Appendix D

Financial Analysis

Flathead NF Annual Road Maintenance Financial Analysis
Based on Three-year Average Funding

Jurisdiction FS - FOREST SERVICE
System NFSR - NATIONAL FOREST SYSTEM ROAD
Route Status EX - EXISTING
Primary Maintainer (All)
ADMIN_ORG (Multiple Items)

Step 1: Choose your Unit. Road Mile values will be populated from INFRA Road Core Data.

Step 2: Enter the Average Cost/mile to do Annual Maintenance by Maintenance Level.

Step 3: Enter the Average maintenace cycle by Maintenance Level.

Sum of Segment Length (Miles)					
Operational Maintenance Level	Total	Cost to Maintain/Mile	Maintenance Cycle	Annual Cost/Mile	Total Annual Cost
1 - BASIC CUSTODIAL CARE (CLOSED)	2051	$700	20	$35	$72,000
2 - HIGH CLEARANCE VEHICLES	506	$2,000	7	$286	$144,500
3 - SUITABLE FOR PASSENGER CARS	761	$3,500	4	$875	$666,000
4 - MODERATE DEGREE OF USER COMFORT	172	$6,500	3	$2,167	$373,500
5 - HIGH DEGREE OF USER COMFORT	29	$7,000	2	$3,500	$100,500
Grand Total	**3519**				$1,256,000

Annual Cost/Mile will be calculated based on Cost/mile and maintenance cycle.

Total Annual Cost will be calculated by multiplying Annual Cost/mile by Total Miles using road appropriations and summing the Maintenance Level.

Estimated Annual Funds Available for Road Maintenance	
Collected Trust Funds (CWFS, CWK2, CWKV)	$76,726
Timber Sale Purchaser	$39,762
Stewardship Integrated Resource Contracts	
Title II (RAC)	
Other Non-FS	
Other FS Appropriated Funds	$24,000
NFRR	
CMRD	$447,690
Estimated Funds Available for Annual Road Maintenance	$588,178
Estimated Funds Needed or Available for Road Mainteannce	($667,822)

Step 4: Enter the funding by source available for Annual Road Maintenance.

CMRD 3-year average 2011-2013 = $994,867
Minus 55% for timber support = **$447,690**

Average Annual Regional (R1) Cost for Road Maintenance by Maintenance Level

[illegible]

Assumptions:

1 Include only annual maintenance activities. Deferred maintenance needed to bring the road up to standard is not included.
2 Drainage is the main consideration for maintenance.
3 As the maintenance level increases attention to user comfort and safety increases accordingly.
4 Forest Service Policy set forth in manuals and handbooks is followed.
5 Guidelines for Road maintenance Levels by SDTDC 2011 used as reference.
6 Planning and inspection for maintenance is not included.
7 Major structures such as Bridge and Retaining wall maintenance is not included.
8 Cost are based on the February 2011 Northern Region Cost Estimating Guide for Road Construction.
9 Mobilization is included. Equipment will be clean and weed free before it arrives on National Forest System lands.
10 Maintenance cycle was determined from a *Regional* average of roads receiving maintance reported on the Road Accomplishment Reports for FY2008 to 2010. Maitanenance cycle for the type of work was also factored in.
11 Average length of road by ML is a *Regional* average.
12 Maintenance activities by maintenance level included in the cost are as follows.

Description of Work	ML 1: Road is in storage and is in a stable condition. No potential exists for resource damage when vehicular traffic is eliminated. Maintain physical closure device (berm) and drainage and signs. Road Maintenance is done on a **10 year cycle**. Average length is 1 miles.	ML 2: High clearance vehicle use. Passenger car traffic, user comfort, and user convenience are not considered; low traffic volume and low speed; drainage structures are dips; surface smoothness is not considered; and very few signs. Outsloped single lane road without a ditch. Brush to maintain access and drainage. Spot blade to maintain drainage. Clean/Repair structures (cattleguard, gate) and signs. Road Maintenance is done on a **5 year cycle**. Average length is 2 miles.	ML 3: Passenger car use. User comfort and convenience are not considered; single lane with turnouts; low speeds with low to moderate traffic volume; drainage structures include ditch, culverts and dips; and some surface roughness is acceptable. Surface blade to maintain template and drainage. Surface is compact, crowned or sloped to drain without segregation of surface materials; no ruts or rills; suitable material is recovered and incorporated; unsuitable material is removed. Ditches and culverts function efficiently. Clean/Repair structures (cattleguard, gate) and signs. Spot Surface with government furnished aggregate. Road Maintenance is done on a **3 year cycle**. Average length is 4 miles.	ML 4: Passenger car use. Provide moderate degree of user comfort and convenience; moderate speeds and traffic volume; drainage structures are culverts; and double lane aggregate surface with dust abatement with a ditch. Brush to maintain sight distance. Surface blade free of washboard, potholes, or other irregularities. Surface is smooth, compact, crowned or sloped to drain without segregation of surface materials; no ruts or rills; suitable material is recovered and incorporated; unsuitable material is removed. Surface remains stable and dust does not become air borne for normal open season (July to October). Shoulders are shaped to provide a smooth transition to traveled way and drain efficiently. Ditches and culverts function efficiently. Clean/Repair structures (cattleguard, gate) and signs. Spot Surface with government furnished aggregate. Road Maintenance is done on a **2 year cycle**. Average length is 3 miles.	ML 5: Passenger car use. Provide high degree of user comfort and convenience; highest traffic volume and speeds; drainage structures are culverts; and double lane paved surface. Brush to maintain access and drainage. Surface Repair include pothole patching, crack sealing, chip sealing and removal of unsuitable material. Shoulders are shaped to provide a smooth transition to traveled way and drain efficiently. Ditches and culverts function efficiently. Clean/Repair structures (cattleguard, gate) and signs. Paint pavement markings. Road Maintenance is done on a **2 year cycle**. Average length is 2 miles.
Blading	–	Spot: 500 ft/spot, 4 spots/mile/5 years	4 passes with motor grader (2 passes to clean ditch, 2 passes to level road & final shape)/ 3 years	8 passes (2 passes to clean ditch, 3 passes to level the road, 3 passes for final shaping)/ 2 years	Shoulder: 4 passess (2 passes per side); Broom surface of road (4 passes)/ 2 years
Brushing	–	medium/5 years	medium/ 3 years	medium/ 3 years	medium/ 3 year
Clean/repair culverts and dips	–	20 dips @ 264 ft spacing/ 5 years	20 culversts @ 264 ft spacing/ 3 years	20 culverts @ 264 ft spacing/ 2 years	20 culverts @ 264 ft spacing/2 years
Clean/Repair Structure include associcated signs	1 per road/10 years	1 per road/7 years	1 per road/7 years	1 per road/ 7 years	1 per road/ 7 years
Dust Abatement	–	–	–	5280 gal/mile (14080 sq yd @ 0.375 gal/sqyd)/4 years	
Paint pavement markings	–	–			Edge Lines (10560 ft/mile)/4 years
Repair asphalt - patching and chip seal	–				Patching 0.5%/mile/1 year Chip Seal/12 years
Sign Maintenance	Replace 2 per road/7 years	Replace 3 per road/7 years	Replace 6 per road/7 years	Replace 8 per road/7 years	Replace 8 per road/ 7 years
Spot Surfacing	–		20cy/100ft/spot 5 spots/mile/6 years	20cy/100ft/spot 5 spots/mile/ 4 years	
Cost to Maintain/Mile	$700	$2,000	$3,500	$6,500	$7,000
Mtce Cycle	10	5	3	2	2
Annual Cost/Mile	$70	$400	$1,167	$3,250	$3,500

Why We Decommission Roads -

Economic Implications of Removing Forest Roads

The Forest Service has actively pursued reducing the total number of NFS roads through targeting unneeded roads for decommissioning or conversion to other uses. Federal regulation directs the agency to identify the road system needed for land management, that's environmentally responsible, and considers likely future funding. Adverse effects of roads on the natural environment are widely recognized. However, many individuals have cited economics as a motivation for decommissioning unneeded roads. This argument would hold more value if the economist could fully value the environment effects associated with a road in addition to the cost of keeping it or removing it.

Considering the global economics of a road system is typically beyond the ability of land managers. However, road managers are routinely faced with a straight forward financial decision. "What is the difference in cost between decommissioning a road or maintaining the road into the future?"

One of the simplest ways to approach this question is to determine the breakeven point between the present value of decommissioning and a uniform series of annual road maintenance costs. In other words, how long can you maintain a mile of road for the same price of decommissioning it? Using average costs and a discount rate of 4%, Exercise 1 shows that it is cheaper to store a road in Maintenance Level 1 forever than it is to decommission the road. This is done by comparing the present value of the decommissioning with the present value of a perpetual annual series of road maintenance. (See the attached calculations.)

If you're not going to consider the time value of money, the breakeven point would be only thirty years. (If you don't consider a discount rate for the time value of money, loan me $100 today and I will gladly repay you the $100 thirty years from now.)

What's the point? It takes a very long time to recover the investment in road decommissioning with reduced road maintenance spending. The sample calculation indicates that you will never recover to cost of decommissioning. If it turns out that you need access over that corridor again in the future, the economic difference is even greater.

Present Value of a perpetual series: $P_{mtce} = a/i = \$200/mi / 0.04 = \$5000/mi$

Present Value of decommissioning: $P_{decom} = \$6000/mi$ Note: $P_{mtce} < P_{decom}$

The sample calculations show that if you need to construct new road in 25 years as an option to storing the road and reconditioning the road when needed, it costs about three times as much. The shorter the time interval between entries, the greater the difference in cost. The longer the time between entries, the closer the options become. However, the present cost of decommissioning plus new construction will always be greater than the present cost of the uniform series of annual road maintenance plus the road reconditioning. This occurs because as the time interval increases, the present cost of future new construction and the present cost of future road reconditioning approach zero. The present cost of road decommissioning will always be greater than the present value of a perpetual uniform series for road maintenance. (See calculations – Case 3)

Decommissioning roads can affect the value of remaining timber stands. A fundamental principle of harvest area planning is to amortize the road cost over multiple entries. Decommissioning roads when there are future access needs results in greater road cost for those remaining timber stands. This reduces the value of the remaining commercial timber and limits forest restoration options due to increased transportation costs.

Decommissioning unauthorized (or non-system) roads represents a significant investment, but does not increase available funding for road maintenance. Decommissioning roads in Maintenance Level 1 (long-term storage) or Maintenance Level 2 (managed for high clearance vehicles) also does not increase road maintenance funding. Removing these roads from the system simply means there will be fewer miles of road receiving almost no maintenance.

The real benefits from road decommissioning are ecological, not financial.

What do we know for sure?

- All roads impact the natural environment. Some are much worse than others.
- You can keep forest roads for a long time at a low standard while preserving your access options. This is often much cheaper than decommissioning.
- Once you decommission a road, it's difficult to reestablish that access.
- Decommissioning a road that might be used for future timber access affects the value of those remaining stands. This cost is rarely accounted for in decisions to decommission roads.
- Fire behavior is becoming more extreme. We can predict the number of ignitions, but not the locations. Road access is handy for fire response. Loses due to limited fire access are not part of the breakeven analysis.

- Managers are not always very good at identifying ongoing road access needs. Few forests have a reliable 5-Year Vegetation Management Plan. No one has a thirty or forty year plan. It’s not uncommon to see road built on the same location multiple times in the same decade.
- Forest restoration projects rarely generate enough value to pay for road development.

Suggestions:

- One of the primary goals of road decommissioning is for watershed restoration. Preliminary research is indicating that 90% of road related sediment is coming from 5% of the roads. Focus on finding those problem locations and spend our limited funding on mitigating the problems. (BMPs, Reconstruction, Relocation)
- Unneeded roads that fall in that problem 5% should be targeted for decommissioning. It’s worth the investment.
- Spend the majority of your available road funds keeping the drainage working on the existing road system. Most roads should be as self-maintaining as possible.
- Provide a high level of maintenance for the handful of most important recreation roads.
- Local roads should only be reconditioned to highway vehicle standards when needed and funded by forest restoration projects. Return them to storage when you are finished.
- Chasing road decommissioning target puts the program focus on the easiest road miles, not the 5% causing the greatest impact to water quality.

Road Storage Vs. Decommissioning

Sample Calculations

Assume: Average Cost to Decommission in R1 = \$6,000 per mile

Average Cost of New Construction = \$50,000 per mile

Average Cost to Recondition a Stored Road = \$10,000 mile

Average Annual Maintenance Cost to Store Roads (ML 1) = \$200 per mile

Annual Discount Rate for Time Value = 4%

Case 1 – Decommission vs. Maintain Forever

Present Value of road decommissioning - \$6000 / mile

Present value of a perpetual annual series maintenance - P = a/i = \$200/mi / 0.04 = \$5000 / mile

Note: $P_{mtce} < P_{decom}$ You can store the road forever cheaper than decommissioning.

Case 2 – Access Is Needed in 25 Years

Option 1 – Decommission the road and build a new road in 25 years.

$$P_{opt\ 1} = \$6000/mi + \frac{\$50{,}000(1)}{(1+0.04)^{25}} = \$24{,}756/mile$$

Option 2 – Maintain the road for 25 years and recondition it when needed.

$$P_{opt\ 2} = \frac{\$200/mi(1.04^{25}-1)}{0.04(1.04^{25})} + \frac{\$10{,}000/mi(1)}{1.04^{25}} = \$6{,}876/mile$$

Note: $P_{opt\ 2} < P_{opt\ 1}$ Storing the road is about one third of the cost.

Case 3 – Access is Needed a Long Time From Now

Option 1 – Decommission the road and build a new road in the future.

$$P_{opt\ 1} = \$6000/mi + \frac{\$50{,}000/mi}{1.04^n}$$

Option 2 – Maintain the road in storage and recondition it when access is needed.

$$P_{opt\ 2} = \frac{\$200/mi(1.04^n - 1)}{0.04(1.04^n)} + \frac{\$10{,}000/mi}{1.04^n}$$

If n=300 years, $P_{opt\ 1}$ = \$6000/mile and P_{opt2} = \$5000/mile

As 'n' gets very large, the present value of new construction and reconditioning approaches zero.

Note: It will always be cheaper to store the road rather than rebuild a new one.