shrub planting and grass seeding have also been accomplished to restore impacted areas. Co-op law enforcement patrols with the county have been increased, but ORV traffic continues to create problems, especially in the winter.

Another major area of damage on the Missoula District is at the confluence of Plant Creek with Miller Creek (approximately 13 miles up Miller Creek). The riparian area is sustaining vehicle damage. Some streamside areas in Graves Creek are also being impacted.

-----X-----

## MONITORING ITEM 4-3

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20% [or acres that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (this measure is not in the Forest Plan)].

Compaction - Of the units reviewed in 1990 (7 on Missoula RD, 5 on Ninemile RD, 8 on Plains/Thompson Falls RD, 4 on Seeley Lake RD, and 3 on Superior RD) to determine if compaction or displacement had occurred, only one showed effects that were equal to or greater than 20 percent over a natural condition. This would suggest that less than 4 percent of all units are having difficulty meeting the minimum standard set forth in the Forest Plan. 1990 was also a somewhat dry year and with the dry weather of the previous years the soils moistures have not recovered and the risk of compaction has been very low. Better seasonal restrictions that are being used for ground-based equipment have also helped.

Machinery is not the only source of soil compaction. Compaction can also occur from cattle trampling on sensitive, wet soils. It should be noted that the riparian areas with cattle grazing continue to show extensive compaction problems on the wetter areas. During the summer of 1990 several allotments implemented new grazing plans which have shown some improvement, but it is too soon to determine if this will allow for an upward trend in these sensitive areas. This situation exists in almost all other areas that can be gotten to by cattle. This compaction is reducing the productivity of these riparian areas greater than 20 percent and therefore is outside of the allowed Forest Plan variability. This is a continuing problem and a difficult one to easily resolve. The Forest should continue to place importance on this situation plus monitor those areas where management has changed to determine the effectiveness of these changes. This paragraph has an important link to Forest Plan monitoring item: 6-2 and should also be considered when dealing with the overall management of Range.

Slash Retention - Of the units reviewed in 1990, approximately 53 percent did not have the minimal residual slash (10 tons) left on site to meet the amount recommended by research. This was 20 out of 38 units observed. These units were visited during Timber Sale Reviews, specific units that the Soil Scientist was asked to visit, and occasional units that were visited during trips around the Forest for other reasons. THIS IS AGAIN A CONTINUING PROBLEM and emphasis should be placed on this item to try and correct this situation. The present research data (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will drop Soil Productivity. All districts continue to have units that do not meet minimum amounts of biomass retained. Often the problem seemed to be contractual and when it was not in the contract in an enforceable manner the administrator couldn't get it done.

One other important factor in this situation and that the Forest understanding is typically lacking on all levels.

Cost of this item was \$3,100.

## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20% <i>[or acres that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (this measure is not in the Forest Plan)]</i> .

**Evaluation:** We continue to have problems meeting soil productivity standards. We're seeing improvement in recent activities. The problems we're finding are soil compaction due to machinery on some timber harvest units, soil compaction due to livestock grazing in riparian areas, and lack of adequate slash (woody debris) retention in some timber harvest units. We will continue to monitor and strive to improve management practices.

### Results:

**Compaction:** Of the 32 timber harvest units reviewed in 1991 to determine if compaction or displacement had occurred (5 on Missoula RD, 5 on Ninemile RD, 11 on Plains/Thompson Falls RD, 6 on Seeley Lake RD, and 5 on Superior RD), only four showed effects that were equal to or greater than 20 percent over a natural condition. This suggests that 12.5 percent of all units are having difficulty meeting the minimum standard set forth in the Forest Plan. Precipitation was above average in 1991. Soil moistures recovered somewhat from the recent drought and the risk of compaction increased over previous years. Better seasonal restrictions used for ground-based equipment along with increased levels of slash retention are improving our ability to avoid soil compaction.

Machinery is not the only source of soil compaction. Compaction can also be caused by cattle trampling on sensitive, wet soils. Riparian areas with cattle grazing continue to show extensive compaction problems. New grazing plans were implemented on several allotments in 1990. In the summer of 1991, several of these allotments were visited to determine how the new plans were working out and to see if additional mitigation was needed. Some of these allotments have shown some improvement, but it is too soon to determine if we have a sustained upward trend in the more sensitive areas. If grazing continues on those sites they will not begin recovery. Even if grazing is eliminated from sensitive sites, recovery will still take many years due to the extensive past impacts. This situation exists in almost all riparian areas that have been grazed. The compaction that is associated with this heavy grazing is reducing the productivity of these riparian sites greater than 20 percent, and therefore is outside of the allowed Forest Plan variability.

The 1991 reviews show that heavy grazing has changed species composition on many riparian sites. This heavy grazing has deepened channels, causing water tables to drop. Compaction, over utilization on sensitive species, microsite change from water table changes, and crown damage are all factors in change in species composition. Palatable native shrub species such as willow, red-osier dogwood, and maple are being hedged severely or are gone entirely from sites, replaced by nonpalatable shrub species like alder, hawthorne, and snowberry. In grazed areas where the water table has lowered, non-native species such as bluegrass, knapweed, mullan, houndstounge, and sulfur cinquefoil are becoming dominant. In riparian areas



### Water and Soil Item 4-3

where cattle grazing has not occurred, these non-native species often do not dominate the native flora. These grazing issues are being addressed in revisions of allotment management plans (see Item 6-2).

**Slash Retention:** Of the timber harvest units reviewed in 1991, 17 percent (nine out of 53 sampled units) did not have the minimal residual slash (10 tons per acre, recommended by research). These units were visited during Timber Sale Reviews (listed in Item 3-1), specific units that the Soil Scientist was asked to visit, and occasional units that were visited during trips around the Forest for other reasons. This item has shown a marked improvement over the past years. This is in part due to past emphasis given to this situation and new sale clauses that are being used. The current research (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will reduce soil productivity. All districts continue to have a few units that do not meet minimum amounts of biomass retained, but all districts have also shown excellent improvement recently.

## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20% <i>[or acres that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (this measure is not in the Forest Plan)]</i> .

**Evaluation:** Although we continue to have some problems meeting soil productivity standards, we are seeing improvement in recent activities. The problems are soil compaction due to machinery on some timber harvest units, soil compaction due to livestock grazing in riparian areas, and lack of adequate slash (woody debris) retention in some timber harvest units. We will continue to monitor and strive to improve management practices.

### Results:

**Compaction:** Of the 34 timber harvest units reviewed in 1992 to determine if compaction or displacement had occurred (3 on Missoula RD, 3 on Ninemile RD, 12 on Plains/Thompson Falls RD, 7 on Seeley Lake RD, and 9 on Superior RD), only two showed effects that were equal to or greater than 20 percent over a natural condition. This suggests that 6 percent of all units are having difficulty meeting the minimum standard set forth in the Forest Plan. Precipitation was below average in 1992. Soil moistures remained dry for long periods and the risk of compaction was greatly decreased over previous years. Better seasonal restrictions used for ground-based equipment along with increased levels of slash retention are improving our ability to avoid soil compaction.

Machinery is not the only source of soil compaction. Compaction can also be caused by cattle trampling on sensitive, wet soils. Riparian areas with cattle grazing continue to show extensive compaction problems. New grazing plans were implemented on several allotments in 1990. In the summer of 1992, several of these allotments were revisited to determine how the new plans were working out and to see if additional mitigation was needed. Some of these allotments have shown some improvement, but it is too soon to determine if we have a sustained upward trend in the more sensitive areas. If grazing continues on those sites they will not begin recovery. Even if grazing is eliminated from sensitive sites, recovery will still take many years due to the extensive past impacts. This situation exists in almost all riparian areas that have been grazed. The compaction that is associated with this heavy grazing is reducing the productivity of these riparian sites greater than 20 percent, and therefore is outside of the allowed Forest Plan variability.

The 1992 reviews show that heavy grazing has changed species composition on many riparian sites. This heavy grazing has deepened channels, causing water tables to drop. Compaction, over utilization on sensitive species, microsite change from water table changes, and crown damage are all factors in change in species composition. Palatable native shrub species such as willow, red-osier dogwood, and maple are being hedged severely or are gone entirely from sites, replaced by nonpalatable shrub species like alder, hawthorne, and snowberry. In grazed areas where the water table has lowered, non-native species such as bluegrass, knapweed, mullan, houndstounge, and sulfur cinquefoil are becoming dominant. In riparian areas

### Water and Soil Item 4-3

where cattle grazing has not occurred, these non-native species do not usually dominate the native flora. These grazing issues are being addressed in revisions of allotment management plans (see Item 6-2).

**Slash Retention:** Of the timber harvest units reviewed in 1992, 24 percent (8 out of 34 sampled units) did not have the minimal residual slash (10 tons per acre, recommended by research). These units were visited during Timber Sale Reviews (listed in Item 3-1), specific units that the Soil Scientist was asked to visit, and occasional units that were visited during trips around the Forest for other reasons. This item has shown a marked improvement over the past years but showed a slight increase in 1992. The improvement is in part due to past emphasis given to this situation and new sale clauses that are being used. However, these new clauses need better administration by sale administrators and contracting officer's representatives. The current research (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will reduce soil productivity. This situation does not meet Forest Plan Standards. All districts continue to have some units that do not meet minimum amounts of biomass retained.

## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20%. Areas that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (which reduces soil productivity.

**Evaluation:** Although we continue to have some problems meeting soil productivity standards, we are seeing improvement in recent activities. The problems are soil compaction due to machinery on some timber harvest units, soil compaction due to livestock grazing in riparian areas, and lack of adequate slash (woody debris) retention in some timber harvest units. We will continue to monitor and strive to improve management practices.

**Results:**

**Compaction:** Of the units reviewed in 1993 (5 on D3, 2 on D4, 11 on D5, 4 on D6 and 5 on D7), none showed effects from compaction that were greater than 20 percent over the natural condition. Therefore, all units reviewed were within Forest Plan Monitoring Standards. This would suggest that the Forest continues to work hard at meeting the minimum standard set forth in the Forest Plan and that the equipment and practices used to reduce the compaction are working. 1993 received a higher than average amount of precipitation than previous years. The soil moistures remained high for long periods during the year and the risk of compaction was greater than previous years. Better seasonal restrictions that are being used for ground-based equipment continue to help plus the higher amounts of slash left on the units also provide protection. Additionally, the use of new types of equipment also provide for protection.

Machinery is not the only source of soil compaction. Compaction can also occur from cattle trampling on sensitive, wet riparian soils. It should be noted that the riparian areas with cattle grazing continue to show extensive compaction problems. During the past 5 years, a good number of allotments implemented new grazing plans. In the past several years, these allotments were revisited to determine how these new plans were working out and to see if additional mitigation was needed. Some of these allotments have shown some improvement but it continues to be too soon to determine if this will allow for an upward trend in the more sensitive areas. These reviews pointed out that this continued, heavy grazing has changed the riparian species composition of many sites. With this continual grazing, these sites will not begin recovery.

If grazing is eliminated recovery will still take decades due to the extensive abust that has occurred in the past. This situation exists in almost all sites that have heavy cattle usage. The compaction that is associated with this heavy grazing is reducing the productivity of these riparian sites greater than 20 percent and therefore is outside of the allowed Forest Plan variability. Additionally, this heavy useage has greatly affected the shrub component and the water tables. By so greatly affecting the natural vegetation has allowed for extremely severe noxious weed invasion.

During the 1993 field reviews the observation that plant composition has been drastically changed became very evident and this due to the extremely heavy grazing. This heavy grazing has deepened the channels

which caused watertables to drop. Additionally, compaction, over utilization on sensitive species, microsite change from watertable changes and crown damage has added to the change in species composition. Palatable native shrub species such as willow, redosier dogwood and maple are being hedged severely or are gone entirely from sites and are being replaced with nonpalatable shrub species like alder, hawthorne and snowberry. In grazed areas where the watertable has been changed non-native species such as bluegrass, knapweed, mullan, hound's tounge and sulfur cinquefol are becoming the dominant types. It is important to note that in areas where cattle grazing has not occurred, these non-native species do not occur. In order to meet the Forest Plan Standards the Forest will need to continue to place importance on this situation plus monitor those areas where management has changed, to determine the effectiveness of these changes. This paragraph has an important link to Forest Plan monitoring item: 6-2 and should also be considered when dealing with the overall management of Range.

**Slash Retention:** Of the units reviewed in 1993, approximately 19 percent did not have the minimal residual slash (10 tons) left on site in a well distributed manner to meet the amount recommended by research. This was 5 out of 27 units observed. These units were visited during Timber Sale Reviews, specific units that the Soil Scientist was asked to visit and occasional units that were visited during trips around the Forest for other reasons. This item has shown a marked improvement over 1992. This is in part due to a lack of concern by the Forest to this situation, New sale clauses exist to deal with this situation but need to be enforced by administrators and COR's. The present research data (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will drop Soil Productivity. This situation does not meet Forest Plan Standards. All districts continue to have a few units that do not meet minimum amounts of biomass retained.

Cost of this item was \$3,200.

## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20%. Areas that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (which reduces soil productivity).

**Evaluation:** Although we continue to have some problems meeting soil productivity standards, we are seeing improvement in recent activities. The problems are soil compaction due to machinery on some timber harvest units, soil compaction due to livestock grazing in riparian areas, and lack of adequate slash (woody debris) retention in some timber harvest units. We will continue to monitor and strive to improve management practices.

**Results:**

**Compaction:** Because of the Columbia River Basin study activity in 1994 and the severe fire season, the number of units monitored in 1994 was substantially reduced. Of the units reviewed in 1994, ( 1 on Missoula District, 6 on Plains/ Thompson Falls District, 3 on Superior District), none showed effects from compaction that were greater than 20 percent over the natural condition. Therefore, all units reviewed were within Forest Plan Monitoring Standards. This would suggest that the Forest is working hard to meet the minimum standard set forth in the Forest Plan, and that the equipment and practices used to reduce compaction are working. Precipitation received in 1994 was below average and soil moistures were severely reduced in the early spring. Soil moisture had not returned to normal by December of 1994. This helped protect soils from equipment damage. The Forest continues to improve seasonal restrictions for ground based equipment plus the higher quantities of slash left on the units also provides added protection. New types of equipment promise to have less impact as well.

Machinery is not the only source of soil compaction. Compaction can also occur from cattle trampling on sensitive, wet riparian soils. It should be noted that the riparian areas with cattle grazing continue to show extensive compaction problems. During the past 6 years, a good number of allotments implemented new grazing plans. In the past several years, these allotments were revisited to determine how these new plans were working out and to see if additional mitigation was needed. Some of these allotments have shown some improvement but it continues to be too soon to determine if this will allow for an upward trend in the more sensitive areas. These reviews pointed out that this continued, heavy grazing has changed the riparian species composition of many sites. With this continual grazing, these sites will not begin recovery.

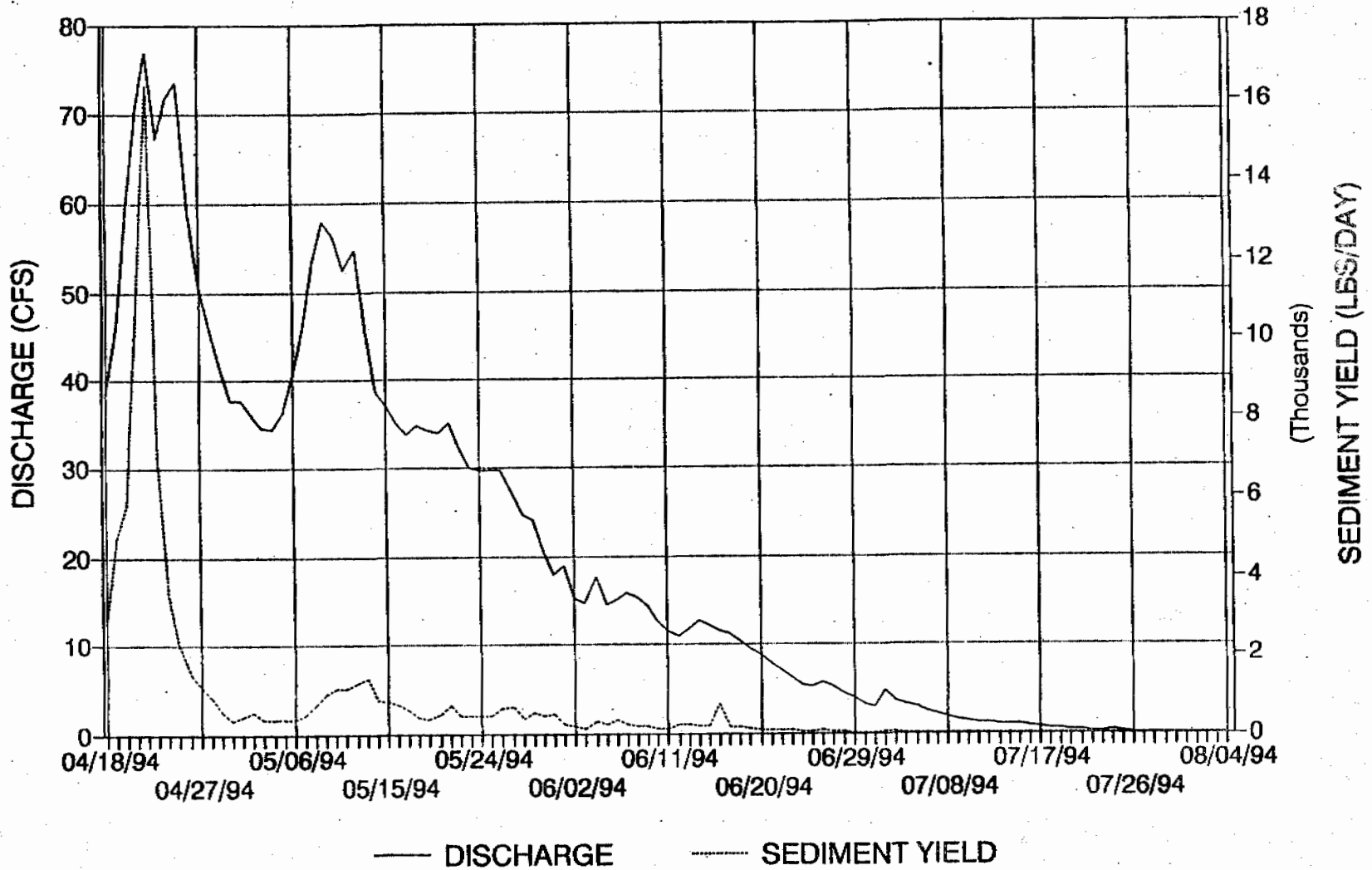
Even if grazing were to be eliminated, recovery would still take decades due to the extensive abuse that has occurred in the past. This situation exists in almost all sites that have heavy cattle use. The compaction that is associated with this heavy grazing is reducing the productivity of these riparian sites greater than 20 percent and therefore is outside of the allowed Forest Plan variability. Additionally, this heavy use has greatly affected the shrub component and the water tables. This in turn has allowed for severe noxious weed invasion.

During the 1994 field reviews, plant composition was observed to have changed due to grazing. Heavy grazing has deepened the channels which causes watertables to drop. This was evident in the South Fork/East Fork Allotment, the Little Thompson Allotment, and the Hinchwood Area. Additionally, compaction, over-utilization on sensitive species, microsite change from watertable changes and crown damage has added to the change in species composition. Palatable native shrub species such as willow, redosier dogwood and maple are being hedged severely or are gone entirely from sites and are being replaced with nonpalatable shrub species like alder, hawthorne and snowberry. In grazed areas where the watertable has been changed non-native species such as bluegrass, knapweed, mullan, hound's tongue and sulfur cinquefoil are becoming the dominant types. It is important to note that in areas where cattle grazing has not occurred, these non-native species do not occur. In order to meet the Forest Plan Standards, the Forest will need to continue to emphasize the importance of this situation plus monitor areas where management has changed and to determine the effectiveness of these changes. This paragraph has an important link to Forest Plan monitoring item: 6-2 and should also be considered when dealing with the overall management of Range.

**Slash Retention:** Of the units reviewed in 1994, approximately 20 percent did not have the minimal residual slash (10 tons) left on site in a well distributed manner to meet the amount recommended by research and the Forest Plan guidelines. This was 2 out of 10 units observed. These units were visited during Timber Sale Reviews, specific units that the Soil Scientist was asked to visit and occasional units that were visited during trips around the Forest for other reasons. This item, although improved over 1992, has shown no specific trend upward. This may be due to a lack of understanding or attention in silvicultural and fire prescriptions. New sale clauses exist to deal with these issues and have the potential to improve the situation if enforced by sale administrators and contracting officers. The present research data shows that not meeting minimum levels of biomass retention will drop soil productivity. This situation does not meet Forest Plan standards. Districts visited continue to have a few units that do not meet minimum amounts of biomass retention.

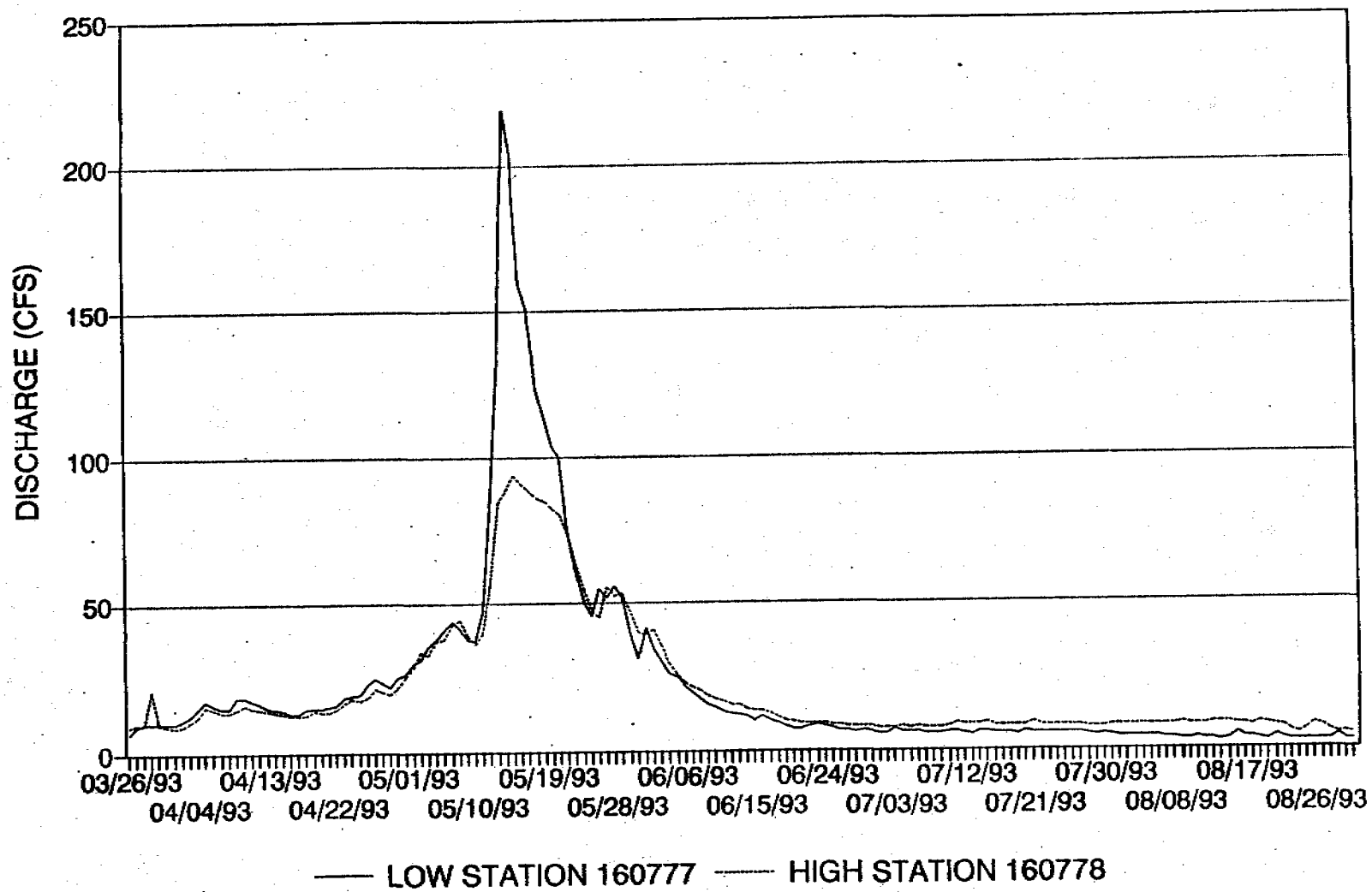
Cost of this item was \$2,100.

# 160777 LITTLE JOE CREEK 1994 SEDIMENT YIELD VS DISCHARGE

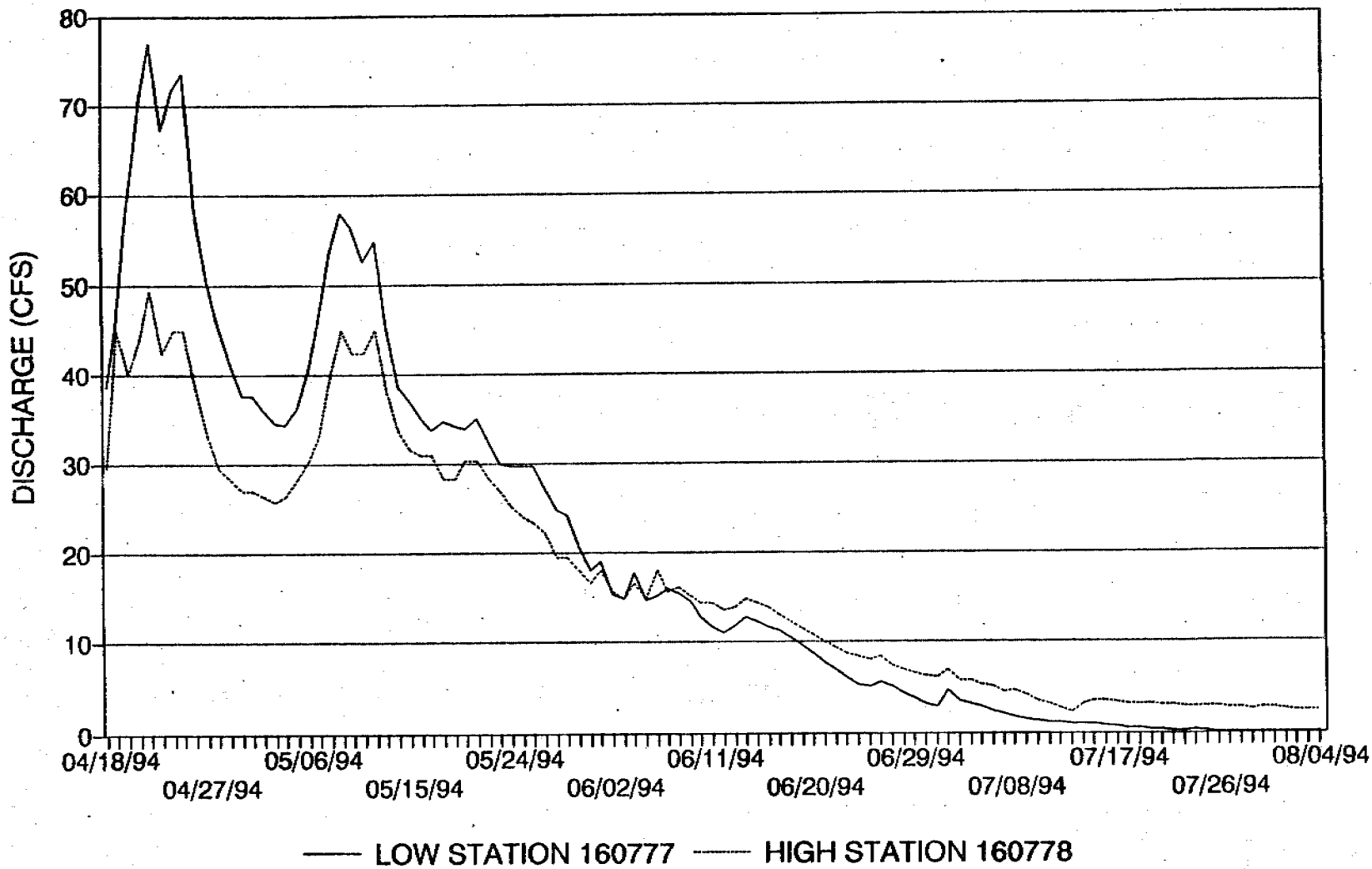




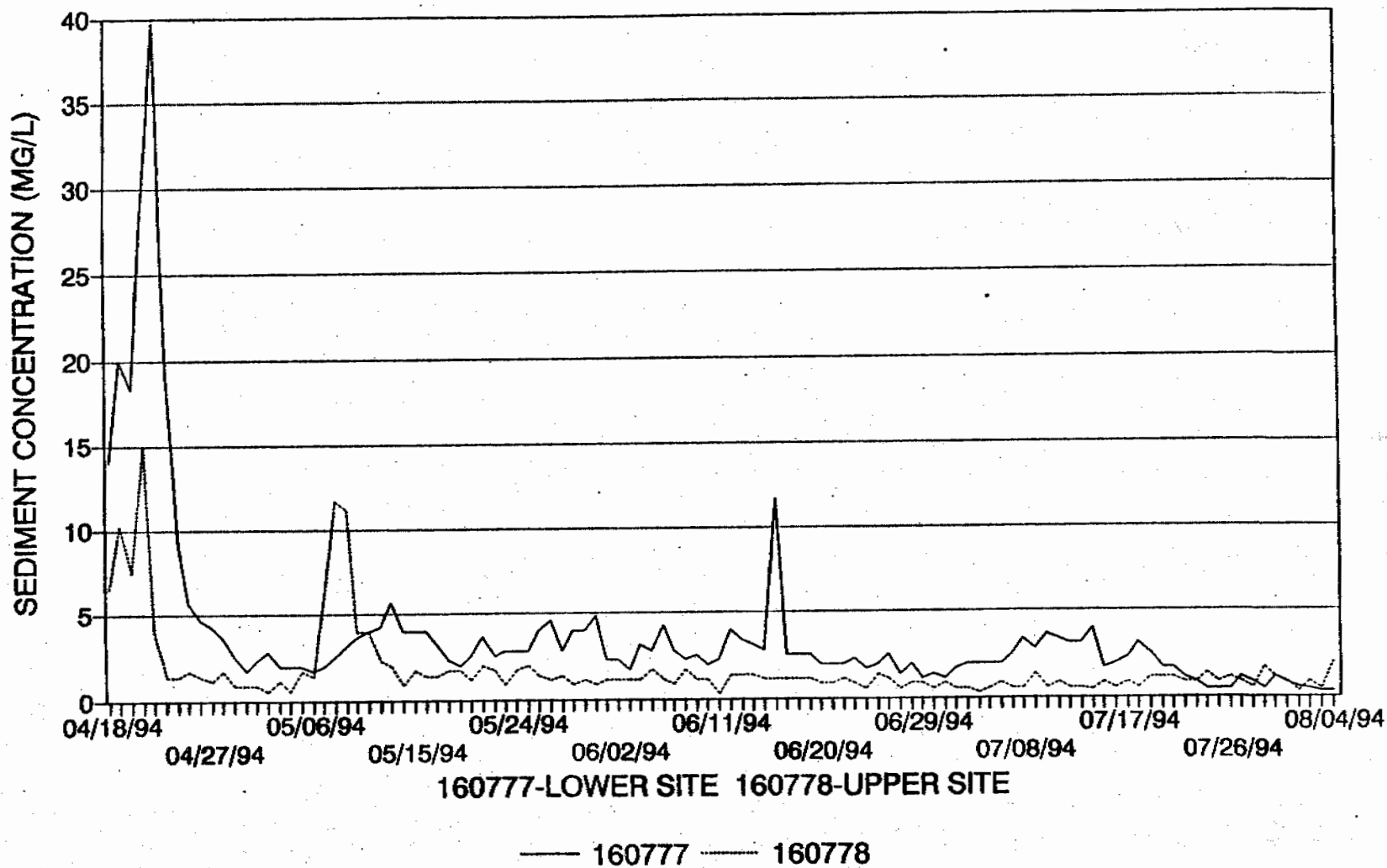
# 160777--160778 LITTLE JOE CREEK 1993 HYDROGRAPH



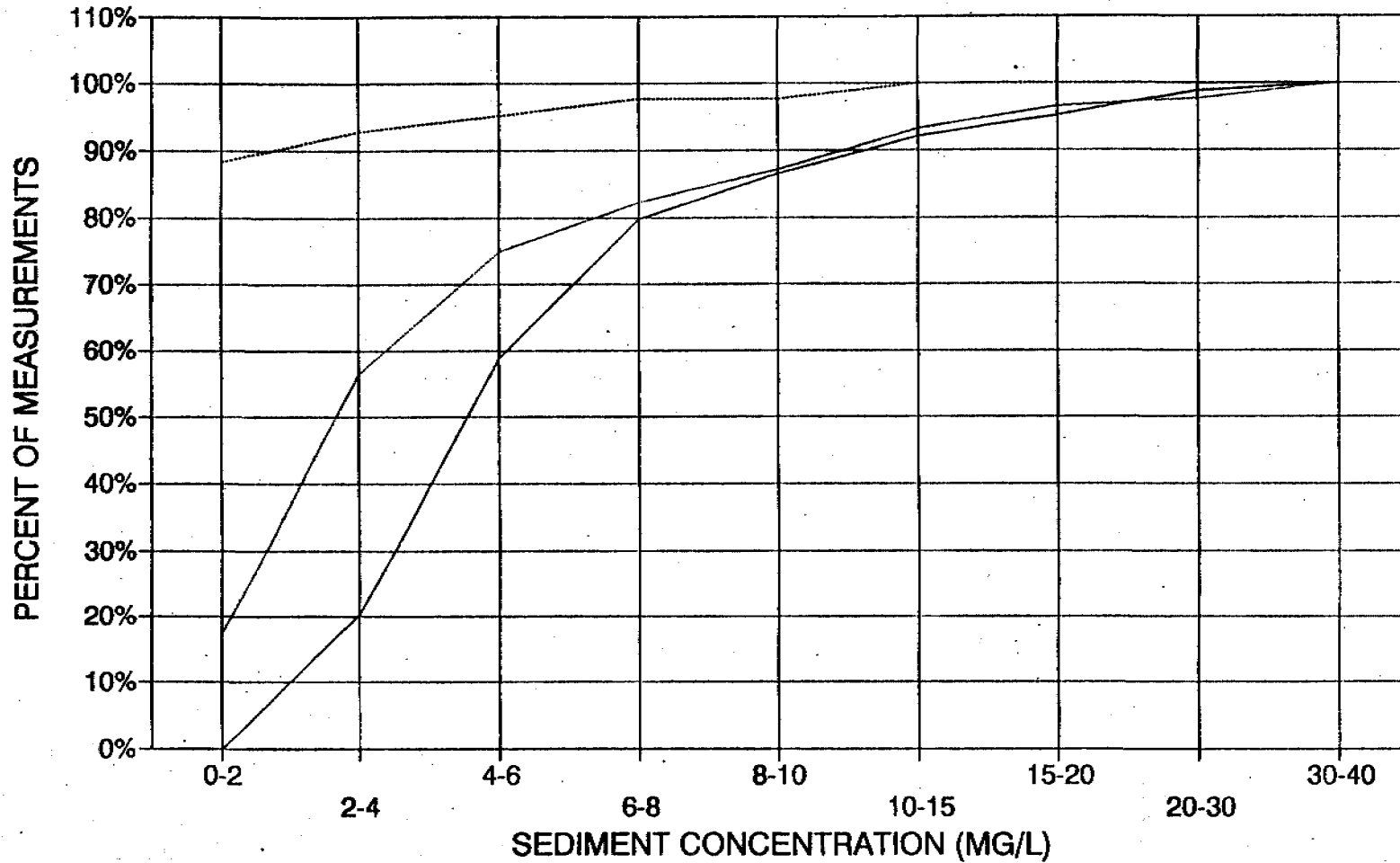
# 160777--160778 LITTLE JOE CREEK 1994 HYDROGRAPH



# 160777--160778 LITTLE JOE CREEK 1994 SEDIMENT CONCENTRATIONS



# SEDIMENT CONCENTRATION @ SELECTED SITES 1994 RANGE OF SEDIMENT CONCENTRATIONS



— ROCK CREEK AT USGS — N.FORK BLACKFOOT — UPPER LITTLE JOE

# 160778 LITTLE JOE CREEK 1994 SEDIMENT YIELD VS DISCHARGE

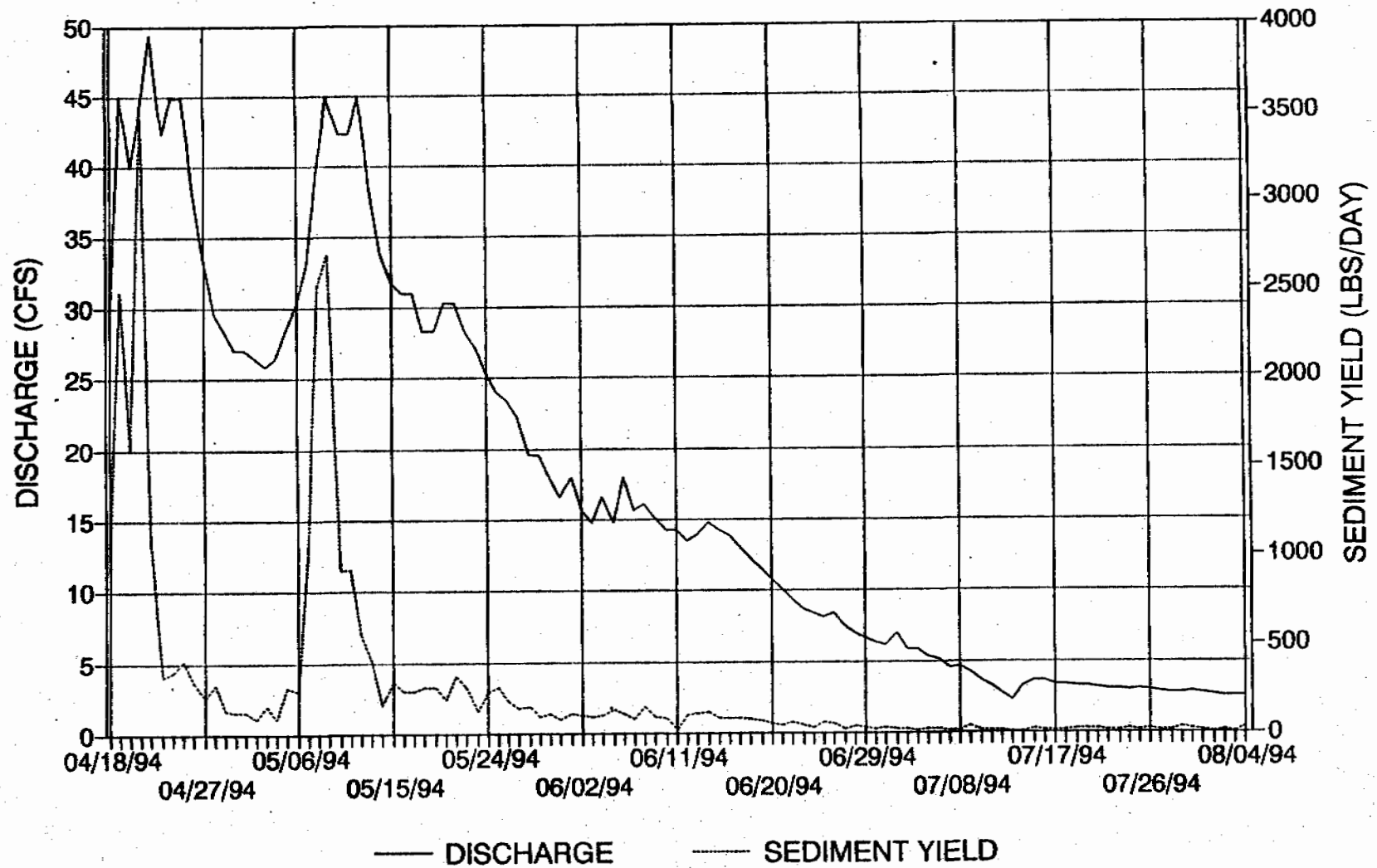


Table I

Comparison of 1993 and 1994 sediment yield, water yield, and sediment load at 160777 and 160778.

LOWER LITTLE JOE 160777	1993	1994
WATER YIELD (AC/FT)	6336	4423
SEDIMENT YIELD	157139	83955
SEDIMENT LOAD	10770	5754

UPPER LITTLE JOE 160778	1993	1994
WATER YIELD (AC/FT)	5512	3796
SEDIMENT YIELD	134261	28209
SEDIMENT LOAD	29969	6297

## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20%. Areas that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (which reduces soil productivity).

**Evaluation:** Although we continue to have some problems meeting soil productivity standards, we are seeing improvement in recent activities. The problems are soil compaction from machinery on some timber harvest units, soil compaction from livestock grazing in riparian areas, and lack of adequate slash (woody debris) retention in some timber harvest units. We will continue to monitor and strive to improve management practices.

### Results:

**Compaction:** In 1995 the Forest Watershed Staff monitored 10 sites (2 per District). Of the units that were reviewed, none showed effects from compaction that were greater than 20 percent over the natural condition. Therefore, all units reviewed were within Forest Plan Monitoring Standards. This would suggest that the Forest continues to work hard at meeting the minimum standard set forth in the Forest Plan and that the equipment and practices used to reduce the compaction are working. In 1995, the Forest received a more normal amount of precipitation. Soil moisture amounts stayed at field capacity generally all year and went into the winter with saturated soil conditions. The Forest continues to use better seasonal restrictions for ground-based equipment plus the higher amounts of slash left on the units also provide protection. Additionally, the use of new types of equipment also provide for protection, especially, site preparation where grapple piling is better protecting the soils.

Machinery is not the only source of soil compaction. Compaction can also occur from cattle trampling on sensitive, wet riparian soils. Many riparian areas with cattle grazing continue to show extensive compaction problems. During the past several years, a good number of allotments implemented new grazing plans. In the past 5 years, these allotments were revisited to determine how these new plans were working out and to see if additional mitigation was needed. Some allotments have shown some improvement but it is too soon to determine if this will allow for an upward trend in the more sensitive areas. Continued heavy grazing has changed the riparian species composition of many sites. With this continual grazing, these sites will not begin recovery.

Without grazing, recovery would take many years. This situation exists in almost all riparian sites that have heavy cattle usage. The compaction that is associated with this heavy grazing is reducing the productivity of these riparian sites greater than 20 percent and is outside of the allowed Forest Plan variability. This heavy use also affects the shrub component and the water tables. In places, this has allowed for severe noxious weed invasion.

The 1995 field reviews supported the observation that plant composition has been altered because of heavy grazing. This was seen in the South Fork/East Fork Allotment, the Little Thompson Allotment and the

### **Water and Soil Item 4-3**

Hinchwood Area. In riparian areas of these allotments the heavy grazing has deepened stream channels, causing watertables to drop. Additionally, compaction, over utilization of sensitive species, microsite change from watertable changes and crown damage has added to the change in species composition. Palatable native shrub species such as willow, redosier dogwood and maple are being hedged severely or are gone entirely from sites and are being replaced with nonpalatable shrub species like alder, hawthorne and snowberry. In grazed areas where the water table has changed, non-native species such as bluegrass, knapweed, mullin, hound's tongue and sulfur cinquefoil are becoming the dominant types. It is important to note that in areas where cattle grazing has not occurred, these non-native species are less frequent. In order to meet the Forest Plan Standards, the Forest will need to continue to place importance on this situation plus monitor those areas where management has changed, to determine the effectiveness of these changes. (See 6-2)

**Slash Retention:** The Forest continues to struggle with the amount of woody debris left on harvest sites. Presently, 80 % of the units have the minimal residual slash (10 tons) left on-site in a well distributed manner, as recommended by research and the Forest Plan guidelines. These units were specific units that the Soil Scientist visited and occasional units that were visited during trips around the Forest for other reasons. This item continues to show no clear trend and is up and down annually. There may need to be further awareness and commitment by the Forest silviculturists and fire people to this situation. New sale clauses exist to deal with this situation but need to be enforced by administrators and COR's. The present research data (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will drop Soil Productivity. The current situation does not meet Forest Plan Standards on 20% of sampled units. All Districts visited continue to have a few units that do not meet minimum amounts of biomass retained, with some having more difficulty than others.



## ITEM 4-3 Soil Productivity

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitoring the effect of soil disturbance/displacement and slash retention on land productivity	Annual	Movement or compaction of soils reducing initiate productivity more than 20%. Areas that are left less than 10 tons of well distributed slash greater than 3 inches in diameter (which reduces soil productivity).

**Evaluation:** Although we continue to have some problems meeting soil productivity standards, we are seeing improvement in recent activities. Problems of soil compaction from machinery on some timber harvest units and lack of adequate slash (woody debris) retention are diminishing. Soil compaction from livestock grazing in riparian areas continues to be a difficulty. We will continue to monitor and strive to improve management practices.

### Results:

**Compaction: Harvest sites** - In 1996, the Forest Watershed Staff monitored 12 sites (2 per District and 2 State BMP Audits). Of the units that were reviewed, none showed effects from compaction that were greater than 20 percent over the natural condition. Therefore, all units reviewed were within Forest Plan Monitoring Standards. This would suggest that the Forest continues to work hard at meeting the minimum standard set forth in the Forest Plan and that the equipment and practices used to reduce the compaction are working. In 1996, the Forest received a more normal amount of precipitation. Soil moisture amounts stayed at field capacity generally all year and went into the winter with saturated soil conditions. The Forest continues to use better seasonal restrictions for ground-based equipment plus the higher amounts of slash left on the units also provide protection. Additionally, the use of new types of equipment also provide for protection, especially, site preparation where grapple piling is better protecting the soils.

**Grazing sites** - The more problematic source of soil compaction is cattle grazing, particularly trampling on sensitive, wet riparian soils. Many riparian areas with cattle grazing continue to show extensive compaction problems. During the past several years, a good number of allotments corrected allotment numbers to address resource damage. In the past 6 years, these allotments were revisited to determine how these new plans were working out and to see if additional mitigation was needed. Some allotments have shown some improvement but it is too soon to determine if this will allow for an upward trend in the more sensitive areas. In addition, 2 years ago, NEPA analysis was begun for permit renewal, which will cover all existing permits over a 15 year cycle.

The 1996 field reviews supported the observation that plant composition has been altered because of heavy grazing. This was seen in the South Fork/East Fork Allotment, the Little Thompson Allotment and the Hinchwood Area. In riparian areas of these allotments the heavy grazing has deepened stream channels, causing watertables to drop. Additionally, compaction, over utilization of sensitive species, microsite change from watertable changes and crown damage has added to the change in species composition. Palatable native shrub species such as willow, redosier dogwood and maple are being hedged severely or are gone entirely from

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sites and are being replaced with nonpalatable shrub species like alder, hawthorne and snowberry. In grazed areas where the water table has changed, non-native species such as bluegrass, knapweed, mullan, hound's tongue and sulfur cinquefoil are becoming the dominant types. It is important to note that in areas where cattle grazing has not occurred, these non-native species are less frequent. In order to meet the Forest Plan Standards, the Forest will need to continue to place importance on this situation plus monitor those areas where management has changed, to determine the effectiveness of these changes. (See 6-2)

**Slash Retention:** In the harvest units that were reviewed in 1996, a considerable improvement has been noted in the woody debris that is left on sites. All units but one met the minimal residual slash (10 tons) left on site in a well distributed manner. These units were specific units that the Soil Scientist visited and occasional units that were visited during trips around the Forest for other reasons. New sale clauses exist to improve this situation and are being enforced by sale administrators and contracting officer representatives. The present research data (Stark and Harvey are the leaders in this research) shows that not meeting minimum levels of biomass retention will drop Soil Productivity.

**Best Management Practices(BMP):** In 1996, it was noted that of the areas reviewed (16 sites), some had BMP or SMZ violations. Upon further review it was determined that much of the problem was understanding of what is needed.

**Recommendation:** It was recommended and agreed that Forest would do BMP and SMZ training during the winter of 1997 to enhance understanding of these requirements.(This training was accomplished February of 1997.)

Cost of this item was \$2,100.

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Soil Productivity**

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitor for compliance with existing State and Federal water quality statutes	Annual	Activities not meeting State and Federal water quality standards or leading to long-term degradation of aquatic environment.

**Evaluation:** In the winter of 1997 the Forest developed and implemented a training session dealing with erosion practices, sediment and BMP's. This session was given to over half the employees on the Forest. The aim of the session was to have the Forest Employees better trained when dealing with soil and water problems. Across the Forest there are some problems meeting soil productivity standards but these seem to occur in just a few practices. Soil compaction from livestock grazing in riparian areas continues to be a difficulty. We will continue to monitor and work to improve management practices so that the Forest's range allotments will finally meet Forest Plan and State Water Quality Standards.

**Recommendation:**

It is recommended that Forest Watershed Staff continue to train individuals on BMP Requirements and SMZ Standards.

It is also recommended that the Watershed Staff review road designs to assure that BMP's are installed in all projects.

**Methods:** There are various methods that are used to monitor soil productivity. When dealing with compaction, the change in bulk density is used. When dealing with nutrient recycling, the amount of woody debris left on a site after activity is used. When looking at organic residues, the amount of organic matter on the soil surface is considered.

*Monitoring Objective: The monitoring objective is to determine the amount of soil movement, soil bulk density changes or organic matter changes. Any movement, compaction or organic matter changes of the soil that reduces initiate productivity more than 20 percent does not meet Forest Plan Standards.*

**Results:**

**Harvest Sites - Compaction -** In 1997 the Forest Watershed Staff monitored 15 units that had been tractor harvested during the winter, spring or summer. The majority of these units were blowdown from a wind event that affected units across the Forest. Of the units we reviewed, none showed effects from compaction that were greater than 20 percent over the natural condition and, thus, meet Forest Plan Standards.

**Grazing Sites - Compaction -** Cattle grazing continues to be the more problematic source of soil compaction, especially trampling the sensitive, wet riparian sites. The monitoring team observed three

allotments which continue to show extensive damage from grazing to the riparian areas. These are the South Fork/East Fork Lolo Allotment, the Little Thompson Allotment and the Hinchwood/Clark Allotment. Each year as these allotments are visited they continue to not meet the Forest Plan Standards for grazing.

In 1997, the monitoring team conducted field reviews. They found plant composition, stream channels and compaction situations have been severely altered because of the heavy grazing. This heavy grazing has deepened stream channels, causing watertables to drop. Compaction, over utilization of sensitive species, microsite changes from watertable changes and crown damage has added to the change in species composition. Palatable native shrub species such as willow, redosier dogwood and maple are being hedged severely or are gone entirely from sites and are being replaced with nonpalatable shrub species like alder, hawthorne and snowberry. In grazed areas where the watertable has changed, non-native species such as bluegrass, knapweed, mullan, hound's tongue and sulfur cinquefoil are becoming the dominant species.

Harvest Sites - Slash Retention - In the units we reviewed in 1997, woody debris requirements were met in all cases. The Forest will continue to monitor units to see that the present trend continues but it is very important to note the progress that the Forest has made over the past years in this area.

Roads - BMP's - In 1997 there was a high level of precipitation and with it high spring runoff and flow. The monitoring team noted many roads lacked the proper BMP's, had excessive erosion, high sediment delivery and rutting. In existing roads, the Lolo N.F. should install drainage features. As maintenance is done on these existing facilities, it will be important to incorporate needed BMP's to meet our Memorandum of Understanding with the State and other timber companies.

Harvest Sites - BMP's - It has become apparent Specialist's Reports or EA's required BMP's but BMP's were not in the contract and, therefore, were not implemented on the ground. This seemed to happen on a regular basis. In 1997, the Forest formed a Team to assess the reasons for this situation. During the winter of 1998, this team will develop a report and make recommendations to eliminate the problem.

Cost of this item was \$3,300.

**ITEM 4-3  
Soil Productivity**

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitor the effect of soil disturbance/displacement on land productivity.	Annual	Movement or compaction of soils reducing productivity more than 20 percent.

**Introduction:** The objective of this monitoring item is to determine whether changes in soil bulk density and organic matter or amount of soil movement, reduces basic soil productivity more than 20 percent.

**Methods:** Several procedures are used to monitor soil productivity. Range allotments are monitored annually to assess the amount of soil compaction in sensitive areas caused by grazing. Compaction on roads and skid trails is assessed during annual Forest Plan monitoring field reviews of timber sales. The potential for organic matter and nutrient recycling is assessed on these sites from the amount of woody debris left on site after timber harvest activities. The amount of soil movement is inferred by evaluating the potential for tractor harvest to cause soil displacement on units where slopes are greater than 35 percent. These units are individually reviewed and approved to assure meeting soil productivity standards.

**Results:** In 1998, three requests were received to tractor harvest units on slopes greater than 35 percent. In all cases, only a portion of the individual units were on slopes greater than 35 percent. The cases were evaluated based on soil type, particularly soil texture and rock content, moisture conditions, length of skid, distance to drainage way, and potential mitigating measures to be applied. In all cases, tractor harvest was able to proceed within acceptable limits.

Across the forest in 1998, 21 active timber sales had contract requirements for woody debris retention. Of those sales, 122 of 129 units were found to have sufficient amounts of woody debris remaining after harvest. Units that were monitored by timber sale administrators in 1998 met woody debris requirements 95 percent of the time.

Two timber sales were reviewed during the 1998 Forest Plan Monitoring Trips. The harvest on these sales was completed in 1997. Of the units that were reviewed, none showed effects from compaction that would affect soil productivity more than 20 percent. One unit in each sale was found to "...fall short of coarse woody debris standards...". These findings were documented in Forest Supervisor memo 1920/2540 "Forest Plan Project Monitoring Trips, FY 98" dated January 4, 1999.

Cattle grazing has been a chronic source of soil compaction, especially in sensitive riparian sites. The 1997 Monitoring Report identified three allotments with compaction problems from grazing riparian areas. These are the South Fork/East Fork Lolo Allotment, the Little Thompson Allotment, and the Hinchwood/Clark Allotment. The Hinchwood/Clark Allotment has been closed and the National Forest boundary fence has been fairly successful in keeping cattle from trespassing on NF lands. Riparian fencing and close administration of the Little Thompson Allotment have been effective in excluding cattle from streamside areas. In the South Fork/East Fork Allotment, aggressive herding methods are used to keep cattle away from streamside areas. Most of the riparian areas sensitive to compaction in this allotment

are along Lost Park and East Fork Lolo Creeks on National Forest land. In 1998, a portable electric fence was installed to exclude cattle from a particularly sensitive location along Lost Park Creek. Monitoring during the summer of 1998 revealed localized impacts to two other sensitive areas, one along another reach of Lost Park Creek and one along East Fork Lolo Creek. Portable electric fencing will be used to exclude these locations in 1999.

**Evaluation:** Certain practices have problems meeting soil productivity standards. Soil compaction from livestock grazing in riparian areas continues to be one of them although notable improvements were made in 1998 on problems described in 1997. Organic matter, in the form of coarse woody debris retained in harvest units, was found to be sufficient in 95 percent of the units requiring such retention in 1998.

The coarse woody debris requirement arose when many silviculture prescriptions combined clear cutting and tractor piling site preparation. Prescriptions have evolved away from clear cutting and tractor piling to partial cutting followed by under burning. Currently, many treated stands are of small diameter and the coarse woody material retained is of smaller diameter (4.5 to 5.5 inches) than was envisioned when this monitoring item was developed. Small diameter material is often fully or partially consumed in slash treatment following harvest.

**Recommendation:** The Forest Silviculturist, Wildlife Biologist, and Soil Scientist need to review the intent and approach currently used to insure sufficient coarse woody debris retention following timber harvest and suggest modifications or improvements.

Continue to monitor and work to improve management practices so all range allotments meet Forest Plan Standards.

**ITEM 4-3**  
**Soil Productivity**

ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED	REPORTING PERIOD	VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION
Monitor the effect of soil disturbance/displacement on land productivity.	Annual	Movement or compaction of soils reducing productivity more than 20 percent.

**Introduction:** The objective of this monitoring item is to determine whether changes in soil bulk density and organic matter or amount of soil movement, reduces basic soil productivity more than 20 percent.

**Methods:** Several procedures are used to monitor soil productivity. Range allotments are monitored annually to assess the amount of soil compaction in sensitive areas caused by grazing. Compaction on roads and skid trails is assessed during annual Forest Plan monitoring field reviews of timber sales. The potential for organic matter and nutrient recycling is assessed on these sites from the amount of woody debris left on site after timber harvest activities. The amount of soil movement is inferred by evaluating the potential for tractor harvest to cause soil displacement on units where slopes are greater than 35 percent. These units are individually reviewed and approved to assure meeting soil productivity standards.

**Results:** In 1999, one request was received to tractor harvest on slopes greater than 35 percent. Only a portion of the unit had a slope greater than 35 percent. The unit was evaluated based on soil type, particularly soil texture and rock content, moisture condition, length of skid, distance to drainage way, and potential mitigating measures to be applied. In this instance, tractor harvest was able to proceed without a risk of causing unacceptable soil displacement.

Across the forest in 1999, 11 active timber sales had contract requirements for woody debris retention. Of those sales, 46 of 48 units were found to have sufficient amounts of woody debris remaining after harvest and post-sale slash treatment. After burning, two units were determined to be below standards for coarse woody debris. Units that were monitored by timber sale administrators in 1999 met woody debris requirements 96 percent of the time.

One timber sale was reviewed during the 1999 Forest Plan Monitoring Trips (Dry Camp Timber Sale and Ecosystem Management Burn). On this project, fire was used to expose mineral soil for site preparation of ponderosa pine, rejuvenate shrubs, increase forage and reduce fuels. The project resulted in a natural pattern and structure of "...snags, fire-killed dead [trees] and coarse woody debris." These findings were documented in Forest Supervisor memo 1920 "Annual Forest Plan Project Monitoring Field Trips, FY 99", dated January 31, 2000.

Cattle grazing has been a chronic source of soil compaction, especially in sensitive riparian sites. The 1997 Monitoring Report identified three allotments with compaction problems from grazing riparian areas, the South Fork/East Fork Lolo Allotment, the Little Thompson Allotment, and the Hinchwood/Clark Allotment. The Hinchwood/Clark Allotment was closed and the National Forest boundary fence has been fairly successful in keeping cattle from trespassing on NF lands. Riparian fencing and close administration of the Little Thompson Allotment have been effective in excluding cattle from streamside areas. In the South Fork/East Fork Allotment, aggressive herding methods are used to keep cattle away from streamside areas. Most of the riparian areas sensitive to compaction in this allotment are along Lost Park and East Fork Lolo Creeks on NF land. In 1998, a portable electric fence was installed to exclude cattle from a particularly sensitive location along Lost Park Creek. Monitoring during 1998 revealed localized impacts to two other sensitive areas, one along another reach of Lost Park Creek and one along East Fork Lolo Creek. Additional portable electric fencing was installed to exclude these locations in 1999 but for other reasons cattle were not turned out on this pasture in 1999.

**Evaluation:** Certain practices have problems meeting soil productivity standards. Soil compaction from livestock grazing in riparian areas continues to be one of them although notable improvements have been made in the last three years. Organic matter, in the form of coarse woody debris retained in harvest units, was found to be sufficient in 96 percent of the harvest units requiring such retention in 1999.

The coarse woody debris requirement arose when many silviculture prescriptions combined clear cutting and tractor piling site preparation. Prescriptions have evolved away from clear cutting and tractor piling to partial cutting followed by under burning. Currently, many treated stands are of small diameter and the coarse woody material retained is of smaller diameter (4.5 to 5.5 inches) than was envisioned when this monitoring item was developed. Small diameter material is often fully or partially consumed in slash treatment following harvest.

**Recommendation:** The forest silviculturist, wildlife biologist, and soil scientist need to review the intent and approaches currently used to insure sufficient coarse woody debris retention following timber harvest and suggest modifications or improvements.

Continue to monitor and work to improve management practices so all range allotments meet Forest Plan Standards.



### Monitoring Item 4-3: Soil Productivity

<b>ACTIVITY, PRACTICE OR EFFECT TO BE MEASURED:</b>	Monitor the effect of soil disturbance/displacement on land productivity.
<b>REPORTING PERIOD:</b>	Annual
<b>VARIABILITY (+/-) WHICH WOULD INITIATE FURTHER EVALUATION:</b>	Movement or compaction of soils reducing productivity more than 20 percent.

**Introduction:** The objective of this monitoring item is to determine whether changes in soil bulk density and organic matter or amount of soil movement reduces basic soil productivity more than 20 percent.

**Methods:** Several procedures are used to monitor soil productivity. Range allotments are monitored annually to assess the amount of soil compaction in sensitive areas caused by grazing. Compaction on roads and skid trails is assessed during annual Forest Plan monitoring field reviews of timber sales. The potential for organic matter and nutrient recycling is assessed on these sites from the amount of woody debris left on site after timber harvest activities. The amount of soil movement is inferred by evaluating the potential for tractor harvest to cause soil displacement on units where slopes are greater than 35 percent. These units are individually reviewed for approval to assure meeting soil productivity standards.

**Results:** During 2000 and 2001, the Lolo National Forest had 13 active timber sales with contract requirements for coarse woody debris retention. Of the 13 timber sales, 111 units had coarse woody debris left on site. Out of the 111 units with coarse woody debris 71 units were assessed for adequacy of coarse woody debris. All of the units assessed were found, by general observation, to have had sufficient amounts of coarse woody debris remaining on site after harvest. In addition, 43 units met the Forest's scarification guidelines.

**Table 4-3A. Timber Sale Units Assessed for Coarse Woody Debris Retention in 2000 and 2001.**

Timber Sale	District	Number of Units	Number of Units Requiring Woody Debris	Number of Units assessed for Woody Debris	Number of Units w/ sufficient Woody Debris
Northside	Missoula	24	24	8	8
Lolo Cloudburst	Missoula	83	40	16	16
Marshall Ski 2	Missoula	5	0	0	0
Arch Loop	Seeley Lake	7	7	7	7
Chain of Lakes	Seeley Lake	13	0	0	0
Arch Inez	Seeley Lake	4	3	3	3
Dry Camp	Plains	3	3	3	3
Raven	Plains	5	5	5	5

Timber Sale	District	Number of Units	Number of Units Requiring Woody Debris	Number of Units assessed for Woody Debris	Number of Units w/ sufficient Woody Debris
Boyer	Plains	10	10	10	10
Hard Knox	Plains	12	12	12	12
Fitness	Plains	2	2	2	2
Mosquito	Plains	1	1	1	1
Wee Teepee	Plains	2	2	2	2
Chipmunk	Plains	2	2	2	2

**Evaluation:** In 2000 and 2001, retention of coarse woody debris in harvest units was found to be sufficient in all of the harvest units requiring such retention.

The coarse woody debris retention requirement arose when many silvicultural prescriptions combined clearcutting and tractor piling site preparation. Prescriptions have evolved away from clearcutting and tractor piling to partial cutting followed by underburning. Currently, many treated stands contain trees of small diameter and the coarse woody material retained is of smaller diameter (4.5 to 5.5 inches) than was envisioned when this monitoring item was developed. Small diameter material is often fully or partially consumed in slash treatment following harvest.

Previous Forest Plan Monitoring and Evaluation Reports recommended that silviculturists, wildlife biologists, and soil scientists review the intents and approaches used to insure sufficient coarse woody debris retention following timber harvest and suggest modifications or improvements. To address this recommendation, an updated version of "The Woody Debris Resource on the Lolo National Forest" was released as a review draft in June 2002.

**Recommendation:** Certain management practices have problems meeting soil productivity standards. Soil compaction from livestock grazing in riparian areas continues to be one of these practices although notable improvements have been made in the last several years. Range allotments will continue to be monitored and management practices improved so that all range allotments meet Forest Plan standards.