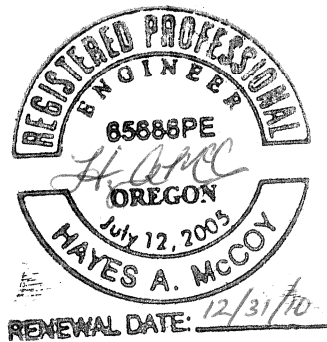


ROAD IMPROVEMENT PLAN

PREPARED FOR:

CROOKED RIVER RANCH SPECIAL ROAD DISTRICT

MARCH, 2009



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INTRODUCTION

At the request of the Crooked River Ranch Special Road District (CRRSRD), AKS Engineering & Forestry (AKS) has prepared this Road Improvement Plan for use in the development of CRRSRD's transportation infrastructure. This plan is being jointly funded by the Crooked River Ranch Special Road District and the Crooked River Ranch Club and Maintenance Association for the mutual benefit of both organizations. The scope of the Road Improvement Plan includes:

- An inventory of all roads within the CRRSRD
- Review of the adopted Road Management Plan
- Review of road maintenance practices
- Contact agencies that utilize roads within the CRRSRD for feedback on transportation improvements
- Classify roads into Local, Collector, or Commercial
- Prepare a list of road improvements

Currently, the CRRSRD and the Crooked River Ranch Club and Maintenance Association have an adopted Road Management Plan (see Appendix 3) that outlines the history, responsibilities, transportation issues, planned improvements, and standards. The Road Management Plan has adopted ODOT standards for road improvements. Additionally, the Crooked River Ranch Club and Maintenance Association had an evaluation of their Road Conditions and Maintenance Practices prepared by Brian F. Barnett, PE, in 2007 (see Appendix 4).

During the preparation of this report, AKS contacted the CRRSRD, the CRRSRD Citizen's Advisory Committee, the Crooked River Ranch Club and Maintenance Association Maintenance Committee, the Crooked River Ranch Rural Fire Protection District, the Redmond School District, the Culver School District, the Deschutes County Sheriff's Office, and the Jefferson County Sheriff's Office. Additionally, Mike Moore, High Desert Aggregate & Paving, Mike McHaney, Jefferson County Roadmaster, and Rich Black, Jefferson County Engineer, provided very useful information that assisted with the preparation of this report and diagrams.

ROAD INVENTORY

In December, 2008 and January, 2009, AKS performed a road inventory of all roads within the CRRSRD. Intersections, road surface, road length, and road width were identified in order to provide the CRRSRD with a complete inventory of their jurisdiction (see Appendix 1). Additionally, the data would be useful in determining road improvement priorities and estimated costs.

Crooked River Ranch currently has approximately 90 miles of roads, of which 11 +/- miles are maintained by Jefferson or Deschutes County. Approximately 77 miles are under the CRRSRD's jurisdiction and the remaining 2 miles of roads are within private easements.

All County maintained roads are paved, striped, signed, and maintained to County standards.

Roads under the CRRSRD have variable surfaces consisting of dirt, red cinders, gravel, chip seal/oil mat, and asphalt. Some paved surfaces are striped and others are not. Intersection street signage, speed signs, and some curve signage are found on most roads. Of the 77 miles of roads under the CRRSRD's jurisdiction, 25.7 miles are paved, 10.7 have gravel surfaces, and 40.6 miles are dirt or red cinders. Most of the roads that serve a larger number of residents have been paved. Please see Diagram 1 for a summary of current road surfaces.

Most of the paving on CRRSRD roads have been completed during the past ten years. The pavement improvements have been inconsistent, obviously due to the lack of a standard for road improvements (which did not exist prior to 2008). Variable depths of base rock and pavement were encountered. Some paved roads have held up well and others exhibit premature deterioration. A few of the paving improvements (~3 miles) have been for local roads which only serve the residents that directly access the road.

A number of intersections have inadequate sight distance (see Recommended Road Improvements). Many of these intersections have obstructing brush and juniper trees that create potentially hazardous intersections. Some intersections would require mass grading or road realignment and could be cost prohibitive when compared to the volume of traffic for the intersection. Adequate sight distance was based off of AASHTO standards for intersection sight distance. Sight distance is generally based off of the 85th percentile speed; however the variable traffic patterns, the time of year, and the extra expense associated with obtaining the 85th percentile speed made gathering this data impractical. Design speeds were assumed to be 25 mph for gravel roads and 35 mph for paved roads, which is generally the posted speed limit for gravel and paved roads, respectively. It is true that a significant portion of traffic will travel faster than the posted speeds over some stretches of roads. AKS recommends further investigation into adequate sight distance for intersections prior to commencing construction activities to improving intersections.

Drainage structures, including ditches and culverts, are present within some road alignments, usually with the most recent improvements. Portions of roads are located at the lowest point in the drainage basin and can serve as a collection point for stormwater runoff. Recent rocking combined with regrading ditches have improved drainage on some roads. Most drainage problems encountered are found on roads that have not been rocked or paved recently, and often exhibit lack of crown and necessary ditching.

Some roads, such as Sundown Canyon, have steep sections which exceed a 10% grade (the maximum grade allowed by Jefferson and Deschutes Counties). Many of these roads are near the Deschutes River and there is not a cost-effective solution to flatten these grades. Flatter grades would require more right-of-way, grading, excavation, and blasting. During the preparation of this report and interactions with various Crooked River Ranch organizations, no specific complaints about road grades were received. However, steep roads must have well maintained ditches and culverts to prevent premature road degradation.

EVALUATION OF ROAD MANAGEMENT PLAN

The Road Management Plan was adopted by the CRRSRD and the Club and Maintenance Association in 2008 to ensure road improvements were constructed in a consistent manner and to a set standard. Every year, the Road Management Plan is reviewed by the CRRSRD and the Club and Maintenance Association for possible changes. AKS has reviewed the Road Management Plan and recommends the following changes:

1. The minimum standard for road improvements is based on the road's classification, which is based on average daily traffic (ADT). ADT with the Ranch can vary depending on the time of year or day of the week. There is no described standard on how ADT shall be obtained. Additionally, other important factors (such as traffic circulation, emergency response, future development, and future road improvements) are not considered in determining whether a road is classified as Collector or Local. AKS recommends abandoning classification based on ADT and instead, permanently classify each road under the CRRSRD's jurisdiction. A permanent classification would allow the CRRSRD to easily identify those roads that should have paved surfaces and those roads that should have gravel surfaces. The classification will also help prioritize which roads should be improved. This report has included a recommended road classification specifying each road as either Local, Commercial, or Collector.
2. There are some roads within Crooked River Ranch that serve commercial traffic rather than residential traffic. Commercial traffic generally consists of larger vehicles and heavier loads, which will increase wear and tear on road surfaces. AKS recommends including a Commercial Road classification that requires more base rock (8" depth) and pavement (2-1/2" or E-11 Oil Mat) to sustain the heavier truck traffic often associated with commercial areas.
3. The Road Management Plan includes very little on drainage infrastructure but states roads shall have a minimum one foot deep ditch and mentions the importance of culverts. AKS recommends the CRRSRD adopt Jefferson County's drainage requirements, which specifically require 18" cross culverts (with exceptions), 12" driveway culverts, and adequate stormwater infrastructure to accommodate the 50-year storm. Additionally, AKS recommends the minimum ditch depth be increased to 1.5 feet and include check dams at regular intervals on grades steeper than 5%. Driveway culvert maintenance should be the responsibility of the owner of the driveway. Cross culvert maintenance should be the responsibility of the CRRSRD. Road improvements initiated by the CRRSRD should include providing adequate drainage infrastructure (including driveway culverts for legal driveways) along all improvements.

This will minimize damage caused by stormwater runoff and extend the life of road improvements, which will save money for CRRSRD.

4. The majority of roads within the CRRSRD are local roads and according to the Road Management Plan, shall have a gravel surface. The Road Management Plan requires gravel surfaces to meet ODOT specifications for $\frac{3}{4}$ "-0" rock. However, $\frac{3}{4}$ "-0" rock meeting ODOT specifications is intended for base rock that will be covered by a paved surface. The specification is not for a gravel surfaced road. Although ODOT does not have a specification for surface gravel, many other jurisdictions do (WASHDOT, Caltrans, etc.). Last year, CRRSRD roads were graveled with a $\frac{3}{4}$ "-0" reject rock from Cline Butte. This material does not meet ODOT specifications, although it was also used by Deschutes County for resurfacing some of their gravel roads in 2008. Additionally, there was positive feedback from Ranch residents with the use of this material. AKS recommends that local roads within the CRRSRD be surfaced with a cost-effective, locally available reject rock material. The material should $\frac{3}{4}$ "-0" and approved by the CRRSRD and the Road Supervisor. Gravel should be placed in no more than 6" lifts, wetted to optimum moisture content, formed to a crown section, and compacted. The CRRSRD may request the material to be tested for adequate compaction (see recommended compaction specifications in Appendix 2) at 500 foot intervals.
5. The Road Management Plan outlines future road improvements within the CRRSRD. This report has prepared a comprehensive list of improvements that should be adopted by the Road Management Plan. The list of improvements considers the current funding of the CRRSRD and their ability to maintain paved roads within their jurisdiction.
6. The Road Management Plan clearly specifies that local roads shall have a gravel surface. This report's recommended road classification includes some local roads that currently have paved surfaces. In time, paved roads will deteriorate and require an overlay or chip seal. The CRRSRD and the Club and Maintenance Association should not be responsible for maintaining a paved road with a local classification. Funding is inadequate for this type of maintenance and does not proportionally benefit Ranch residents. AKS recommends any future pavement improvements to local roads be covered by an LID process or other cost sharing agreement that burdens those residents who live adjacent to the local road to be improved. Current paved local roads include Rim Road, Horny Hollow Trail, and Ridge Place. AKS is unaware of any LID or road maintenance agreements that exist for these roads. If the recommended road classification policy is adopted, residents along these roads should be informed that future pavement maintenance will not be funded by the CRRSRD.

7. The Road Management Plan does not contain specifics on signage and striping. AKS recommends that roads within the CRRSRD have adequate traffic signage conforming to MUTCD standards. There are many intersections that have “Yield” signs where a “Stop” sign is appropriate. Yield intersections are appropriate where there is adequate sight distance for a moving vehicle to safely merge or enter another road. Many of the encountered “Yield” intersections do not have adequate sight distance. As funding permits, “Yield” signs should be replaced with “Stop” signs and additional signage installed for sharp curves, speed limits, dangerous intersections, etc.

Most of the paved roads within the CRRSRD are striped. The Road Management Plan should specify whether Collector and Commercial roads should be striped or not. Striped roads assist with traffic control, but require occasional restriping and therefore more funding. Collector and commercial roads within the CRRSRD experience relatively low traffic volumes and may not need striping. However, striping assists drivers on dark nights with limited visibility. AKS recommends the CRRSRD establish a clear policy on striping so future improvements will be constructed consistently. If adopted, striping should be consistent with Jefferson County specifications or ODOT standards.

8. The summary of road lengths in the Road Management Plan is not correct and should be updated. Please see “Road Inventory” for correct road lengths.

CONTACT WITH OTHER AGENCIES

In preparation of this report, AKS contacted other agencies that utilize the roads within the CRRSRD. A summary of their comments are as follows:

Crooked River Ranch Rural Fire Protection District

A list of requested road improvements from the Fire District can be found in Appendix 6. Additionally, AKS met with the Fire District to discuss potential road improvements. The Fire District prioritized the roads they would like to see paved and discussed their rationale. Providing a paved road along Rainbow-Bullhead is their highest priority, followed by paving Dove Road, then paving Golden Mantle Road. The Fire District also commented how they appreciated the many recent road improvements and are very supportive of a secondary access that would extend Quail Road to Lower Bridge Road.

Redmond School District

AKS attempted to contact the transportation supervisor from the Redmond School District, but received no response.

Culver School District

AKS spoke with the Culver School District's transportation supervisor. The school district was concerned with dust from roads (Geneva View, specifically) that has clogged air filters on some buses. Per the Road Management Plan, funding does not permit dust abatement, therefore this issue will likely remain.

Deschutes County Sheriff's Office

AKS contacted the Deschutes County Sheriff's Office and discussed any transportation problems they encounter. The sergeant AKS contacted stated his office patrols a very small part of Crooked River Ranch, but was supportive of a secondary access to Lower Bridge Road. Deputies reported no transportation problems.

Jefferson County Sheriff's Office

AKS attempted to contact the Jefferson County Sheriff's Office, but received no response.

ROAD CLASSIFICATION

The current Road Management Plan adopted by the CRRSRD bases road classification on Average Daily Trips (ADT). Roads with an ADT of 600-2500 are classified as a collector road and roads with an ADT of 0-600 are classified as a local road. AKS is not aware of any document that actually classifies some or all of the roads within the Ranch or any traffic counts used to classify any roads.

Roads classified as Collectors are to be paved and roads classified as Local are to have gravel surfaces according to the Road Management Plan. Basing the classifications off of ADT allows for an arbitrary interpretation of what each road should be classified. Classifying each road in Crooked River Ranch will provide a legitimate basis for prioritizing future road improvements and maintenance. This study has prepared a Diagram that designates road classifications within Crooked River Ranch (See Diagram 2). The Road classifications are not based on traffic counts. Accurate traffic counts can be expensive to obtain and should be acquired during peak traffic flows, which occur during the warmer months. Due to relatively low traffic usage on CRRSRD roads, obtaining traffic counts may be unnecessary and could yield variable results. The proposed classification is based on the following factors:

- Potential number of residential lots the road will serve
- Current surface of the existing road (paved roads are assumed to attract more traffic)
- Proximity to other collectors or County Roads
- Potential to improve the traffic circulation within Crooked River Ranch
- Access for emergency vehicles

In addition to classifying roads as Local or Collector, this report recommends creating a commercial classification for roads within the commercial areas of the Ranch. A commercial classification would require more base rock and thicker pavement/oil mat to accommodate heavier loading that generally accompany commercial areas.

The following lists County, Collector, and Commercial Roads. All other roads under the CRRSRD's jurisdiction are classified as local roads by this report.

Roads under County Jurisdiction:

Chinook (from entrance to the Ranch to just past the intersection of Chinook & Clubhouse Road)

Cinder

North Hill

Mustang (from intersection with Chinook to intersection with Shad)

Peninsula (from intersection with Cinder to intersection with Meadow)

Shad (from intersection with Mustang to intersection with Sundown Canyon)

Collectors:

Badger (West of Chinook)

Basalt

Bullhead

Canary (from intersection with Shad to intersection with Sand Ridge)

Chinook (all areas not under County jurisdiction)

Dove (from intersection with Quail to intersection with River)

Ermine (from intersection with Quail to intersection with Sage Hen)

Horny Hollow Trail (from intersection with Hill to intersection with Ranch House)

Meadow (from intersection with Peninsula to intersection with Scout Camp Trail)

Mustang (West of intersection with Shad)

Panorama Circle

Parkey

Peninsula (from intersection with Shad to intersection with Cinder)

Quail

Rainbow (from Quail to intersection with Bullhead)

Rainbow (South of Badger)

River (from intersection with Quail to intersection with Dove)

Sage Hen

Sand Ridge (from intersection with Shad to intersection with Canary)

Shad (from intersection with Sundown Canyon to intersection with Peninsula)

Commercial:

Buffalo

Business Circle

Clubhouse Road

Commercial Loop

Ranch House

ROAD MAINTENANCE

Both the adopted Road Management Plan and the Road Evaluation by Mr. Barnett have recommended road maintenance practices. This report provides some basic maintenance practices that will extend the service life of roads. All roads should be inspected at least once per year, preferably in the spring, by the Road Supervisor. A list of necessary repairs should be prepared and reviewed by the CRRSRD and the Road Supervisor.

Appendix 7 contains a summary of estimated construction and maintenance costs, a scenario outlining costs of maintaining paved roads, and a summary of crack sealing and patching on existing paved roads. The costs were prepared in 2009 and may not reflect current contractor prices. These costs can be used for a rough estimate of future road improvements and maintenance costs; however, AKS can prepare cost estimates reflecting current costs and identify other potential issues associated with road improvements.

Paved Roads

Below is a list of pavement repairs that can be used to rehabilitate a paved surface. Minor pavement repairs can be a cost effective method to extend the service life of a paved surface if funding is not presently available for a chip seal or asphalt overlay. Evaluation and repair of the road's existing drainage infrastructure should accompany repair of paved roads – especially if drainage is the cause of the damage. Possible repairs to paved surfaces include:

Crack Sealing

Pavement cracks at least ¼" in width should be sealed with a flexible crack sealant. Sealing pavement cracks improves the life of the paved surface and prevents water from infiltrating the base rock and creating further damage.

Slurry Seal

Asphalt paved roads that are degraded due to weathering and have minor cracking can be slurry sealed, which uses a mixture of fine gradated rock with emulsified asphalt. Prior to slurry sealing roads, large cracks should be sealed as described above. Slurry seals extend the life of a road for a few years and prevent water from infiltrating into the rock base, but are not commonly used.

Fog Coat

Roads that are degraded due to weathering, but have little cracking or fracturing can be sealed by a fog coat. A fog coat is a thin seal of the road surface with a mixture of emulsified oil and water. Like slurry seals, fog coats extend the life of a road for a few years and prevent water from infiltrating the rock base. Fog coats are rather inexpensive and are ideal for oxidized chip seals.

Asphalt Patching

Substantial pavement damage isolated in certain areas can be ground down and replaced with 2" of hot-mix asphalt. Patching prevents further degradation of the damaged area, but often does not fix the reason for the damage (i.e. surface damage caused by a low point where runoff collects).

Chip Seal

Deteriorated paved roads can be repaired by a chip seal overlay (one shot or two shot, depending on the extent of surface damage). Chip seals prevent moisture from infiltrating the rock base and can add some structural strength to the road with the addition of more aggregate. Any substantial cracking or road surface deterioration should be repaired before overlaying with a new chip seal. A new chip seal should provide an adequate surface for a paved road for 5-10 years.

Asphalt Overlay

Deteriorated and damaged paved roads can be repaired by asphalt overlays. Asphalt overlays are a more durable repair method and more costly. A thin leveling course (~1/2") of asphalt can be laid to reform the road's original crown shape if the damage is substantial. Applications of 2" thick asphalt overlays are a standard depth. A new asphalt overlay should provide an adequate surface for a paved road for 15-20 years. As with chip seals, substantial cracking and road surface deterioration should be repaired before applying an asphalt overlay.

Shoulder Work and Intersections

After the placement of an asphalt overlay or chip seal, a new gravel shoulder should be placed on each side of the road (Road Management Standards require two feet width). The gravel shoulder helps stabilize the side of the road and prevents deterioration on the sides of the road. Overlays and chip seals should extend into intersecting roads and driveways to protect the improved road.

Gravel Roads

Grading

Gravel roads should be graded to maintain a crown or shed section and to evenly distribute aggregate across the surface. Grading the roads should redistribute gravel from the shoulder of the road to spread it evenly across the traveled surface. Maintaining a cross slope around 4% is considered adequate. A rounded, parabolic, or flat crown should be avoided since this will lead to eventual surface damage caused by precipitation and runoff. Roads should be graded under ideal moisture conditions. Too dry or too wet roads will each have their own drawbacks. Use of a water truck will be necessary during dry conditions, but can be avoided during the spring if the roads are moist. Compacting the gravel surface after grading is an effective

method to minimize unraveling of the surface and extend the lifetime of the road. Furthermore, applying dust abatement (magnesium chloride) can extend the service life of the gravel by 3-5 years.

Resurfacing

At some point, the existing gravel surface will have deteriorated to an extent where re-gravelling the road is necessary. Using locally available reject gravel with adequate fine material is utilized by many jurisdictions for gravel roads. ODOT specified ¾"-0" rock is for base material and not adequate as a gravel surface. Prior to placing gravel, clean out culverts and re-grade ditches. Raise grades of low areas with drainage problems and install culverts as needed. Gravel shall be placed in 6" maximum lifts with adequate moisture content. The gravel should be formed and compacted to a crown or shed section with a cross slope of about 4%. Smooth transitions shall be constructed between driveways and intersecting roads. Applying dust abatement is a cost-effective method to extend the service life of the gravel.

Dust Abatement

Dust abatement is currently not part of road maintenance practices within Crooked River Ranch. Often, dust abatement is seen as an extra cost that can be sacrificed to save money. However, applications of Magnesium Chloride also assist in stabilizing and preserving the integrity of gravel roads. Magnesium Chloride attracts moisture, which maintains the binding of fine materials within the road base. Including dust abatement with annual watering, blading, and compacting of gravel roads would increase maintenance costs, but could substantially extend the service life of a gravel road.

Drainage

Ditches

Ditches should be graded as necessary to ensure adequate flow along road grades and to maintain adequate depth to retain stormwater runoff. Smooth transitions between culverts should be maintained and excess material deposited where it will not obstruct stormwater runoff. Ditches should be a minimum of 1.5 feet deep, although deeper ditches may be necessary to provide positive drainage to culverts. Check dams should be placed on steeper roads (>5%) at adequate intervals to minimize erosion.

Culverts

Culverts should be clear of debris and allow for free flow of stormwater runoff. Providing sumps at the inlets and outlets of culverts helps minimize the amount of debris entering a culvert. Placing rock at the inlets and outlets will help stabilize the ends of the culvert and minimize erosion.

RECOMMENDED ROAD IMPROVEMENTS

The following are recommended improvements, which are based on AKS's inventory of the CRRSRD roads, the recommended road classification, and discussions with agencies that serve Crooked River Ranch. See Diagram 3 to identify the location of the proposed improvements. Please note the cost estimates provided are very preliminary and can vary substantially depending on the actual constructed improvements. The extent of road improvements is based on the existing funding the CRRSRD receives. Additional funding may allow for more road improvements, but the road system should be evaluated to determine an appropriate priority for road improvements.

Road Improvements should conform to adopted CRRSRD standards and be based on the road's classification. See Appendix 2 for standard road cross sections.

Geometric design of roads shall conform to current AASHTO recommendations. Construction specifications shall conform to current ODOT Standard Specifications, except as modified by the Engineer. Drainage improvements shall conform to Jefferson County Code Road Standards. Deviations from standards shall be considered by the CRRSRD as applicable.

- 1. Secondary Exit from Crooked River Ranch to Lower Bridge Road:** Extend paved road from Southern terminus of Quail road to Lower Bridge Road. The secondary exit would provide a much needed additional route for traffic entering and exiting the Ranch. Currently, small numbers of drivers utilize unimproved dirt roads on BLM lands that pass by either side of Steamboat Rock and connect to Lower Bridge Road. This area is not under the jurisdiction of the CRRSRD. Re-establishing the CRRSRD's boundary would be necessary to include a propose route to Lower Bridge Road. Adding this route to the CRRSRD system would substantially change traffic patterns within the Ranch. Many residents in the southern portions of the Ranch would likely use this route rather than Chinook Drive. The altered traffic patterns would result in more use of CRRSRD roads rather than County maintained roads and could lead to more frequent road maintenance. The CRRSRD needs to be especially aware of its limited funding and to analyze the secondary exit's financial impact. Total length = 1.0 mile.
Estimated Cost: \$450,000

- 2. Badger Road Curves Improvements:** The Badger Road curves are a current traffic hazard, especially during winter driving conditions (often this section of road is closed during hazardous conditions). The curves are very tight and may need additional superelevation. Additionally, sight distance at the intersections of Badger & Steelhead and Badger & Rainbow is inadequate. The Badger Road curves are located outside of dedicated public right-of-way. Badger Road needs to be surveyed and analyzed for design solutions that will improve safety on curves between Rainbow and Steelhead as well as improve

intersection sight distance. Additionally, right-of-way should be acquired and adjacent parcels realigned. The design solution will involve grading, excavation, and realignment of Badger Road. Please note the provided cost estimate is a very rough number and is largely dependant on the design solution. Total length = 0.2 miles.

Estimated Cost: \$100,000

- 3. Pave Rainbow and Bullhead:** Rainbow and Bullhead Roads comprise the largest area of Crooked River Ranch without any paved roads. A paved road from Rainbow Road's northern intersection with Quail Road to Bullhead Road's intersection with Badger would improve traffic circulation in this area and benefit many Ranch residents. To facilitate this improvement, the intersection between Bullhead and Rainbow would need to be re-aligned to allow for smooth travel. Sight distance at the intersection between Bullhead and Badger is inadequate and could require grading. Although acquiring right-of-way can occur at any time, improvements to the Badger Road curves should be completed before improving Rainbow and Bullhead. There are safety concerns with the alignment and grade of the Badger Road curves and improving Rainbow and Bullhead would likely increase traffic to this difficult section of road. Total Length = 2.2 miles.

Estimated Cost: \$450,000

- 4. Pave Dove Road:** Provide a paved surface on Dove Road from the end of pavement (at the BLM boundary) to the intersection with River Road. Paving Dove Road in this area improves traffic circulation and provides better emergency access. Total length = 2.6 miles.

Estimated Cost: \$450,000

- 5. Pave Business Circle:** Pave remainder of Business Circle to Commercial Standards. Total Length = 0.4 miles.

Estimated Cost: \$120,000

Sight Distance

Many intersections within CRRSRD roads do not have adequate intersection sight distance. Juniper trees often create sight obstructions at intersections. Some intersections have obstructions caused by terrain and would require mass grading to fix. Most of these intersections experience relatively low traffic volume, although the potential for a collision exists.

To improve sight distance at intersections obstructed by juniper trees and brush:

- Remove juniper trees and brush in the public right-of-way.
- With property owner's permission, remove juniper trees within the intersection sight triangle. If possible, acquire sight distance easements to ensure long term maintenance of sight distance triangle.

- If the property owner does not grant permission, ensure juniper trees are pruned per the local regulations.
- Install intersection signs on the major road prior to the intersection to warn motorists.

Obstructed intersection sight distance caused by topography can be very costly to improve and can be cost-prohibitive for an intersection with low traffic volume. The CRRSRD's limited funding will likely not be spent on improving these intersections. However, installing intersection traffic signs are a cost-effective measure that make drivers aware of intersections and can improve safety.

Intersections with inadequate sight distance include:

Bill's Place & Sand Ridge
 Blue Jay & Dove
 Bullhead & Badger
 Buckskin & Quail
 Canyon & Shad
 Cinder Cone & Cinder
 Cinder Cone & Shad
 Ermine & Bullhead
 Hummingbird & Sand Ridge
 Narissa & Dylan
 Nighthawk & Quail
 Nine Peaks (Private) & Shad
 Noah Butte & Shad
 Parkey & Dove
 Panorama & Shad
 Rainbow & Badger
 Rainbow & Quail
 Sandy Place & Cinder
 Scenic View & Shad
 Steelhead & Badger
 Tarpon & Rim

Pavement Improvements:

Some of the paved roads under the CRRSRD's jurisdiction are beginning to show cracking and should receive some maintenance and repair soon. Most work would consist of sealing cracks and occasional patchwork. The Club and Maintenance Association and the CRRSRD plan to have incidental repairs accomplished this year on Chinook Drive. Other roads that may require repairs soon include:

Parkey (between the new chip seal sections placed in 2008)
 Peninsula
 Quail (between the new chip seal sections placed in 2008)

Sage Hen

There were other paved roads which exhibit occasional cracking and shoulder failure, but were in reasonable condition and are not expected to require repairs within the next few years.

Gravel Road Improvements:

A number of local roads were resurfaced with reject gravel in 2008. The gravel was wetted down and compacted to provide a firm base. These roads are holding up well, although many of them do not have a well defined crown. A well defined crown will help prevent stormwater from ponding on the road and increase the likelihood of potholes.

As discussed previously, local roads within the Ranch should continue to be re-graveled as funding allows. Ditch grading and installation of necessary culverts should occur at the same time as local roads are being re-graveled. Priority to re-graveling should be based on number of residents served and emergency access.

CONCLUSION

The primary concern of the CRRSRD (and the Club and Ranch Maintenance Association) should be road funding. Current funding for the CRRSRD is not adequate to continually convert gravel roads to paved roads, and possibly to maintain existing paved roads. The recommended improvements in this report represent an approximate limit of paved roads the CRRSRD (with the help of the Association) can expect to maintain in a reasonable condition. After those improvements are complete, most of the CRRSRD funds are expected to go towards maintaining current infrastructure. As shown in Appendix 7, maintaining existing paved surfaces with chip seals can minimize costs and could potentially work within the CRRSRD and the Association's budgets.

At this time, including dust abatement (MgCl) with annual gravel maintenance does not appear cost effective for the Ranch. However, applying dust abatement can potentially increase the lifetime of gravel roads – especially those that receive substantial traffic. If budgets permit, AKS recommends experimenting with dust abatement on specific gravel roads (Steelhead, north of Badger might be an ideal candidate) to determine if dust abatement could benefit the Ranch's gravel road maintenance. Both Jefferson and Deschutes Counties utilize dust abatement and coordination with their application schedules could help reduce the potential cost.

There are residents in Crooked River Ranch who would like to see more paved roads. However, the CRRSRD will require a permanent increase in funding to continually pave more roads. Alternatively, residents can set up a Local Improvement District which would allow additional roads to be paved under separate funding.

Future road improvements need to adhere to the current Road Management Plan that is adopted by the CRRSRD and the Club and Ranch Maintenance Association. The minimum standards included in the Road Management Plan will ensure adequate road construction within the Ranch and extend the durability of new roads. This report's recommendations to the Road Management Plan will also ensure improved road quality and extend the value of the limited funding road improvements receive. Furthermore, the adoption of specific drainage standards for the Ranch can minimize damage caused by stormwater runoff, extend the lifetime of road improvements, and save much needed funds in the future. High road quality improves the value of Crooked River Ranch, which yields a benefit to CRRSRD's tax base.

During the preparation of this report, many organizations responded very favorably to a secondary access to Crooked River Ranch via Lower Bridge and Quail Roads. Many agencies that serve Crooked River Ranch and the residents would benefit greatly by an alternate route to and from the Ranch. A secondary access to Crooked River Ranch would alter the traffic patterns of the Ranch and result in heavier traffic

on CRRSRD maintained roads. The extent of heavier traffic is not known, but there is a potential for increased maintenance cost on CRRSRD's roads.

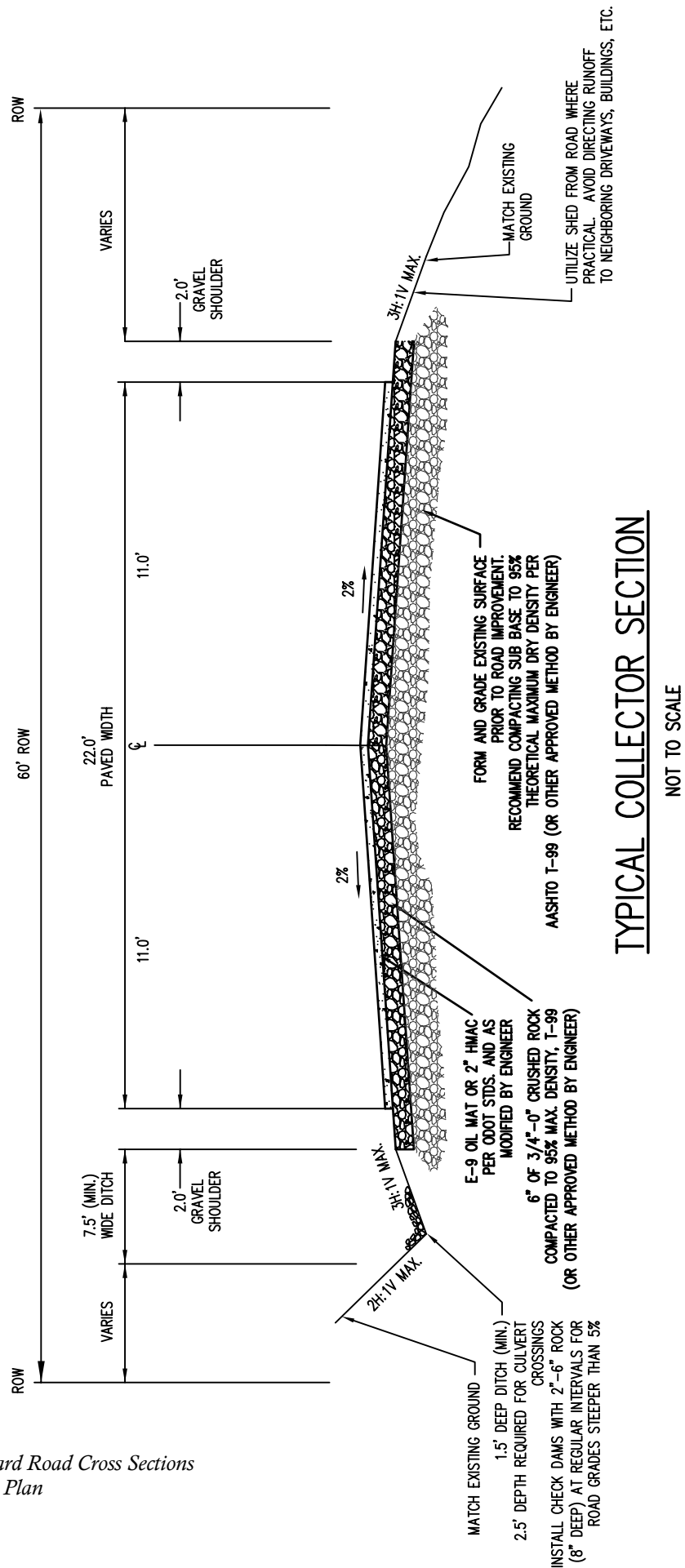
Lastly, increased intersection sight distance and traffic signage within the CRRSRD's jurisdiction will improve traffic safety within the Ranch. Small improvements such as these can be accomplished with limited funding and yield important benefits.

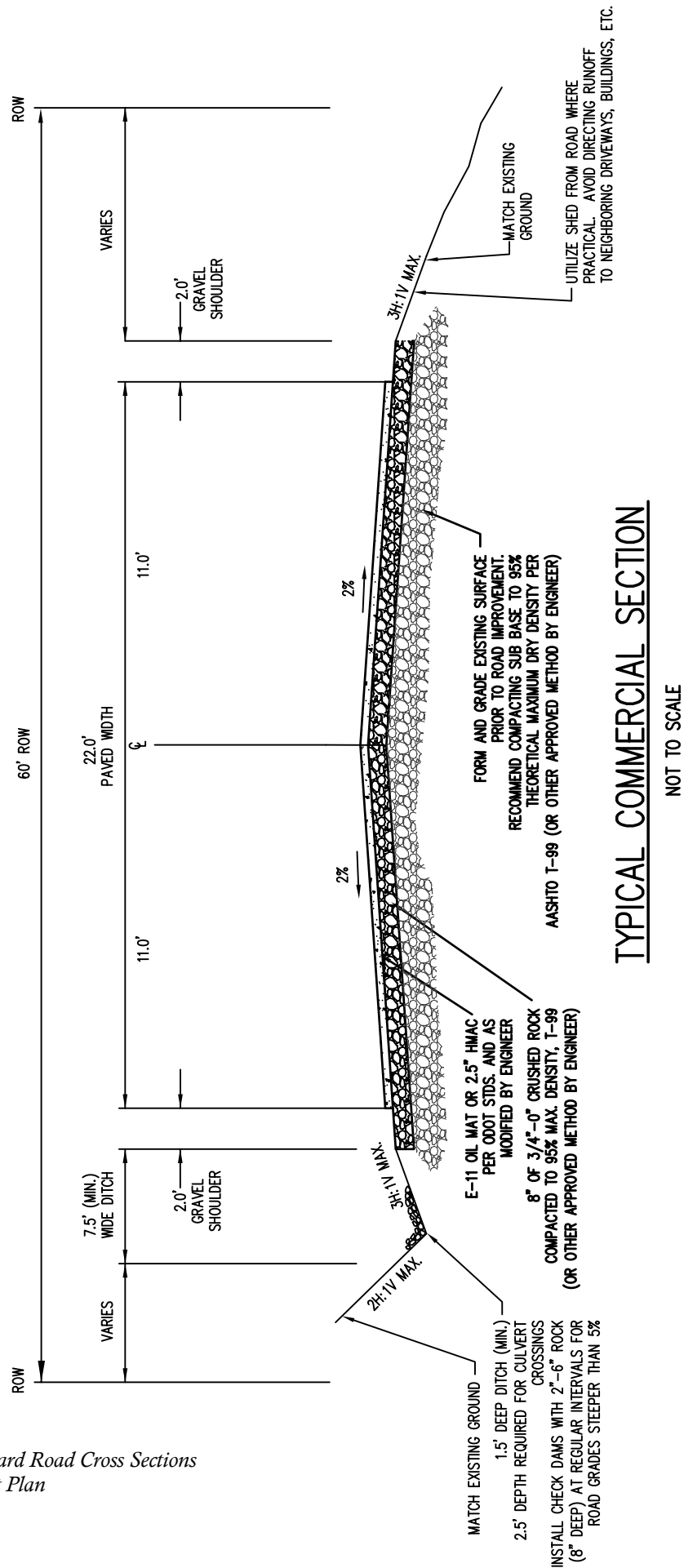
ROAD NAME	DISTANCE	CLASS.	DIRT	REJECT	CINDER	GRAVEL	OIL MAT	ASPHALT	MIN. WID	MAX. WID
ANTELOPE DR	0.9	Local	0.2	0.4		0.3			10	27
BADGER RD (E. OF CHINOOK)	0.4	Local	0.4						18	22
BADGER RD (W. OF CHINOOK)	1.8	Collector						1.8	22	24
BASALT RD	0.5	Collector					0.5		22	23
BIG SKY PL	0.2	Local	0.2						15	15
BILL'S PL (CRR)	0.1	Local	0.1						12	13
BILL'S PL (PRIVATE)	0.1	Private	0.1						12	12
BLUE JAY	1.1	Local	1.1						16	17
BOBCAT CT	0.2	Local	0.2						9	12
BOX CANYON	0.2	Local	0.2						12	12
BROKENTOP DR	0.2	Local				0.2			14	16
BUCKAROO PL	0.1	Local				0.1			14	14
BUCKHORN PL	0.2	Local	0.2						15	15
BUCKSKIN LN	1.0	Local	1.0						17	17
BUFFALO PL	0.1	Commercial					0.1		15	15
BULLHEAD RD	1.1	Commercial	0.7		0.4				21	23
BUSINESS CIRCLE	0.5	Commercial	0.4					0.1	14	21
CANARY RD (N. OF SAND RIDGE)	0.4	Collector					0.4		14	24
CANARY RD (S. OF SAND RIDGE)	0.3	Local	0.3						14	24
CANYON DR	0.8	Local	0.8						14	19
CANYON VIEW	0.2	Local	0.2						14	14
CASCADE VIEW PL	0.1	Local	0.1							
CHANDLER RIDGE PL	0.3	Local	0.3						14	16
CHAPARRAL PL	0.1	Local	0.1						17	17
CHICKADEE RD	1.0	Local	0.3	0.7					17	20
CHINOOK DR (COUNTY)	2.8	County						2.8	-	-
CHINOOK DR (CRR)	1.6	Commercial						1.6	24	24
CHIPMUNK RD	1.0	Local	1.0						19	20
CHUKKAR	0.2	Local	0.2						13	14
CINDER CONE	0.5	Local	0.5						19	19
CINDER DR	1.6	County						1.6	-	-
CLUBHOUSE RD	0.4	Commercial						0.4	24	24
COMMERCIAL LOOP	0.9	Commercial						0.9	23	24
CORNER PL	0.1	Local				0.1			16	16
CORRAL PL	0.1	Local	0.1						16	16
COTTONTAIL DR	0.3	Local			0.3				23	23
COUGAR RD	0.7	Local	0.7						20	20
CRATER LOOP RD	0.9	Local	0.7	0.2					19	21
CRESCENT PL (CRR)	0.2	Local	0.2						14	14
CRESCENT PL (PRIVATE)	0.1	Private	0.1						14	14
CROOKED	0.1	Local	0.1						18	18
DANE'S PL	0.1	Local	0.1						15	15
DEER CROSSING PL	0.2	Local	0.2						13	20
DEER RD	0.3	Local			0.3				15	15
DINGO LN	0.6	Local	0.6						19	19
DOVE (RIVER TO CRR IN BLM)	2.7	Collector	2.7						20	23
DOVE (QUAIL TO CRR IN BLM)	0.3	Collector					0.3		22	23

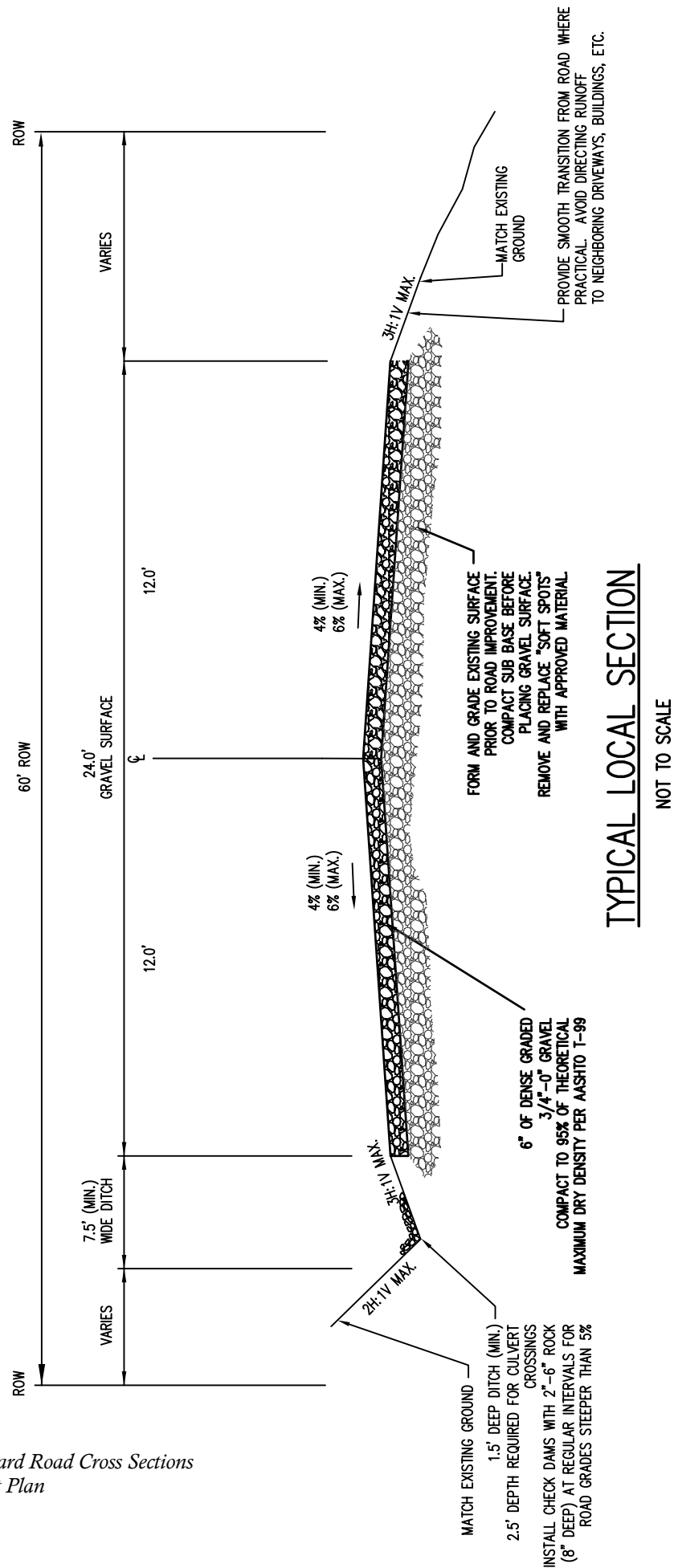
ROAD NAME	DISTANCE	CLASS.	DIRT	REJECT	CINDER	GRAVEL	OIL MAT	ASPHALT	MIN. WID	MAX. WID
DOVE (ROBIN TO RIVER)	1.0	Local	1.0						20	23
DYLAN CIRCLE	0.7	Local	0.7						17	17
EAGLE VISTA PL	0.1	Local				0.1			18	18
ELKHORN LN	0.4	Local	0.4						17	18
EQUESTRIAN PL	0.1	Local	0.1						17	17
ERMINE RD (QUAIL TO SAGE HEN)	0.6	Collector						0.6	24	24
ERMINE RD (SAGE HEN BULLHEAD)	0.7	Local	0.7						20	20
FAWN DR	0.5	Local	0.2	0.3					20	22
FERRETT RD	1.0	Local	1.0						18	20
FILLY PL	0.1	Local	0.1						17	17
FOLLY WATERS	0.5	Local		0.5					17	19
FOX CT	0.2	Local	0.2						21	21
FROG CT	0.1	Local	0.1						19	19
GENEVA VIEW PL	1.1	Local		1.1					20	20
GOLDEN MANTEL RD	0.8	Local	0.8						18	19
GONO PL	0.1	Local	0.1						13	13
GRASSLAND PL	0.1	Local	0.1						15	15
GROUNDHOG RD (CRR)	0.7	Local	0.3	0.4					11	19
GROUNDHOG RD (PRIVATE)	0.5	Private	0.5						16	16
GROUSE PL	0.1	Private	0.1						12	12
HADDOCK RD	0.4	Local	0.4						14	14
HAYS RD	0.3	Private					0.3		24	24
HAWK PL	0.0	Local				0.0			15	15
HIGHCONE DR	0.6	Local	0.6						18	19
HILL RD	0.7	County						0.7	-	-
HOMESTEAD PL	0.1	Local				0.1			15	15
HOOD VIEW PL	0.1	Local	0.1						17	17
HORN'Y HOLLOW TRAIL (HILL TO R.H.)	0.2	Commercial						0.2	12	12
HORN'Y HOLLOW TRAIL (R.H. TO END)	1.7	Local						1.7	12	12
HUMMINGBIRD RD	0.4	Local	0.4						15	16
ICE	0.7	Local	0.7						24	24
JACK PINE PL	0.1	Local	0.1						19	19
JEANE'S PL	0.0	Local	0.0						14	14
JEFFERSON VIEW PL	0.1	Local				0.1			18	18
LORDS PL	0.1	Local			0.1				18	18
LYNX CT	0.2	Local		0.2					12	13
MARE PL	0.1	Local	0.1						16	16
MARMOT CR	0.2	Private			0.2				11	11
MAVERICK RD	0.7	Local			0.7				17	22
MEADOW RD (PEN. TO SCOUT CAMP)	0.6	Collector					0.6		14	23
MEADOW RD (S. SCOUT CAMP TRAIL)	0.1	Local	0.1							
MESA	0.2	Local	0.2						14	18
MINNOW CT	0.2	Local	0.2						12	12
MUSTANG RD (COUNTY)	1.1	County						1.1	-	-
MUSTANG RD (CRR)	0.7	Collector					0.7		23	23
NARISSA (EAST)	0.1	Local	0.1						17	17
NARISSA (WEST)	0.1	Local	0.1						15	15

ROAD NAME	DISTANCE	CLASS.	DIRT	REJECT	CINDER	GRAVEL	OIL MAT	ASPHALT	MIN. WID	MAX. WID
NIGHTHAWK LN	0.6	Local	0.6						20	21
NINE PEAKS PL	0.1	Private			0.1				12	12
NOAH BUTTE DR	0.2	Local	0.2						16	16
OASIS CT	0.1	Local	0.1						12	12
ONYX RD	0.4	Local	0.4						16	17
OTTER CT	0.1	Local	0.1						14	14
OUTLOOK PL	0.1	Local			0.1				17	17
PANORAMA RD	1.0	Collector						1.0	23	24
PARKEY	0.6	Collector					0.4	0.2	23	23
PASTURE CT	0.2	Local	0.2						14	17
PENINSULA DR (COUNTY)	1.1	County						1.1	-	-
PENINSULA DR (CRR)	2.5	Collector		0.4				2.1	17	24
PENINSULA DR (CRR - N. GENEVA V.)	0.9	Local	0.9							
PERCH RD	0.4	Local	0.4						19	20
PHEASANT PL	0.4	Private	0.4						8	12
PLACER	0.1	Local	0.1						16	16
PONY TRAIL	0.5	Local	0.5						17	18
PORCUPINE PL	0.1	Local				0.1			12	12
PRAIRIE RD	0.7	Local				0.7			16	18
PUMA RD	0.9	Local	0.9						14	19
PUMICE CT	0.1	Local	0.1						15	15
QUAIL	5.5	Collector					4.9	0.6	22	24
RAINBOW DR	0.3	Local	0.3						13	13
RAINBOW RD (BADGER TO S. QUAIL)	1.3	Collector						1.3	23	23
RAINBOW RD (BULLHEAD TO BADGER)	0.9	Local	0.9						20	21
RAINBOW RD (N. QUAIL TO BULLFROG)	1.1	Collector	1.1						20	21
RANCH HOUSE PL	0.1	Commercial					0.1		11	11
RIDGE PL	0.3	Local					0.3		16	16
RIFFLE	0.1	Local	0.1						14	14
RIM RD	1.0	Local						1.0	24	24
RIVER (E. OF DOVE)	0.2	Collector					0.2		23	23
RIVER (W. OF DOVE)	0.7	Local		0.7					10	23
RIVER TERRACE PL	0.1	Local	0.1						13	13
ROBIN DR	0.8	Local	0.8						20	20
ROUNDUP PL	0.3	Local	0.3						14	18
SAGE HEN RD	0.7	Collector						0.7	20	24
SALMON RD	0.4	Local		0.4					15	16
SAND RIDGE RD (CANARY TO SHAD)	1.2	Collector					1.2		19	23
SAND RIDGE RD (CANARY TO CHICK.)	0.5	Local		0.5					19	23
SANDY PL	0.2	Local	0.2						16	16
SCENIC VIEW PL	0.1	Local	0.1						15	15
SCOUT CAMP TRAIL	0.3	Local	0.3						17	19
SHAD RD (COUNTY)	4.0	County						4.0	-	-
SHAD RD (CRR)	1.5	Collector						1.5	24	25
SHELF CR	0.0	Local	0.0						12	12
SHELTERED PL	0.1	Local	0.1						16	16
SISTERS VIEW PL	0.1	Local	0.1						13	13

ROAD NAME	DISTANCE	CLASS.	DIRT	REJECT	CINDER	GRAVEL	OIL MAT	ASPHALT	MIN. WID	MAX. WID
SNUG PL	0.1	Local	0.1						16	16
SPARROW DR	0.6	Local	0.5		0.1					
SPUR PL	0.3	Local	0.3						15	20
STALLION DR	1.0	Local	1.0						19	20
STEELHEAD	2.2	Local	1.4	0.8					18	22
STEELHEAD FALLS	1.1	Local	1.1						24	26
SUMMIT VIEW PL	0.1	Private	0.1						12	12
SUMPTER	0.7	Local	0.7						20	21
SUNDOWN CANYON RD	1.0	Local	0.3	0.7					15	17
SWALLOW DR	0.4	Local	0.4						16	16
SWANNIES PL	0.1	Local	0.1						14	14
TADPOLE CT	0.1	Local	0.1						18	18
TARPON RD	0.4	Local	0.4						15	16
TERRESAN PL	0.0	Local	0.0						13	13
THICKET	0.2	Local	0.2						15	22
TOWER RD	0.3	Private		0.3					18	18
TROUT RD	0.9	Local	0.2		0.2	0.5			10	16
UPLIFT	0.1	Local	0.1						17	17
UPPER RIDGE RD	0.3	Local				0.3			20	20
WATERHOLE PL	0.4	Local	0.4						17	17
WHEAT GRASS RD	0.5	Local		0.5					17	18
TOTAL MILES	90.3		40.0	8.1	2.6	2.6	10.1	27.0		
TOTAL PRIVATE	2.2	miles								
TOTAL COUNTY	11.4	miles								
TOTAL SRD	76.7	miles								
TOTAL COLLECTOR	23.1	miles								
TOTAL COMMERCIAL	4.9	miles								
TOTAL LOCAL	48.7	miles								







ROAD MANAGEMENT PLAN

FOR

CROOKED RIVER RANCH

SPECIAL ROAD DISTRICT

AND

CLUB AND MAINTENANCE ASSOCIATION

2008

INTRODUCTION:

Roads within Crooked River Ranch (“CRR”) are the highest priority for the CRR residents, the Crooked River Ranch Club and Maintenance Association (Association), and the Crooked River Ranch Special Road District (District). The unofficial total miles of roads within CRR are approximately 120 miles. There are 11.9 miles of roads maintained by Deschutes and Jefferson Counties. The balance of the road system is maintained by the District and the Association. This currently consists of approximately 13.8 miles of paved roads and 90 miles of non-paved (gravel and/or dirt) roads.

The counties of Deschutes and Jefferson have jurisdiction over public roads as stated in ORS Chapter 368. However, they only maintain roads accepted into the “County Road System”. To be considered for adoption into the county road system a road must comply, in all respects, with the design standards of the county. However, they are not likely to accept any additional roads for maintenance into their road system due to budgetary constraints. The District and Association therefore need to plan on being responsible for the improvements and maintenance of the balance of the road system.

This Road Management Plan deals with the roads in CRR that are not accepted into the County Road System (“CRR roads”). It establishes agreed upon roles and responsibilities for the District and the Association, highlights road issues, develops construction and maintenance standards, and identifies roads planned for improvements.

HISTORY:

In 1972, Bill MacPherson developed the original CRR subdivision. It was the developer’s responsibility to construct and maintain the road system as stated in the Covenants, Conditions and Restrictions: The Association is “obligated for the cost of removal of snow from and the maintaining of all roads, streets, avenues and places within this plat...” (CC&R’s Articles IX).

Until 1982, CRR was zoned as Rural Recreation, lots were sold and intended to be used for recreational purposes. As owners started to build permanent residences, the zoning was changed to Rural Residential to accommodate the needs of a growing, permanent population. The road system, as maintained by the Association, was thought to be inadequate to meet the needs of this growing population. In 1982, an election was held to create a “Special Road District” empowered to assess, levy and collect taxes on all taxable real property within the district. The District encompasses all platted property within the CRR. All properties within the District pay \$0.814/\$1000 of the taxable value of their property to the District as property taxes each year. This amounts to an annual income of approximately \$175,000 to be used for road improvement and maintenance.

On June 27, 2000, the District and the Association entered into a settlement agreement that designated the District as having primary authority and jurisdiction over the public

roads within the boundaries of the District except roads accepted by Deschutes or Jefferson County. The agreement also delegates to the Association the authority to perform road maintenance on the District managed roads. The District shall determine, and the Association shall comply with, District road maintenance standards.

ROLES AND RESPONSIBILITIES:

The District has the primary responsibility for CRR roads. It is a form of local government with three elected Board of Directors who meet monthly at a public meeting. Their primary roles and responsibilities are as follows:

1. Implement construction and improvement of CRR roads;
2. Notify Association of all improvement projects;
3. Develop road construction and maintenance standards;
4. Provide a forum to receive public input on road issues;
5. Develop an annual budget;
6. Have open and timely communication with the Association;
7. Notify Association of all District meetings;
8. Have a representative attend all Association meetings where road issues are discussed;
9. Advise Association of road maintenance issues; and
10. Work jointly with Association to develop and maintain a Road Management Plan.

The District encourages residents of the ranch to attend the monthly meetings in order to be informed and to offer input to help the District better serve the ranch residents.

The Association is delegated with the authority to perform road maintenance on District managed roads. The Association is a private non-profit mutual benefit corporation with members incorporated under ORS Chapter 65. The Association is governed by a nine-elected Board of Directors that hold monthly meetings open to all CRR members. Their primary roles and responsibilities related to road management are as follows:

1. Perform required maintenance on all CRR roads in accordance with District standards;
2. Perform snow removal and sanding of roads as needed;
3. Construct gravel road improvements;
4. Develop an annual road maintenance budget;
5. Develop and maintain a continual six-month schedule of road improvements and maintenance activities with time projections;
6. Notify the District of all road improvement and other projects to be performed;
7. Notify the District of all regular or anticipated maintenance activity;
8. Have open and timely communication with the District;
9. Notify the District of all meetings that road issues will be discussed; and
10. Work jointly with District to develop and maintain a Road Management Plan.

ISSUES:

Drainage of roadways, dust abatement, washboard roads, speed, emergency exit route, missing street signs, and safety of non-motorized traffic are among just some of the issues that are being identified, and reviewed.

Many roads have a flat parabolic crown or no crown. This allows water to stand on the road surface, weakening the structure and causing potholes and washboard surfaces. Many of the roads had ditches that were filled with roadway aggregate that has been bladed off the surface. The roadway material that was bladed to the ditch, further exacerbating the drainage problems often blocked crossing culverts and driveway culverts.

Dust abatement is a concern for many residents on the ranch. The policy of the District and the Association has been to not spend District or Association funds on dust abatement. Dust abatement can be contracted for and funded by individual or groups of individuals on District managed roads. Contact the Association administration office for the process and application forms to apply dust abatement.

Wash boarded road surfaces are accelerated by hard braking, fast acceleration, and excessive speed on both gravel and native material roads. Grading the roads to eliminate the wash boarding creates more dust and allows for higher speeds which cause the surface to develop wash boards again. This is a never ending cycle, which has been difficult to resolve.

Speeding is a problem and safety issue. There are no speed limits established on district roads. Speed limits can only be established by the State Traffic Engineer. This is usually done after a speed limit investigation is completed. The speed is then set at the 85th percentile, which is the speed that 85 percent of the traffic is traveling. However, this may not be the speed that is desired by the community, but what may be designated once the study is completed. Another process to establish speed limits on some District managed roads is to identify the roads that are residential and ask the county to pass a resolution that sets the speed at 25 mph. ORS 801.430 defines a residential district as a territory not comprising a business district that is contiguous to a highway that:

- (1) Has access to property occupied primarily by multifamily dwellings; or
- (2) Has an average of 150 feet or less between accesses or approaches to:
 - a. Dwellings, churches, public parks within cities or other residential facilities; or
 - b. Dwellings and buildings used for business.

The road of Horny Hollow Trail is currently in the process of being declared a "residential district" to set the speed limit at 25mph.

Missing street signs are being replaced as they are identified and funds are available.

Separation of non-motorized users of roads from vehicular traffic is a safety issue. Currently, this is being addressed through an ongoing process of identification of safe community pathway routes and development of appropriate standards.

STANDARD ROAD SECTION:

The roads within the District that meet the criteria to be classified as Arterial or Major Collector, in accordance with the criteria in the county road standards, are currently a part of the county road system. Roads that will be improved and maintained by the District and Association would all be classified as Minor Collectors or Local Roads, with the majority meeting the Local Roads classification.

The County Code requires that improvements on any roads within the county shall be completed in accordance with the minimum road design standards. However, neither the District nor the Association has the resources to initially improve roads to these standards. The minimum road design standard initially will be to provide an adequate base that can be further improved in the future. When funds become available, improvements will be made to the roads to bring them up to county standard.

INITIAL MINIMUM ROAD DESIGN STANDARDS

	Collector	Local Road
Typical ADT	600-2500	0-600
Min R/W width	60 ft	60 ft
Lane Width	11 ft	10 ft
Shoulder Width	2 ft	2 ft
Shoulder Surface	Gravel	Gravel
Sub-base Depth		4 inch
Base Depth	6 inch	2 inch
Road Surface	AC or Oil Mat	Gravel
Surface Depth	2 inch AC/3 shot	2 inch

It should be noted, that Oil Mat (Chip Seal) roads might not be as smooth as AC constructed roads. However, the intent for using Oil Mat surface is to get additional hard surface roads with the cost savings.

All roads shall be constructed in accordance with Oregon Department of Transportation "Standard Specifications for Highway Construction".

Sub-base gravel shall well graded "reject gravel" that can be easily graded and compacted, without an excess of organic material, which is approved by the Association road supervisor.

Base and surface gravel shall comply with Section 02630 of the 2002 Oregon Department of Transportation Standard Specifications. Gradation shall comply with Table 02630-1, English measurement, 3/4"-0" requirement, sand equivalent shall be not less than 22. It

is the intent that aggregates shall be such that when watered, shaped and compacted, the base material will be firm and stable and there will be minimum raveling under moderate traffic conditions.

All road sections shall be graded with a 4 percent slope on gravel roads and a 2 percent slope on hard surface roads from the center down to the edge and a minimum one foot ditch on each side with a 3 to 1 slope and an 1 1/2 to 1 back slope. A lesser depth ditch may be approved by the Association road supervisor based on sub base conditions and/or topography of the surrounding area.

Where practical, all road sections shall be graded with a pedestrian/equestrian pathway between the ditch and the right of way line as the roads are improved. The minimum width for these pathways will be five (5) feet. Due to limited resources, these pathways will be roughed in only, and may not include removal of large trees and larger rocks.

MAINTENANCE:

Paved and oil mat roads are to be surveyed annually to identify the number and location of surface cracks. The cracks will then be sealed to exclude water from entering the roadway structure.

All roadways will be crowned to maintain proper drainage. Roadway crowns shall be a flat "A" shape, rather than a curved or rounded shape. The slope from the center of the road to the outer edge should slope down in a straight line at four to six percent.

Ditches are necessary for adequate drainage and shall be kept free of obstructions. To allow proper drainage culverts are also critical and must be unobstructed to allow proper drainage. Surface material previously bladed to the sides of roadways shall be removed to allow proper drainage.

All gravel and natural surfaced roads will be bladed at least once a year.

Pathway maintenance will be limited at this time due to budgetary constraints. Other recourses, owners or volunteers will need to accomplish any needed maintenance of pathways.

Driveway maintenance is the responsibility of the property owners. Owners whose driveways are accessed from a paved road should be inspected by them and maintained to insure against damaging the pavement. To prevent damaging the pavement, it is recommended that the property owner provide a concrete or asphalt driveway approach extending a minimum of three feet from the pavement edge and a minimum of twelve feet wide. This is a minimum recommendation for existing driveways and does not meet the county standard. The county standard driveway approach will be required with any new construction or improvement.

PLANNED IMPROVEMENTS:

Limited funds are available for road improvements and maintenance. The primary objective is to provide for a safe and sustainable road surface for a network of roads that benefits residents by reducing the distance and time traveled on unimproved roads. A secondary objective is to reduce the time and expense of maintaining CRR roads. Available funds will be utilized in a balance between maintenance, improvements by graveling native surfaced roads, and improvements of roads to a hard surface.

The second objective is to separate motorized vehicle traffic from pedestrians and equestrians.

Factors in determining road improvements and maintenance are:

1. Safety,
2. Average Daily Traffic,
3. Designated traffic routes/emergency routes,
4. Driveway density and density at build-out,
5. Road grade/slope, and
6. Maintenance cost and/or savings.

The Association budgets funds annually for road maintenance. This includes purchasing material for improving roads and the cost of operating and maintaining the Association Road Maintenance Department. The Association improves roads to the Local Road standard listed in the Standard Road Section. The goal of the Association is to improve three to four miles of roads each year to this standard.

In 2006, the District applied for and received funds from a program called “flex lease”. This program allows for funding from borrowed moneys to complete some paving projects sooner than they could with just their normal income. The majority of the tax income for the next 10 years will be used to repay this loan. The roads that are proposed for improvements of a hard surface are:

2008:

1. Quail Rd. from Shad Rd. to Buckskin Ln. and Mustang Rd. from Quail Rd to Shad Rd. (tax funds)
2. Quail Rd. from Ermine Rd to the Southern boundary of CRR., River Rd. from Quail Rd. to Dove Rd. and Dove Rd. from Quail Rd. to ¼ mile South. (Flex lease)

2009-2010:

1. Rainbow Dr. from Quail Rd. to Bullhead Rd. (flex lease)
2. Bullhead Rd. from Rainbow Dr. to Badger Rd. (flex lease)

Projects that are unscheduled, but are needed at this time are:

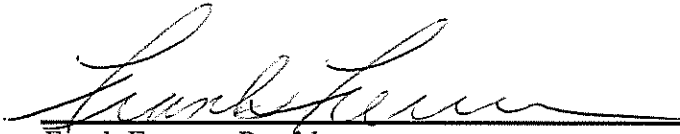
1. Badger Rd. hill modifications. (The District applied for a grant early in 2008 for funds to provide concrete barriers along the road.)
2. Chinook Dr. from Clubhouse Rd. to Hill Rd. overlay and/or chip seal.

Property owners may have the road adjacent to their property improved with a hard surface through a Local Improvement District (LID) process. The property owners along a road agree to pay for the improvement and petition the County to have the work accomplished. Property owners who want to proceed in having their road improved and are willing to pay for it should contact the Association administration office for information. The road to be improved must connect to an existing hard surfaced road. The District and the Association may participate in the cost of the improvement depending on resources and funding.

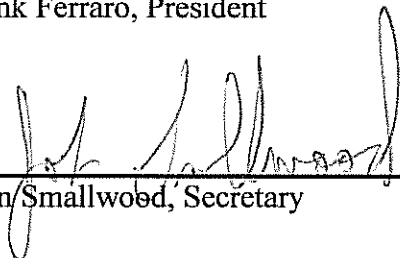
Adopted:

Crooked River Ranch Club and Maintenance Association

On the 19th day of May



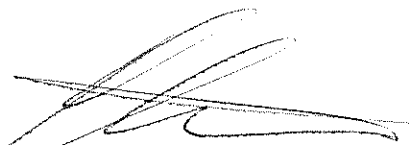
Frank Ferraro, President



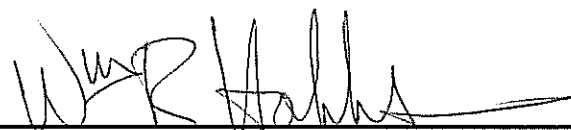
John Smallwood, Secretary

Crooked River Ranch Special Road District

On the 19 day of March



Clyde Stryker, Chair



William Hobbs, Secretary

Brian F. Barnett, P.E.
39404 Upper Camp Creek Road
Springfield, OR 97478

April 23, 2007

Aaron Palmquist
Community Manager
Crooked River Ranch Club and Maintenance Association
5195 SW Clubhouse Road
PO Box 1477
Crooked River Ranch, OR 97760

Subject: Roadway Conditions and Maintenance Practices

Dear Mr. Palmquist:

This letter summarizes observations of Crooked River Ranch roads during an area visit conducted on April 14, 2007 under your guidance, and recommends several actions that will improve the quality of roadway surfaces and contain maintenance cost.

Background

Crooked River Ranch (CRR) has approximately 122 miles for roads to serve about 2,500 members covering 11,000 acres. Topography is generally slightly rolling with some canyons of Crooked River and Deschutes River. Ranch population is approximately 5,000 persons and is growing steadily.

Of the 122 miles of roadway in CRR about 12 miles are in Jefferson County or Deschutes County inventories. These 12 miles are maintained by the counties and are an asphalt concrete pavement construction and are not the subject of this report.

A few of the roads in CRR are of chip seal or oil mat construction. The remaining approximately 100 miles of roads are aggregate surfaced.

Commercial activities are centered on an 18-hole golf course, clubhouse, swimming pool, small motel, and a 105-space recreational vehicle park. Additional facilities include space for various concessions and a community church. The golf course enjoys approximately 3,400 plays per year and you expect that figure to increase to 4,200 per year. Occupancy of the RV Park during open season is at 65% of spaces available and is not presently used the entire year.

You have plans to increase the open season for the RV Park and expect to increase the maximum stay limit significantly with a resulting increase in overall occupancy.

Weather conditions during site observations were 50 to 55 degrees F, calm air, and intermittent light rain showers. Measurable rain had fallen the previous night making the ground and roads damp to about 2 inches of depth.

Roadway Conditions

Roads evaluated during the area survey were distributed across the Ranch and included Chinook Drive, Antelope Drive, Badger Road, Sage Hen Road, Ermine Road, Quail Road to the Emergency Exit, Parkey Drive, Dove Road, Robin Road, Chickadee road, Sand Ridge Road, Shad Road, Cinder Drive, Basalt Drive, Peninsula Drive, Stallion Drive, Mustang Road, Rim Road, Meadow Road, Geneva View Road, Business Court, and Commercial Loop Road.

The steep grade of Parkey Drive was paved with asphalt concrete pavement, as was Ermine Road from Sage Hen Road northward to approximately Buckskin Lane. Some roads had chip seal surfaces in good condition. These roads include Basalt Drive, Sand Ridge Drive and Meadow Road. Most of the remaining roads observed were gravel, sand or cinder surfaced.

The gravel surfaces exhibited open graded gravel with non-uniform gradation, a low number of fractured faces, appeared to not be very durable, and had low plasticity. Lack of durability and low plasticity was confirmed by your statement that very high volume of dust is produced when driving on these roads. Dust was not airborne during the area survey due to recent rainfall. Very fine material covered the hands when examining a handful of the aggregate. Washboard surface was frequently noted, as were potholes. Most potholes were near the centerline of the road. Roadway crown was not uniform in slope and most roads had a parabolic crown. Where a road had a flat "A" shaped crown the cross slope was very low. Lack of adequate drainage was noted in several places but was especially severe on Quail Road in the vicinity of River Road intersection where the road has been cut into native soils and water from the surrounding area collects in the roadway. This and other roads were effectively localized valleys where snow and rain have no place to flow off and away from the road. Many of the roads had ditches that were filled with roadway aggregate that has been bladed off the surface. The roadway material that was bladed to the ditch, further exacerbating the drainage problems often blocked crossing culverts and driveway culverts.

In summary, some of the roads are in good condition and need modest preventative maintenance. However, most of the roads are in poor condition. The poor condition is attributed to several factors.

- 1) ~~Lack of adequate surface and side drainage due to~~
 - a) Parabolic crown
 - b) Inadequate roadway cross section, i.e. the roads are below surrounding native ground surface
 - c) Ditches are not clean and clear

- d) Culverts are plugged
- 2) Poor quality and gradation of aggregate due to
 - a) High degradation of the rock
 - b) Limited fracture of the rock, i.e. the rock does not appear to be crushed or crushes to a rounded shape
 - c) Highly uniform rock size, i.e. all of the rock will pass a three quarter inch screen but most will be retained on a #4 screen (approximately ¼ inch square openings)
- 3) Maintenance activities improperly attempted
 - a) Spreading dry maintenance aggregate in dry conditions
 - b) Not attempting any compaction of the aggregate when spreading and shaping
 - c) Compaction by road users driving on the freshly shaped gravel is lost to the side of the road

The consequences associated with these factors include

- 1) water ponding along the central third of the road
- 2) water remains in the roadway cross section
- 3) weak structure and high dust
- 4) the rock rolls on itself rather than interlocking together
- 5) a loose structure that will not bind to itself
- 6) any moisture in the gravel is lost
- 7) compaction by road user traffic is lost when the gravel is below the optimum moisture content

Equipment and Labor Resources

You have identified the following major resources.

- 1) One 10 cubic yard dump truck with plow attachments
- 2) One 5 cubic yard dump truck with plow attachments
- 3) Two motor graders (assumed to have plow attachments)
- 4) One dual smooth steel drum roller
- 5) One back hoe
- 6) Several pickup trucks
- 7) Four snow plow attachments for dump trucks and graders
- 8) Two sand distribution units for use in dump trucks
- 9) Gravel storage yard
- 10) Large maintenance building to house some equipment and gravel stockpiles
- 11) Pick up trucks and small tools
- 12) Four full time equivalent (FTE) employees
- 13) Administrative support staff

The apparent gap in equipment resources is a water transportation and distribution truck.

Financial Opportunities

The ranch assesses an annual fee on a per lot basis. From this fee about \$78 per year is allocated to road maintenance generating about \$195,000 per year. Approximately \$100,000 per year is allocated to materials purchases, primarily aggregates for road maintenance and cinders for snow and ice sanding. In addition a Special Road District (SRD) assesses taxes of \$180,000 per year. Since the SRD is creation of county government the SRD board members believe they need to adhere to County road standards. This claim should be investigated and a determination of the applicable state and county laws that govern the SRD board's actions, the construction and maintenance standards required and the materials used.

Recommended Maintenance Practices

Crack sealing

Paved and chip sealed roads must be surveyed annually to identify the number and location of surface cracks. The cracks must be sealed to exclude water from entering the roadway structure. If cracks are allowed and water enters the subsurface the action of driving across the wet area will weaken the sub structure and cause a pothole.

Cross section

Roadways must be free to drain. Those roads that are on level ground must be built up above the native ground so water has a path to flow off of and leave the roadway area. In the case of roads cut into side slopes the road must be "out sloped", "in sloped" with a ditch, or crowned with a ditch.

An out sloped road has the entire road sloped to the low side of the native slope so water is not trapped between the crown and the high native slope. Water is allowed to run across the road and away from the road. An in sloped road has the entire road sloped to the high side of the native slope and ditches collect and direct the water to a culvert which passes the water under the road to the lower native slope. Ditches and culverts must be carefully sized to allow all the water to pass from the roadway quickly. A crowned road with a ditch uses a normal crown and ditches and culverts like an in sloped road.

Crown

All roads must be crowned to maintain drainage. And in the case of horizontal roadway curve the road is elevated at the outer edge to facilitate a proper driving speed. In this report crown for horizontal curvature is not addressed.

Roadway crown should be in a flat "A" shape, rather than a curved or rounded shape. The slope from the center of the road to the outer edge should slope down in a straight line at four to six percent. Water will drain from a straight slope however a curved crown will have much of the center of the road at no slope or very small slope that will not drain. The water remains on

the road and is driven upon by vehicles. This will weaken the surface and subsurface structure and lead to pot holes and washboard surface.

Ditch

Ditches are necessary for adequate drainage and must be kept free of obstructions. Ditches need to be of sufficient depth and slope to move large amounts of water quickly from the roadway area during intense storms.

Culverts

Crossing culverts are critical to removing water from the ditch on the high native slope under the roadway to a dispersal area on the lower side of the roadway or to a natural drainage course.

Material selection

Obtaining appropriate material for gravel road maintenance is critical to maintaining a smooth driving surface, controlling cost, keeping the dust out of the air, silt out of the drainage ways, and in the road structure. The material currently specified is lacking in uniform gradation from large to small particles, and is applied dry in dry weather. Very fine to sandy particles properly mixed with larger rock and at optimum moisture content will permit the gravel to be compacted into a dense, smooth, durable surface.

Good quality properly graded, locally available materials may be difficult to obtain but are worth every effort to find. It is recommended to establish a specification for the gravel and submit it to quarries in the area for price and availability. If the specification is uncommon to the area it may be necessary to purchase a large quantity of material and stockpile it on CRR property for later use. It must be stressed that having the proper moisture in the gravel during placement, spreading, shaping, and compaction is critical to success of this operation.

It does not appear that Oregon Department of Transportation has developed a specification for gravel used as a surfacing material. As a result the County road departments should be consulted to ascertain if they have suitable specification.

If the Counties don't have a suitable specification an alternative must be developed with local conditions considered. A proposed specification is included as an attachment to this report. Please note that this specification was developed for the benefit of water quality and air quality improvement as well as providing a cost effective and functional roadway surface. Adaptation to local conditions may be necessary. In any case a small quantity should be tested in place to verify that it performs as expected.

Compaction

Gravel spread for construction or maintenance purpose must be compacted to develop the material's full strength and to bind the gravel together so it doesn't rut or get swept to the side under the action of traffic. Compaction effort is poorly spent unless the gravel is at optimum moisture content when placed, spread, and compacted. Gravel resurfacing operations should be done when evaporation from the exposed gravel can be limited. As a result, placement when temperature, direct sun, and wind are less intense and humidity is higher is recommended. Also limiting the amount of gravel spread on the road and working the gravel rapidly to a compacted form can maintain moisture content.

Equipment and Personnel

I have had no contact with your staff and have no basis for judging their strengths or weaknesses. However, a training plan should be developed to ensure that all staff members are knowledgeable in the operation of the equipment and in the proper application of the equipment to meet roadway maintenance goals. Maintenance manuals are available from a variety of sources.

The staff to equipment resources ratio suggests the staff could work smaller projects in two teams of two if needed. The superintendent could be paired with one other equipment operator and leave the other pair to operating equipment in a separate team as needed. On gravel reshaping jobs one could operate the grader while the other operates the roller and water truck. On gravel lay down jobs a grader operator, two dump truck drivers, and a compactor operator/water truck driver may be needed.

A water tanker truck must be obtained for use when grading existing gravel surfaces to establish and maintain proper moisture content during shaping and compacting operations. Rental or leasing options may be considered but are outside the scope of this report.

Carbide toothed and edged blades will work very well on motor graders to break up large clumps of crusted aggregate and they wear very well. They may be placed on the plow attachment of the graders if desired, while retaining the standard blade under the belly of the grader. The blade, regardless of type, must be straight from end to end with minimal center wear. If center wear is extreme a parabolic crown will be cut regardless of operator skill.

Road Classification System and Roadway Management Planning

Roads should be classified by their use and once classified may be targeted for maintenance and operational actions or control. The county has classified CRR roads in keeping with their standards and should be obtained and refined for specific use in managing roads in CRR. The classes of roads in the county system are likely to be named Principle Arterial, Minor Arterial, Major Collector, Minor Collector, and Local Road. In CRR the road functions vary as in any community but will likely fall in the county system as Major Collector, Minor Collector and Local Road. You should establish a Functional Classification system unique to CRR regardless

of the county's system. The roads could simply be called Major, Minor, Local, and Culdesac roads. Distribution of road mileage should fall within the guidelines of the following table:

Systems	Percentage of Total Road Length	Typical Characteristics
Major	5 to 10 %	Links to state highway and high volume county roads. Serves CRR traffic generators. (typically these roads will be maintained by the Counties)
Minor	20 to 25%	Distributes traffic to Local roads from Major roads.
Local	65 to 75%	Primarily provides access to land and links to Culdesac roads.
Culdesac		Provides access to land, and is a dead end road

The volume of traffic on a road will decrease with the functional classification.

A roadway management system should be developed that considers existing road condition, existing and future traffic volumes, truck weight and volume, in response to overall CRR goals. The management system should address routine maintenance, response to emergent issues, and enhancement of the system overall. Key goals may include reducing washboard complaints, increasing road quality ratings, reducing per mile expenditures, and increasing miles of paved or sealed roads.

Rehabilitation and Reconstruction vs. Maintenance of Roadways

The decision on the allocation of funds to routine vs. reconstruction vs. paving has significant implications to the future condition of CRR roads. Life cycle cost analysis of alternatives will provide a basis for this decision. It will be tempting to allocate scarce resources to work that makes the most miles of road look good immediately. However, that approach will be most costly in the long term.

The need of the community to see immediate results suggests that allocating a specific portion to washboard removal is mandatory. However it is recommended to also regularly allocate some funds to reconstruction of the sections of road with the highest maintenance cost and community frustration. In this approach, many people benefit by improved maintenance and the biggest financial costs are addressed in a steady and systematic manner.

If the SRD must follow county construction standards that include the minimum depth of gravel material of six inches the funds will be best allocated either to the most heavily traveled roads, or to the areas that are low relative to the native ground level and need to be built up as described above. Build both of these types of roads well. Maintain them well and CRR will eventually have more funds available for washboard removal.

Paving and sealing projects must not be undertaken on weak subgrades or they will quickly break up and be difficult to maintain. Only the highest volume roads should be paved or sealed and only on strong subgrades with adequate drainage.

Public Involvement

The CRR community and the SRD board have a stake in the results of the management and maintenance activities on the CRR roads. Development of the management plan should include the SRD board so that joint goals may be met. If during development of the road management plan it is apparent that inadequate funds are available to achieve the plan goals the key to increasing revenue is community support. An informed understanding of the plan goals and seeing improved results of initial efforts on the roads will aid in obtaining that support.

Conclusion

This report summarizes observations and suggests a course of further action to develop a strategy for roadway management. Additional work must be undertaken to complete a road inventory, develop a management plan, research and secure a source of quality aggregate, develop staff resources and improve equipment capabilities.

If you have any questions or I may be of further service to Crooked River Ranch please contact me.

Sincerely,

Brian F. Barnett, P.E.



Encl. - Driving Surface Aggregate Specification

Driving Surface Aggregate Specifications

Dirt and Gravel Road Maintenance Program

Note that "Driving Surface Aggregate" is now approved by PennDOT for State purchasing. Refer to PennDOT publication 447 (MS-0450-0004) for details.

Pursuant to Section 9106 of the PA Vehicle Code, all Driving Surface Aggregate (DSA) is to be derived from natural stone formations. Stone is defined as rock that has been crushed; rock is defined as consolidated mineral matter. All components of the aggregate mix are to be derived from crushed rock material that meets program specifications for abrasion resistance, pH and freedom from contaminants.

Minus #200 fine composition:

Ninety-eight percent (98%) of fines passing the #200 sieve must be rock material. No clay or silt soil may be added. Limestone material passing the #200 sieve may be used to make up a deficit in the distribution of sandstone aggregate rock, and vice versa. All added material passing the #200 sieve

must be derived from rock material that conforms to program specifications. Lime kiln dust and cement kiln dust may be added to DSA to account for up to 50% of the fines passing the #200 sieve. The amount of particles passing the #200 sieve shall be determined using the washing procedures specified in PTM No. 100.

Passing sieve	Lower %	High %
1 ½ inches	100	
¾ inches	65	95
#4	30	65
#16	15	30
#200	10	15

Table 1. Driving Surface Aggregate specifications.

Size:

The required amounts and allowed ranges, determined by % weight, for various size particles are shown on page 1 of this certification.

LA Abrasion:

The acceptable limit as measured by weight loss is "less than 40% loss". Los Angeles Abrasion test, AASHTO T-96 [ASTM C 131] shall be used to determine this property. Existing data obtained from tests made for and approved by PennDOT will be accepted.

pH:

Aggregate must be in the range of pH 6 to pH 12.45 as measured by EPA 9045C.

Optimum Moisture:

Material is to be delivered and placed at optimum moisture content as determined for that particular source. The optimum percentage moisture is to be determined using Proctor Test ASTM D698, procedure C, Standard.

Transport:

Tarps are to be used to cover 100% of the load's exposed surface from the time of loading until immediately before dumping. This requirement includes standing time waiting to dump.

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- A. All intersections shall be planned for through traffic on the road with the greatest projected average daily traffic (ADT). The side road shall be at right angles (90 degrees) to the main road unless physical constraints of the site or topography require a lesser angle. In no case shall a new road enter an intersection at an angle of less than 75 degrees. Horizontal and vertical alignment for an intersection shall be as shown in Drawing No. 2-4.3 of the Jefferson County Standard Drawings.
- B. Minimum intersection spacing of new roads shall be in accordance with the access spacing distances specified in Table A, Minimum Road Design Standards. Distances shall be measured between intersection centerlines of the roads. Access to state roads and highways shall be at current ODOT standards and are subject to review and approval by ODOT.
- C. Roads located on opposite sides of a through street shall either have their centerlines directly opposite each other or shall meet the minimum access spacing standards specified in Table A.
- D. A roundabout may be required when the level of service (LOS) of an intersection will be less than LOS C.

12.18.210 Drainage.

- A. Minimum Requirements. Drainage facilities shall be designed and constructed to receive and transport at least a fifty (50) year storm frequency for all surface drainage water coming to and passing through the development. The public works director may require additional capacity if failure of the drainage structure would adversely impact highways, railroads, utilities, or emergency services or facilities. The system shall be designed for maximum allowable development of the drainage area served by the drainage facility.
- B. Road culverts shall be corrugated metal pipe with a minimum design life of fifty (50) years. All cross culverts shall be eighteen (18) inches in diameter or larger. Where unusual site conditions warrant and fifty (50) year storm would not cause back flooding, twelve (12) inch diameter culvert may be approved in advance at the discretion of the public works director. Culverts shall be placed in natural drainage areas and shall provide positive drainage. Culverts installed more than ten feet below road grade shall be six inches larger in diameter than otherwise required in this section.
- C. Driveway culverts, where required, shall be twelve (12) inches in diameter or larger and shall be sized such that the culvert will not impede the flow of a fifty (50) year storm.
- D. The grade line of ditches shall be constructed such that ditches and culverts shall share common flow lines.
- E. A minimum of one foot of cover shall be required for all culverts.
- F. Culverts over sixty (60) feet in length and/or having over four feet of cover shall be considered storm sewers and shall be designed and installed in accordance with ODOT storm sewer standards.
- G. Drainage Plans. A complete set of drainage plans, stamped by a licensed engineer, including hydraulic and hydrologic calculations, shall be incorporated in all road improvement plans.
- H. Culverts shall be installed in accordance with ODOT Standard Specifications.
- I. Bridges will be designed by a registered professional Structural Engineer in accordance with current AASHTO and ODOT standards and shall include a

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stamped set of plans and specifications. All bridges shall be designed to receive and transport a minimum 100-year storm frequency of all drainage water coming to the structure at full development of the drainage.

- J. All work shall be in accordance with an erosion control plan reviewed and approved by the Oregon Department of Environmental Quality prior to beginning work.

12.18.220 Driveways.

- A. Permit required. Access or change in type of access onto a county or local access road shall require a permit from the Community Development Department. Access shall be denied at locations that do not meet minimum sight distance and spacing standards. Proof of legal access, provided by the owner/developer, shall be required for all parcels not fronting directly on a county or local access road.
- B. Access Restrictions and Limitations. Driveway access onto arterials and collectors shall not be permitted within one hundred fifty (150) feet of an intersection, or the maximum distance obtainable on the parcel, whichever is less. Driveway access onto minor collectors or local roads shall not be permitted within one hundred (100) feet of an intersection, or the maximum distance obtainable on the parcel, whichever is less.
- C. Driveways shall be spaced at least seventy-five (75) feet apart, measured from the centerline of the driveway, except at the bulb end of a cul-de-sac or when an existing lot width is less than seventy-five (75) feet. Driveway spacing shall be in accordance with applicable city standards when the lot is within an urban growth boundary. Loop driveways shall not be permitted on arterials or major collectors. Loop driveways may be permitted on minor collectors or local roads if the interval between the two access points of the loop driveway is at least seventy-five (75) feet, and both access points are at least seventy five (75) feet from the driveways on adjacent parcels.
- D. When a parcel abuts more than one road, access shall be obtained from the road with the lower functional classification unless unfeasible because of topography or other physical feature.
- E. Commercial and Industrial Access. Requirements for commercial and industrial access will be determined by the public works director in accordance with Section 12.18.200 of this chapter. Safety improvements, including but not limited to left turn lanes, acceleration lanes, and traffic separation, may be required.
- F. Safety improvements, including but not limited to the removal of obstructions or the sloping of cut-banks within the public right-of-way of the parcel served, may be required if deemed necessary by the public works director. The public works director may require that any such improvements within the public right-of-way be done by the county public works department or a licensed contractor. All such work shall be at the sole expense of the landowner. The owner shall be required to post a bond for the cost of such work prior to the beginning of construction.
- G. Sight Distance. Sight distance shall meet current AASHTO standards.
- H. Access Width. The following are the surface width and grade requirements for private driveways:

Type	Width (in feet)		Grade %	
	Min	Max	Desired	Max
Residential	12	20	8	12



**CROOKED RIVER RANCH
RURAL FIRE PROTECTION DISTRICT**

6971 S.W. Shad Road
Terrebonne (CRR), OR 97760-9250

Phone: (541) 923-6776
Fax: (541) 923-5247
Burn Info. Line: (541) 923-4633
email: crr_rfpd@msn.com

DEC 3 - 2008

November 20, 2008

*From
Lexus*

Road Improvement Recommendations

A survey of the Fire Department staff came up with these suggestions.

Bill's Place washed out and rutted, unclear as to the turnaround. A good rock base and drainage might help.

The following need the rock base improved. They are in our priority order:

- Rainbow, Quail to Badger
- Ice and Steelhead Falls Drive
- Peninsula from Geneva View to boundary
- Canyon Drive
- Chuckar between Quail and Blue Jay.

We recommend chip sealing Dove and Bullhead their entire length because of the access it provides, and Golden Mantle for the access north to avoid the Peninsula curves.

If there are any questions, please do not hesitate to call.

Sincerely,


Larry Langley, Chief
CRR RFPD

APPENDIX 7
ESTIMATED ROAD COSTS

Item	Cost	per
2-1/2" HMAC, 22' wide	\$140,000	mile
2" HMAC, 22' wide	\$116,000	mile
E-11 Oil Mat (4-shot), 22' wide	\$71,000	mile
E-9 Oil Mat (3-shot), 22' wide	\$58,000	mile
6" Compacted Rock Base, 26' wide	\$91,000	mile
4" Reject Rock, Watered, Compacted, w/ MgCl, 24' wide (by others)	\$44,000	mile
4" Reject Rock, Watered, Compacted, w/ MgCl, 24' wide (by CRR)	\$33,000	mile
4" Reject Rock, Watered, Compacted, w/o MgCl, 24' wide (by CRR)	\$27,000	mile
2-shot Chip Seal, 22' wide	\$42,000	mile
1-shot Chip Seal, 22' wide	\$29,000	mile
Fog Coat	\$5,000	mile
Gravel Shoulders (2' wide, compacted, both sides)	\$6,000	mile
Crack Sealing (assume moderate cracking)	\$5,000	mile
Grind and Patch Deteriorated AC (assume moderate damage)	\$20,000	mile
Annual Gravel Road Maintenance (by others, w/ MgCl)	\$8,000	mile
Annual Gravel Road Maintenance (by others, w/o MgCl)	\$2,000	mile
Ditching (1.5' Depth, both sides)	\$32,000	mile
18" CMP Culvert (Installed)	\$40	LF
12" CMP Culvert (Installed)	\$30	LF

Estimated costs were prepared in 2009 and may not reflect present costs. Consult AKS to get current cost estimates.

Mobilization, Traffic Control, Intersection Improvements, Driveway Improvements, Excavation, Signage, Striping, Engineering, Surveying, Staking, Testing, and other items not specifically listed are not included in the above prices. Costs for these items are variable and depend largely on the specific project.

Road costs denoted with '(by CRR)' assume CRR Road Maintenance will perform items they are capable of performing, but the remaining work will be performed by others.

Pavement Maintenance Scenario (Asphalt)

Maintenance of Asphalt Road (Assume 15-yr lifetime, road was paved during Year 0)			
Year	Maintenance Measures	Cost	per
6	Crack Seal	\$5,000	mile
6	Pavement Patch	\$20,000	mile
6	Fog Coat	\$5,000	mile
6	Gravel Shoulders	\$6,000	mile
12	Crack Seal	\$5,000	mile
12	Pavement Patch	\$20,000	mile
12	Fog Coat	\$5,000	mile
12	Gravel Shoulders	\$6,000	mile
15	2" HMAC Overlay	\$116,000	mile
15	Gravel Shoulders	\$6,000	mile
	TOTAL	\$194,000	mile
		\$12,933	year/mile

Maintenance of Asphalt Road (Assume 20-yr lifetime, road was paved during Year 0)			
Year	Maintenance Measures	Cost	per
6	Crack Seal	\$5,000	mile
6	Pavement Patch	\$20,000	mile
6	Fog Coat	\$5,000	mile
6	Gravel Shoulders	\$6,000	mile
12	Crack Seal	\$5,000	mile
12	Pavement Patch	\$20,000	mile
12	Fog Coat	\$5,000	mile
12	Gravel Shoulders	\$6,000	mile
17	Crack Seal	\$5,000	mile
17	Pavement Patch	\$20,000	mile
17	Fog Coat	\$5,000	mile
17	Gravel Shoulders	\$6,000	mile
20	2" HMAC Overlay	\$116,000	mile
20	Gravel Shoulders	\$6,000	mile
	TOTAL	\$230,000	mile
		\$11,500	year/mile

Current CRRSRD Paved Roads (Exclude Local Roads)	22.7	miles	
Range of expected maintenance costs	\$293,587	per year (maximum)	
	\$261,050	per year (minimum)	
Paved CRRSRD Roads under Road Plan	28	miles	
Range of expected maintenance costs	\$362,133	per year (maximum)	
	\$322,000	per year (minimum)	
Crack sealing, patching on paved roads	Cost	miles	
Chinook	\$40,000	1.6	
Ermine	\$15,000	0.6	
Parkey	\$5,000	0.2	
Peninsula	\$52,500	2.1	

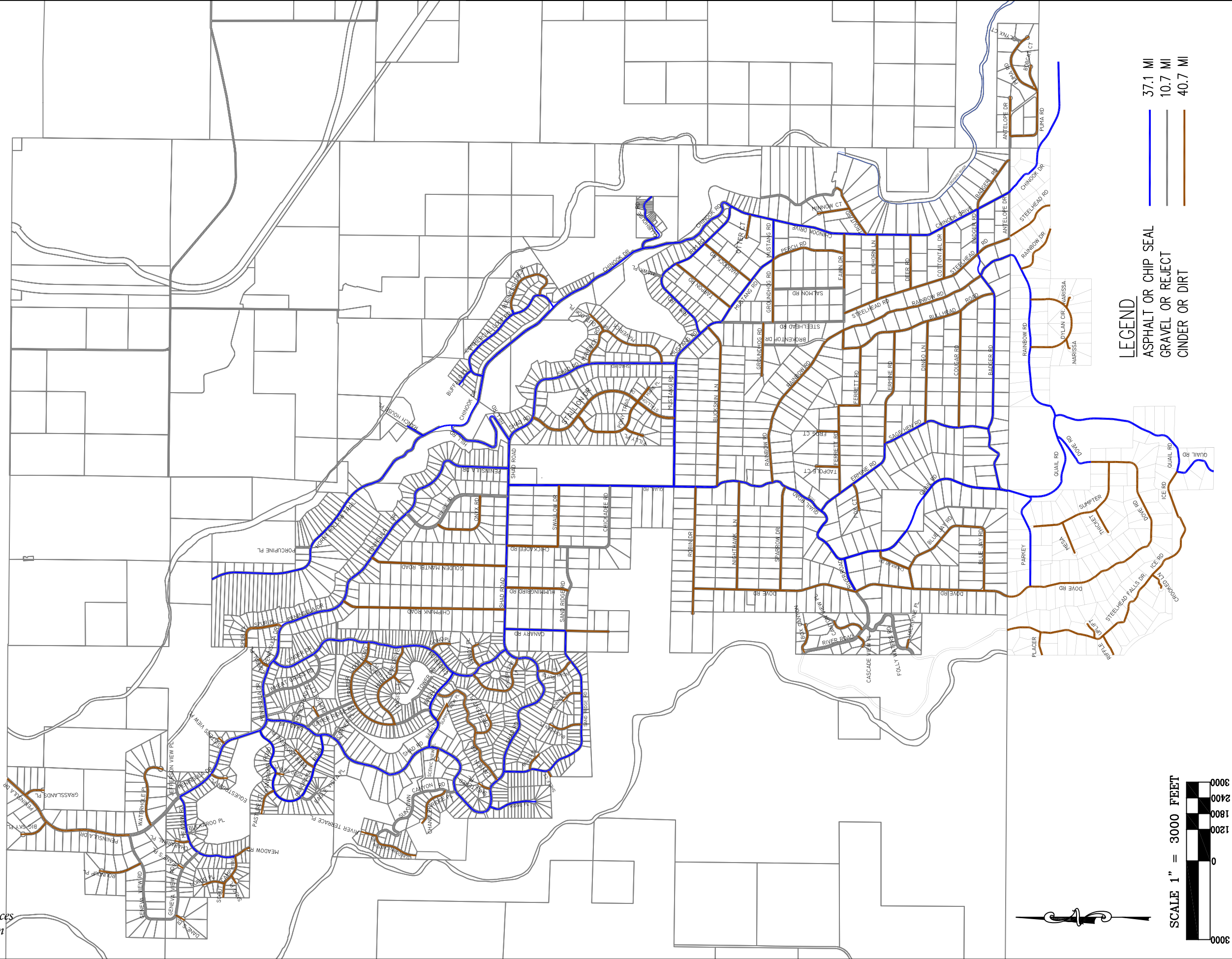
Pavement Maintenance Scenario (Chip Seal)

Maintenance of Chip Seal Road (Assume 7-yr lifetime, road was paved during Year 0)			
Year	Maintenance Measures	Cost	per
4	Gravel Shoulders	\$6,000	mile
4	Fog Coat	\$5,000	mile
7	Gravel Shoulders	\$6,000	mile
7	2-shot Chip Seal	\$42,000	mile
	TOTAL	\$59,000	mile
		\$8,429	year/mile

Maintenance of Chip Seal Road (Assume 10-yr lifetime, road was paved during Year 0)			
Year	Maintenance Measures	Cost	per
4	Gravel Shoulders	\$6,000	mile
4	Fog Coat	\$5,000	mile
7	Gravel Shoulders	\$6,000	mile
7	Fog Coat	\$5,000	mile
10	Gravel Shoulders	\$6,000	mile
10	2-shot Chip Seal	\$42,000	mile
	TOTAL	\$70,000	mile
		\$7,000	year/mile

Current CRRSRD Paved Roads (Exclude Local Roads)	22.7	miles	
Range of expected maintenance costs	\$191,329	per year (maximum)	
	\$158,900	per year (minimum)	
Paved CRRSRD Roads under Road Plan	28	miles	
Range of expected maintenance costs	\$236,000	per year (maximum)	
	\$196,000	per year (minimum)	
Crack sealing, patching on paved roads	Cost	miles	
Chinook	\$40,000	1.6	
Ermine	\$15,000	0.6	
Parkey	\$5,000	0.2	
Peninsula	\$52,500	2.1	

Diagram 1: Road Surfaces
Road Improvement Plan
March, 2009



ROAD SURFACE – 1/13/09

PREPARED FOR:

CRRSRD
P.O. BOX 842
CROOKED RIVER RANCH, OR
97760

JOB NAME: CRR ROAD PLAN

JOB NUMBER: 1981

DRAWING NUMBER: 1981MPL-2

DRAWN BY: HAM

CHECKED BY: HAM

ENGINEERING • PLANNING

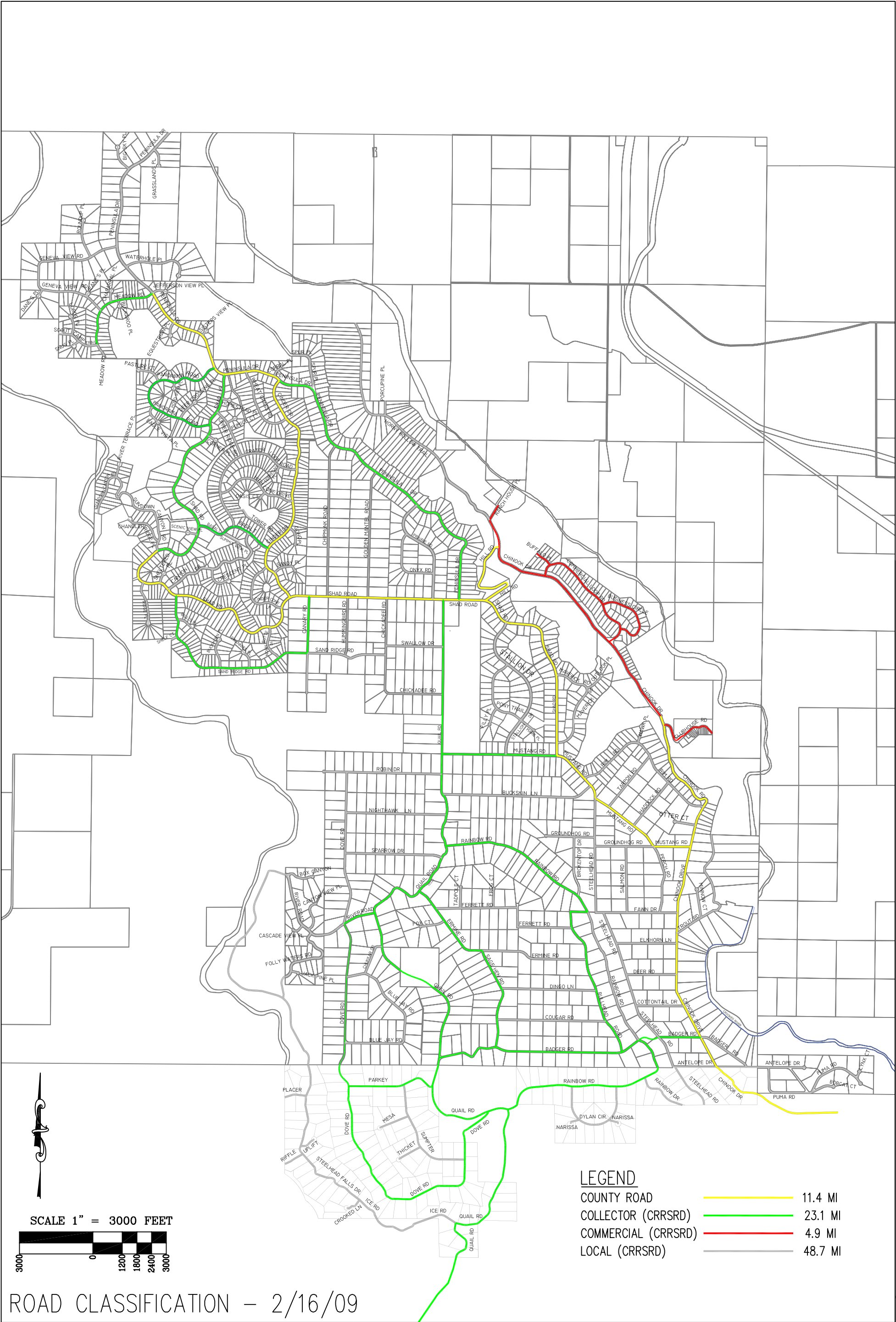
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JOB NUMBER: 1981

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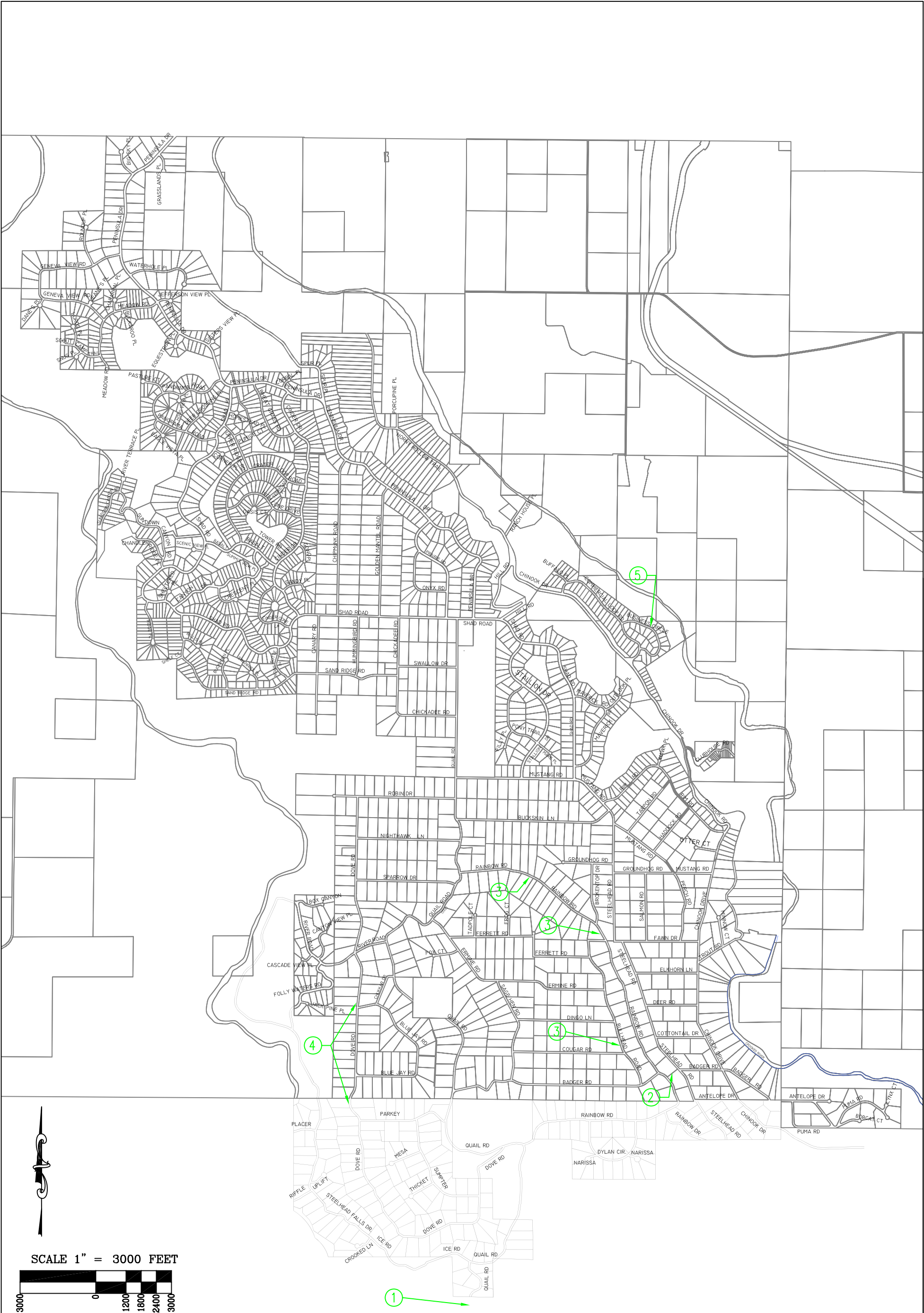
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