Eastern Rex Trail
July 22, 2013
Stage 1 Deliverables

Assessment & Prescription Report

Background: The Rex trail on its current alignment is unsustainable for current levels of use. It traverses flat ground with poor or non-existent drainage; ice-rich permafrost, extensive wetlands; ponding; black spruce muskeg; and many areas of highly sensitive and saturated soils close to or at the surface. Current levels and types of use have degraded the existing alignment to the degree that in many cases, it is impassable to typical and traditional users. In Interior Trails' (IT) assessment, the only truly long-term sustainable management solutions for this trail are:

- Seasonal trail closure: limiting use of the Rex trail to winter only, when degradation and impassability are mostly negated by frozen conditions.
- Large-scale rerouting to better ground, skirting long sections of current trail.
- Upgrade the whole alignment using modern road-building technology.

Since these management options are not feasible due a variety of factors (user expectations, 20A game unit access, private boundaries, DNR budget constraints, and the trail's historical import for local users), DNR seeks what is known in the trails world as a "band-aid solution." That is, a solution that fixes the worst sections of an existing trail to make the entire alignment passable, while recognizing that in the face of persistent unsustainable conditions and unpredictable user behavior, this is most likely a temporary solution, not a permanent one.

The following report is the result of IT's extensive field reconnaissance at each site, review of DNR documents regarding Rex Trail use and history, communication with DNR staff, consultation with other trail experts, and review of a wide range of techniques and structures. The solutions provided in this report represent a hybridization of trail hardening techniques and applications that have been successfully used on other sites in Alaska. However, there is no known direct precedent for long-term monitored trail hardening combining this varied terrain, use intensity, combination of user groups (ATV to semi-truck), and seasons of use (winter-summer); therefore, these prescriptions are somewhat of a site specific test case. Social engineering will be an important part of the success of any trail upgrades, both built into the alignment itself (visual buffers, width) as well as education of user groups and signage on the trail itself. With this background in mind, Interior Trails provides the following analysis and recommendations for Sites #3 & #4 isolated by DNR:

SITE #3: (GPS points "Site 3" to "Site 3 End")

Current Condition Assessment: The trail in Site #3 passes through open wetlands, with wet meadow vegetation and sparse tree cover along the alignment. Currently, this section of trail is impassable to regular ATV traffic due to intermittent saturated soils, sticky mud at the surface, and severe ponding. Overall width of the original trail alignment varies from 10-30' with standing water up to 3' deep in places and a width of impact over 400' wide including braids. During the assessment period in late June to mid July, this portion of the trail always had standing water on it, and was by-passed by major trail braids to the north and south, both of which also had significant standing water and mud holes, worse so to the north. Soil sampling to 2' deep in various places along this portion of the alignment showed consistent gray clay with a surface layer of sandy gravel intermittently present at the far edges of the site where the trail returned to drier ground.

Recommended Prescription Options

Use Type 1 (ATVs & tracked rigs <25k lbs)

- Option 1: Ditch and elevate (D/E) 12' wide with an imported gravel cap intermittent with Geoblock (GB) installation (13') up the middle of the current alignment, using best possible ground. Three sections of Ditch and Elevate (D/E) and two sections of GB have been flagged on the ground.

- Option 2: Use modern road-building techniques to build a primitive highway-style gravel causeway.

Use Type 2 (Above plus wheeled vehicles <15,000 lbs)

- Option 1: Same as Use Type 1. See above.
- Option 2: Same as Use Type 2. See above.

Analysis of Options

The entirety of Site #3 can be described as wetlands, and in some ways the ideal type of ground for ballasted Geoblock installation, which provides tread hardening with minmal imported fill and negates the need for ditches that may disturb hydrology. Some short sections of ground in Site 3 are intact, mostly because traffic has been bypassing this section, but will begin to degrade once high levels of use are routed back on the trail. In intact sections, cheaper D/E can be used to elevate tread and prevent degradation, although it will need to be topped with imported gravel, as the site material is poor quality clay; in the wet, ponded and already degraded sections, ballasted GB can provide a durable travel surface even at the bottom of standing water.

However, although theoretically appropriate for the site and often prescribed and installed around the state, GB at this site has some potential limitations. First, the possibility of the GB being snagged by a dozer or plow blade: one such incident could entirely wreck the installation and would be hard to repair without re-laying. Second, rock ballast is key for underwater installation but can be easily displaced by tracked vehicles. Third, GB is very expensive, and vulnerable to human tampering. One incident of vandalism by a user could threaten the success of the whole investment. Because user behavior has been historically unpredictable in this area, this seems a large risk.

These conditions lead **IT to recommend Option 2 for all user types.** Building a primitive road bed seems the simplest solution in this case. Use geotextile on the ground, pit-run sub-grade and cap with culverts in ponded areas and as needed to promote hydrologic exchange. This technology has been successfully used in large-scale "trail" operations around the state. Consulting with a highway engineer for exact specs is recommended.

Rerouting vehicle traffic is not recommended close to this site due to inferior ground on both sides of the alignment. Although some higher ground is present, wetlands characteristics persist, with drainage areas, ponding, mud pits and wetland vegetation intermittent on both sides. Even the dry ground is hummocky and inconsistent and in many places quite far from the trail. The inferiority of fill on site would require imported gravel. Any reroute would require a significant outlay of resources to make it durable, and would be much longer than an upgrade straight through the existing alignment. This combination of factors does not warrant moving the trail. A cost-effective longer reroute does not seem likely and the reconnaissance necessary is outside the scope of this prescription.

<u>Life Span</u>
If constructed properly, road technology should last decades.

<u>Monitoring & Maintenance</u>
Monitoring of culvert flow and wheel-rutting formation on the surface will be most important. In the first season after construction, monitor to be sure the constructed height brings the tread far enough up above standing water. Depending on settlement or frost heaving, a second lift , or re-grading may be necessary. Barring unanticipated natural events (flooding, seismic activity, overflow) and with primitive conditions expected, this option should be virtually maintenance-free.

<u>Notes:</u>

- In Option 2, the standard Geoblock product is Porous Pavement Panels 5051 in 6.5' widths or an equivalent. Dura-Base makes a product that may be applicable as well but to our knowledge has not been field-tested in trail applications in Alaska.
- Enclosed with deliverables is a PDF by Kevin Meyer on GB installation.
- COE 404 permit may be required for use of GB in a wetland, depending on how Site #3 is delineated by DNR.

<u>Site #4</u> (GPS points "Gravel Site 1" to "New End Site 4")

<u>Current Condition Assessment</u>: Site #4 passes through dense immature spruce forest, mixed birch/spruce forest, open meadow, and a burn. Currently, this section of trail is impassable to regular ATV traffic due to heavy, dense mucky clay. Overall width of the original trail alignment varies from 12-30' with tread entrenchment of 3'-plus below surrounding grade. Including braids to the south, area of impact varies from 75-100' wide. During the assessment period in late June to mid July, this portion of the trail had very little standing water on it, yet the tread surface was saturated to the consistency of

gumbo and behaved like quicksand; weight and impact propagates across the top layer in "waterbed" style. Soil sampling to 2' deep showed persistent heavily clayey soils with some silt and zero gravel, fines, or rock present. The mud in this section has a more orange tint than Section 3 and behaves with more "sucking" and the surface reacts more dynamically to weight.

Recommended Prescription Options

Use Type 1 (ATVs & tracked rigs <25k lbs)

- Option 1: Realign trail for lighter vehicle traffic to follow flagged alignment south of current trail. Clear 24' corridor, wide enough to accommodate a 6' wide traveling surface plus lateral ditches on each side of the tread. Use trees removed from corridor cut into 8' lengths and lay in a single tier on undisturbed tundra to provide a structural bed surface beneath the fill material. Cut ditches with excavator, mounding the fill from the ditches on top of the corduroy. Cap with gravel mined near the site.

- Option 2: Realign trail as in Option 1 using solely primitive ditch and elevate techniques; omit corduroy beneath and omit gravel cap. This option would sacrifice the structural potential of the corduroy and the hardened travel surface of the gravel cap, but would preserve the lifted travel surface and ditches to collect water from the first option and would be superior to rerouting without elevating the tread. This would be significantly simpler and therefore cheaper.

Use Type 2 (Above plus wheeled vehicles <15,000 lbs)

- Option 1: No action. Wheeled vehicles that are currently able to pass through this section can continue to do so without severely degrading the trail. By removing the ATV passes from the alignment, overall traffic will be significantly diminished.

- Option 2: Use modern road-building techniques to build a primitive highway-style gravel causeway. This option would apply to all user groups.

Analysis of Options

IT recommends Option 1 for both user groups (re-route with corduroy/gravel ditch and elevate for Use Type 1 and No Action for Use Type 2). Because this section is passable for the heavier traffic and the main alignment does not show as extensive site damage as Site #3, the main concern is providing passage for ATV traffic in a way that minimizes the current site damage on the trail braids and does not impede larger traffic on the current alignment.

Site #4 differs from Site #3 in several key ways, making a reroute more feasible in this case. Were there no decent ground for rerouting, road-building may have been the only option. However, Site #4 is not a wetland area, and unlike in Site #3, there is higher, drier ground immediately south of the alignment, much of it consistently graded and suitable for D/E, with a 25' visual buffer between the new alignment and the old one to separate user groups. By moving the trail south of the current alignment onto undisturbed ground, it gains 2-3' in height over the low ground, even without elevated tread. If traffic were to pass along a reroute without tread hardening, it would eventually wear to the same level of degradation as the trail, likely uncovering similar muck 2-3' below the surface. But building the trail on undisturbed ground, the vegetative cover and root mat act as a structure of sorts. Because the whole corridor is forested with small diameter trees that will be cleared anyway, a layer of corduroy beneath the ditch and elevate makes good sense and would cost little extra beyond the labor required to cut tree trunks into 8' lengths and lay them in a single tier. When buried beneath 2' of fill, the logs will be resistant to rot and provide another structural component underneath the elevated tread. D/E on top of corduroy will provide elevated tread and drainage. A gravel cap of this surface will add cost but will significantly improve tread durability and minimize wheel ruts. Especially because good gravel is available on-site, the benefit outweighs the cost.

Life Span: With proper installation (ie. careful corduroy placement and gravel capping) and barring overt misuse by vehicular traffic, this solution could last for 20+ years.

Monitoring & Maintenance: Especially in the first year, monitor for corduroy logs levering or creeping out from under fill material or for incomplete coverage. Monitor structural integrity of ditches and depth of wheel ruts. Monitor for user patterns to be sure that traffic is being properly segregated. Maintenance may include reshaping tread, re-grading to erase wheel ruts, reestablishing ditches, or enhancing traffic buffers at entry points. However, structure should perform, even if degraded, without regular maintenance.

Notes:

- Separation of the two alignments is critical; user group education about the reason and intention behind this solution is recommended.
- Because the corduroy will not be bound together, it is essential that it be cut to proper length, limbed and completely covered with fill to give it stability and prevent levering.

Further information:

- Please see "Notes on Construction Types" for materials, methods, distances, widths, and cost estimates.
- Please see "Cross-Section Drawings" for visual plans of construction types.
- Please see "Site #3 GPS" and "Site #4 GPS" for locations of sites, reroutes, and construction types.
- Please see "Site #3 Photos" and "Site #4 Photos" for relevant photos taken at each site.

--Provided by Interior Trails, July 22, 2013
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Notes on Construction Types

*Cost estimates are for materials and labor rates, where available, and are not firm. Estimates provide only a relative comparison between treatment options. Total labor costs will be dependent on contractor wages and/or volunteer labor. Estimates do not include staging, equipment rental, mobilization, fuel or logistics.

Site #3

RECOMMENDED: Primitive Road/Gravel Causeway (4' deep)

- Materials: Geotextile (1800'); Pit Run Gravel (4000 cy); Culvert (4 @ 24"x20')
- Methods:
  1. Mark culvert sites in summer at wettest spots
  2. Lay geotextile on frozen ground.
  3. Build road bed on frozen ground, plowed as close to grade as possible, with dump trucks and dozer. Alternately, stockpile gravel and equipment for summer construction.
  4. When snow melts, ground thaws and road settles, install culvert.
  5. Regrade surface with dozer and compact.

- Distance: 1800'
- Width: 12' travel surface; 20' base
- Cross Sections: See Drawings
- Cost Estimate:

  Material Estimate:
  - Geotextile (17.5' x 309' rolls x 6 rolls): $1900
  - Pit Run gravel (4000 cy @ $6/y): $24,000
  - Culvert: (4 @ 24"x24'): $2800

  Total Material: $28,700

  Labor Estimate: Due to the high variability of techniques and logistics possible, this technique is not calculable using standard trails production rates; contractor will provide bid based on site analysis.

OPTION: Ditch & Elevate

- Materials: Gravel (460 yards); native soil from ditches; woven geotextile fabric (885' in 12" width); culvert (2 sticks, 8" by 20')
- Methods:
  1. Identify and clear location for gravel delivery in winter.

2. Flag centerline and clear corridor where applicable, limb trees for corduroy and cut at 14', no stumps higher than 6".
3. For first section, prepare and lay transverse corduroy in 14' or < lengths.
4. For second & third sections, lay geotextile by hand on ground
5. Build 1' tread with native material excavated from ditches.
6. Cap with 1' imported D1 (staged in winter.)
7. Place two culverts in the middle section at operator discretion to correspond with two lowest places where hydrology demands exchange.

- Distance: 885' total over three sections.
- Width: 12' traveling surface, 30' corridor, 30' from outside edges of ditches.
- Location: See GPS file
- Cross Sections: See Drawings
- Cost Estimate:

  Materials Estimate:
  - D1 (460 yards): $9200
  - Culvert (2 sticks, 8" at 16'): $510

  Labor Estimate:
  - D/E: 4-8 h/100': 35-70 hours
  - Transporting Gravel Cap: Dependent on method/dump
  - Compact: 1h/100' per 2-3" lift: 36 hours

  Total Materials: $9710

  Total Labor: Due to the high variability of techniques and logistics possible, this technique is not calculable using standard trails production rates; contractor will provide bid based on site analysis.

<u>OPTION: Geoblock (GB)</u>

- Materials: GB 5051 (6.5' width) or equivalent; rock ballast (washed, 1.5-3")
- Methods:
  1. Identify location for staged GB pallets delivered in winter.
  2. Flag trail centerline.
  3. Install GB by hand crew as directed by manufacturer (see Kevin Meyer PDF.)
  4. Ballast GB in ponded sections.

- Distance: 910' over two sections
- Width: 13' (2 6.5' panels)
- Location: See GPS file
- Cross Section: See Drawings
- Cost Estimate:

  Material Estimate:
  - Geoblock panels (1820' @ 6.5' wide): $60,000
  - Washed Rock (175 cy @ $20/cy): $3500
  - Woven Geotextile (2 rolls @ 12.5' x 432'): $704

  Labor Estimate:
  - Geoblock Prep/ installation (60h/100'): 540 hours

- Transporting rock ballast: 150 hours

Total Material: $64,204
Total Hours: 690 hours

*NOTE: Add totals from D/E and GB sections for an accurate comparison to the recommended Causeway option total.

Site #4

RECOMMENDED: Ditch & Elevate w/ Corduroy & Gravel Cap

- Materials: Native soil from ditches; limbed corduroy trees (< or = to 6" dbh in 8' lengths); unscreened on-site gravel (100 cubic yards: 2" cap)
- Methods:
  1. Flag centerline along GPS/flagged route to south keeping 25' buffer from main trail EXCEPT first 50' where trail diverges from existing route.
  2. Clear 26' corridor (no stumps higher than 6") EXCEPT in first 50' without ditches, keep corridor as tight as possible (12' or <) and flush cut stumps.
  3. Prepare and lay corduroy in 8' or < lengths from trees 6" or < dbh EXCEPT in first 50' where trail is on good ground.
  4. Excavate ditches and build tread with native material excavated from parallel ditches EXCEPT in first 50' where there are no ditches.
  6. Cap with 2" gravel from on-site material (site at west end of alignment.)
  7. Compact with plate compactor or equivalent attachment.
  8. Build one 20' x 8' pullout midway on route where terrain is best suited.
  9. Rejoin trail in burn. Minimal tree cover prevents good visual separation of reroute and main trail, and limits potential for restricting vehicles. Stop ditching 25' before rejoining and mound cut trees and brush to create berm on either side of rejoining tread. Leave all live trees possible at junction.

- Distance: 2800' (.53 miles)
- Width: 6' traveling surface, 26' corridor, 24' from outside edges of ditches. Provide one 20'x8' pullout at roughly halfway, dependent on ground.
- Location: See GPS file
- Cross Sections: See Drawings
- Cost Estimate:

Material Estimate: all materials on-site, no required purchasing: $
Labor Estimate:

- Flag centerline: 2 hours
- Clearing/Corduroy Prep: 2 h/100': 54 hours
- D/E: 2-4 hours/100': 56-112 hours
- Prepping Site & Mining Gravel: 20 hours
- Transporting Gravel Cap: 8 cf/h: 340 hours
- Compact: 1h/100': 28 hours

Total Material: $0
Total Hours: 500-550

OPTION: Primitive Ditch & Elevate

- Materials: Native soil from ditches
- Methods:
  1. Flag centerline along GPS/flagged route to south keeping 25' buffer off old trail EXCEPT first 50' where trail diverges from existing route.
  2. Clear 26' corridor EXCEPT in first 50' without ditches, keep corridor as tight as possible.
  3. Build tread with native material excavated from parallel ditches EXCEPT in first 50' where there are no ditches.
  4. Rejoin trail in burn. Minimal tree cover prevents good visual separation of reroute and main trail, and limits potential for restricting vehicles. Stop ditching 25' before rejoining and mound cut trees and brush to create berm on either side of rejoining tread. Leave all live trees possible at junction.

- Distance: 2800' (.53 miles)
- Width: 6' traveling surface, 26' corridor, 24' from outside edges of ditches. Provide one 20'x8' pullout at roughly halfway, dependent on ground.
- Location: See GPS file
- Cross Sections: See Drawings
- Cost Estimate:

  Material Estimate: all materials on-site, no required purchasing: $0
  Labor Estimate:
    - Flag centerline: 2 hours
    - Clearing/Brush Removal: 2 h/100': 54 hours
    - D/E: 2-4 hours/100': 56-112 hours

  Total Material: $0
  Total Hours: 112-168

OPTION: Primitive Road/Gravel Causeway (4' deep)
- Materials: Geotextile (2800'); Pit Run (6600 cy); Culvert (3 @ 24"x20')
- Methods:
  1. Mark culvert sites in summer at wettest spots
  2. Lay geotextile on frozen ground.
  3. Build road bed on frozen ground, plowed as close to grade as possible, with dump trucks and dozer. Alternately, stockpile gravel and equipment for summer construction.
  4. When snow melts, ground thaws and road settles, install culvert.
  5. Regrade surface and compact.

- Distance: 2800'
- Width: 12' travel surface; 20' base
- Cross Sections: See Drawings for Site 3/4 Causeway

- Cost Estimate:

  Material Estimate:

  - Geotextile (17.5' x 309' rolls x 9 rolls): $3280
  - Pit Run gravel (6640 cy @ $6/y): $39,800
  - Culvert: (4 @ 24"x24'): $2240

  Total Material: $45,320

  Labor Estimate: Due to the high variability of techniques and logistics possible, this technique is not calculable using standard trails production rates; contractor will provide bid based on site analysis.

--Provided by Interior Trails, July 22, 2013

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Site #3 & #4 Clarification Questions

1. DNR: Part of the reason for requesting multiple options per site and analysis of durability was to examine the cost effectiveness of each treatment option. The lack of labor estimates and equipment rental costs prevents us from performing this analysis. Is it possible to get even a rough estimate/range for each of these options? This is particularly important for Site 4 Use Type 1 Option 1, as we need this info to plan for a construction RFP.

IT: We had several calls in to road-building contractors to access cost information and have just heard back today regarding more specific numbers and rates. The biggest unknown factor for calculating primitive road/causeway construction cost was the seasonal adjustment, because any gravel staging or transport of heavy equipment must happen in the winter due to the trail's inability to support such traffic in the summer. We now know that winter gravel road building operations will cost 30-40% more than similar summer work. Additionally, numbers could vary greatly depending on the size of the company bidding, whether equipment is owned or rented, size of equipment available, etc. Here is a very rough breakdown of the costs, for relative comparison only:

Site 4 Type 1, Option 1:
112 excavator hrs at $140/hr = $15,680
54 timber labor hrs at $53/hr = $2862
20 site/gravel prep at $140/hr = $2800
20 compacting hrs at $140/hr = $2800
340 gravel transport hrs at $53/hr = $18,020
Material costs = $0
Total $42,161*

*** does not include mob/demob, per diem, fuel, or other logistics, which vary depending on site conditions and technical approach.**

Site 4 Type 2, Option 2:
1320 hrs truck time (assuming 2 hr round trip from pit close to trailhead) at $155/hr = $204,600
660 dozer hrs at $155/hr = $102,300
Winter Cost Margin = $122,760 (40%)
Material costs = $45,320
Total $474,980*

***does not include mob/demob, per diem, fuel, or other logistics, which vary depending on site conditions and technical approach.**

Site 3 Types 1&2, Option 2:
800 hrs truck time (assuming 2 hr round trip from pit close to trailhead) at $155/hr = $124,000
400 dozer hrs at $155/hr = $62,000
Winter Cost Margin = $74,400 (40%)
Material costs = $28,700
Total $289,100*

***does not include mob/demob, per diem, fuel, or other logistics, which vary depending on site conditions and technical approach.**

Site 3 Types 1&2, Option 1:

Ditch/Elevate
70 excavator hours at $140/hr: $9800
92 hrs truck time at $155/hr: $14,260
winter cost margin=$5700 (40%)
92 excavator hours/gravel cap at $140/hr: $12,880
36 excavator hours/compact at $140: $5040
Material costs: $9710
Total: $57, 390*

***does not include mob/demob, per diem, fuel, or other logistics, which vary depending on site conditions and technical approach.**

<u>Geoblock</u>
540 labor hours installing Geoblock at $53/hr: $28,620
36 hours truck time: $5580
winter cost margin: $2232
150 labor hours at $53 transporting/laying rock ballast: $7950
Material costs: $64,204
Total: $108,586*

Total combined D/E & Geoblock: $165,976*

***does not include mob/demob, per diem, fuel, or other logistics, which vary depending on site conditions and technical approach.**

2. DNR: In the analysis for Site 4, you mentioned that Site 4 is not a wetland area. Is this a casual, relative term use of "wetland", or was some delineation work done to determine that the area was not a classified as a wetland by the Army Corps of Engineers?

IT: The use of "wetland" in this case was in a practical, not a technical sense, in this case. IT was not hired to delineate wetlands and it was our understanding that there is no COE data available for this site. In a technical sense, it seems likely that much of the first 10 miles of trail would be classified as wetlands at some level. (IT understands that the COE requires three characteristics be met to define something as a jurisdictional (404 CWA) wetland: hydrology (surface or ground water present), hydrophytes (vegetation living in saturated soils) and hydric soils (saturated soils supporting hydrophytes.) Although Site #4 includes some marshy wet sections, practically speaking, Site #4 has different characteristics than Site #3, including higher ground nearby, less standing water, more mature forest on site, no ponding immediately adjacent to site, and no clear evidence of flowing water nearby. This, combined with the presence of non-hydric soils and plants (ie, gravelly, dry soils at the immediate start, in an

aspen grove), led IT to treat this site as *practically distinct* from Site #3, which shows clear characteristics of wetlands as well as degradation of those wetlands.

3. For Type 1 Option 2 in Site 4, you suggested Ditch and Elevate without corduroy or gravel. Is there a reason/benefit for omitting the corduroy? In both Options 1 and 2 the labor hour estimate for clearing and associated brush removal or corduroy prep was 54 hours.

IT: The labor hour estimate is the same for both options because cutting and handling brush--whether in lengths for corduroy or to limb, stack, and remove from the corridor--represents a similar output of work. One of the reasons corduroy is infrequently recommended is because the harvesting and prepping of trees is labor-intensive; in this case, this step has to happen anyway to clear the corridor. The two other liabilities of corduroy are that it is prone to jacking if not properly covered and prone to rot if moisture is not sufficiently low or high, or if it is exposed to air. It is somewhat unusual to have all the conditions present that would support buried corduroy; IT provided Option 2 because there is not a lot of data on buried corduroy over the long term. Option 2 would be the more conservative choice, in that it avoids the potential downsides of corduroy. Leaving off the gravel cap makes it simpler and saves some labor; leaving out the corduroy limits exposure to corduroy's risks. Simple D/E would be a reasonable and typical response here.

In this case however, IT recommends corduroy because it is feasible on site and we strongly feel the benefits outweigh the risks. Deep fill burial should minimize jacking and levering of logs and slow rot; clayey soils should act as a mortar solidifying the structure. A layer of log--even if it someday decomposes--will help protect the ground from traffic and eventual degradation. Consultation with two other trail hardening experts supports this conclusion. However, the success of any construction type is most influenced by the quality of the contractor and implementation, as well as its proper use by vehicle traffic.

4. For Type 2 Option 1 in Site 4, we just wanted to clarify that your assessment is that the trail is capable of supporting both large wheeled vehicles and tracked rigs without severely degrading the trail. The potential confusing phrase was "Wheeled vehicles that are currently able to pass through this section…". Does this mean physically able to pass through the section? Please be reminded that currently wheeled vehicles greater than 1500 lbs are prohibited from using the trail during the unfrozen season.

IT: For the record, it is IT's assessment that this section of the trail is *already* "severely degraded." Any traffic, even regulated, is never going to improve this condition if the trail is not upgraded. There will definitely be some surface impacts (mud holes, rutting) to the trail if it is reopened to large vehicles in its current condition. However, it is IT's assessment that the trail in its current condition is capable of supporting both large wheeled vehicles and tracked rigs (200 passes per year) without degrading the trail to the point of making it impassable *to those users*. This assessment is based on: field observations of tread surface characteristics and depth of wheel-rutting; relatively low numbers of passes by User Group 2 as compared to the most intense period of use by all vehicles before the 2008 closure; DNR staff's comments that large traffic was able to get through the worst sections before closure; large vehicle owners who state they are able to get through the worst sections; and the lack of any evidence of off-trail braids created by larger vehicles trying to bypass degradation.

All things being equal, IT would recommend primitive road construction for this site, as for Site #3, to improve the long-term durability of the trail for all users. However, because of the huge cost difference (in materials alone) between this option and a D/E reroute for smaller traffic, IT recommends leaving the trail as it is for Use Type 2. This would enable DNR to implement the significantly lowest cost solution first, providing immediate improved access for the majority of users, and to compare this

solution's viability with Site #3 over the long run. IT predicts that unimproved, with projected use patterns, the current alignment should provide the 5-year lifespan DNR requires.

5. For Site 4, you recommend a reroute for ATV's while leaving the main stem alone for the larger vehicles. We assume this pattern would hold true for the winter as well, in that the snowmachines could utilize the reroute without causing damage to the constructed trail, but that the heavy equipment and trucks would have to stick to the original trail location. Is this correct?

IT: Yes. Snowmachines and dog teams should be able to travel the 6' corridor re-route easily. Heavy equipment can stay on the main trail, since they currently pass without problems.

6. For the Site 4 reroute, the submitted .gpx files appear to only contain waypoints. Were these waypoints to be connected with a straight line? Is it possible to get either a sketch map of the reroute showing both the approximate centerline of the existing alignment and the approximate centerline of the reroute, or a tracklog of the same?

IT: Because a .53 mile reroute is well outside the scope of work for this contract, IT did ground recon to determine that the terrain would indeed accept a reroute, that there was sufficient timber cover to prescribe cost-effective corduroy, and that there were no terrain red flags on the potential alignment. The GPS waypoints included outline the northernmost edge of any reroute corridor that provides a sufficient visual buffer between the two alignments. For rough calculating purposes the centerline alignment will be 13' to the south of the given waypoints, though the actual centerline may vary from that edge based on the suitability of terrain to the south. IT has not track logged or flagged a centerline, either of the existing trail or of the reroute. IT would be happy to do further work on the reroute (flagging, mapping or drawings) under a change order. This could happen in early August in tandem with our next site visit.

7. There are a large number of other options that have been thrown at us in the past, including wood chips/chunks, mud mats, etc. Were these options /methods left out due to obvious ineffectiveness?

IT: IT considered many options that were left out of the final report, focusing our documents on what we *do* recommend. Chunkwood is not, generally speaking, a long-term trail-hardening solution, especially in wetlands; it provides stabilization, but its performance over time is highly variable. Chunkwood does not come close to gravel as a durable and long-term solution.

IT assumes that by "mud mats" DNR refers to a fabric product made by Nilex, which unrolls to provide a travel surface. We have not worked with this product or seen its use in any trail application in Alaska or elsewhere, but we understand it to be most useful for temporary access to a sensitive site or for intermittent use, not for long-term, heavily-used corridors. As with Geoblock, anchoring is necessary, cost is high, and the potential for tampering or inadvertent damage by plowing or other winter use is high.

--Provided by Interior Trails, July 25, 2013
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