Eastern Rex Trail
August 27, 2013
Stage 2 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 #1 & #2 isolated by DNR:

SITE #1: (GPS points "Site 1" to "Site 1 Rejoin")

Current Condition Assessment: The trail in Site #1 enters mixed spruce and birch forest at the outset, through intermittent small groves of aspen trees, then into open saturated

meadows with severe ponding. The original Site #1's major problems were extreme rutting and entrenchment with no drainage, resulting in standing water on the travel surface and large sticky mud holes due to saturated silt/clay soils. The expanded Site #1 includes permanently ponded areas that are currently impassable to all traffic types without severe resource degradation, as evidenced by wide multi-braided go-arounds on either side of the site. Overall width of the original trail alignment varies from 10-20' with standing water and entrenchment 3'-4' deep in places and a width of impact over 400' wide including braids. During the assessment period in late June to mid July, Site #1 always had sections of 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 clayey soils 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: Mixed solution: Ditch & Elevate (D/E) 12' wide up the middle of current alignment; intermittent Gravel Causeway w/ culverts through ponded sections.
- Option 2: Reroute trail to south and construct tread with D/E.

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 1. See above.

Analysis of Options

Site #1 includes sections of useable but wet tread and sections of severe saturation and degradation. There is mixed forest to the south of the current alignment that would likely provide a useable alignment for reroute (specific route has not been extensively investigated), augmented with D/E and corduroy as in the Site #4 recommended option. However, this site differs in a few key ways. First, while Site #4 was assessed as passable by larger wheeled traffic, Site #1 appears impassable by all traffic without severe resource degradation, due to deep ponding and wetlands characteristics. A Site #1 reroute would have to be wide enough to accommodate all traffic types, with a 12' wide tread surface and a corridor of 32'. Currently, Site #1 has long sections of trail that are either useable in their current condition, or would be useable with drainage and elevated tread.

Despite the slightly cheaper initial cost of the reroute/D/E option, **IT recommends Option 1 for all user types.** D/E will be sufficient for the first half of the alignment where ground is fairly stable and degradation is caused mainly by tread being below grade and holding water. Elevated and drained tread should address this. Upgrading the ponded sections to a primitive road bed/causeway will make the second half passable for all traffic types, with geotextile on the ground, pit-run sub-grade and cap and culverts as needed to promote hydrologic exchange. To decrease costs, IT prescribes intermittent, not continuous, causeway in the second section, concentrating gravel at the ponded areas,

and tapering to existing dry ground in between the ponds. GPS points and construction notes detail where to begin and end tapering.

It is IT's assessment that rerouting all traffic, including the large wheeled vehicles, presents a more likely user group challenge than rerouting only ATV-users, as in Site #4. The success of a corduroy D/E reroute relies on proper use, especially immediately after construction, when the tread structures and ditches set up. The more traffic types and user groups that are funneled into a new alignment, the higher the potential for unpredictable and tread-damaging behavior. A 12' wide reroute, unlike a 6' one, will not discourage high-speed travel or 2-way traffic passing. The relative fragility of this option, compared to the more durable causeway, makes the risk of failure higher. While it may be somewhat costlier in the short term, an up-the-middle route of mixed D/E and causeway will provide a much longer lifespan with very little risk and less need to manage user behavior. A gravel cap on the D/E section could be added at a later date if it were deemed necessary, though IT predicts that D/E will function well on its own at this site.

Life Span

The success of all D/E is dependent on soil durability and user behavior. In this case, the dry soils on site appear to bear traffic well, and the improved drainage as a result of the ditches will dry out the travel surface, solving the problem semi-permanently. A 10-year life span seems likely, perhaps longer with a gravel cap. If constructed properly, gravel causeway/road technology should last decades.

Monitoring & Maintenance

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.

Site #2 (GPS points "Site 2" to "New Site 2 End")

Current Condition Assessment: Site #2 passes through an open boggy meadow and intermittent forest at the southern shore of 7-Mile Lake. Currently, in wet seasons and conditions, this section of trail is impassable to most traffic due to severely saturated sections and deep ponding. Overall width of the original trail alignment varies from 12-30' with tread entrenchment or ponding of 3'-4'. Currently, the main alignment is by-passed to the south by numerous go-arounds (trespassing on private Native allotment property), each in various stages of degradation, all with some standing water or muck holes. Braids are as far as 300' off the main alignment. Initial assessment of the area with pervasive and deep standing water led to the conclusion that the section would need bridging or elevated structures to be sustainable. However, uncommonly hot and dry weather over the course of the assessment period dried up this portion of the trail so that it had very little standing water on it, making visible a more solid than expected tread surface. It became clear in our observations that, although the soil is silty and easily

degraded, it has enough structural integrity to be worth excavating. And when well drained it does not require bridging. It is very likely that elevating tread above ground water and providing ditches w/ culverts to manage water flowing north to join the lake will provide a dry and durable tread surface. Soil sampling to 2' deep showed gray and brown clay/silt soils with intermittent sections of depositional surface gravel. The most highly saturated sections occur where micro-drainages (visible on topo maps and in Google Earth views) flow south to north into the lake; higher and drier ground is intermittently present, significantly so at the eastern end of the site.

Recommended Prescription Options

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

- Option 1: Ditch and Elevate with Culverts and Gravel Cap.
- Option 2: Primitive road/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 1. See above.

Analysis of Options

IT recommends Option 1 for both user groups (Ditch and Elevate up the main alignment with Geotextile, culverts and a gravel cap). Because there is no suitable ground for a reroute that conforms to easement/private property boundaries, the best solution is a durable surface in the existing alignment. Ditch and elevate will provide the simplest, cheapest upgrade using mostly on-site materials from the ditches. It is highly likely that elevated tread combined with culverts and ditches will address the standing water and saturation issues. In the possible scenario that the trail does not dry up enough with this technique, tread hardening in the form of gravel causeway could always be implemented later with nothing lost. It is important to note that D/E construction should be done at the driest possible time in order to capitalize on soil stability. The elevated tread and ditches will not set up if soils are highly saturated during construction. Mid-late-July seems the window that will likely provide most ideal conditions, late enough in the season so that frozen ground has retreated enough to allow surface water to percolate, but in advance of August rain and heavy traffic in the fall.

Life Span: The success of all D/E is dependent on soil durability and user behavior. In this case, the dry soils on site appear to bear traffic well, and the improved drainage as a result of the ditches will dry out the travel surface, solving the problem semi-permanently. A 10-year life span seems likely, perhaps longer with a gravel cap.

Monitoring & Maintenance: 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.

Semi-annual maintenance may include reshaping tread, re-grading to erase wheel ruts, and reestablishing ditches. However, structure should perform, even if degraded, without regular maintenance.

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 #1 GPS" and "Site #2 GPS" for locations of sites, reroutes, and construction types.
- Please see "Site #1 Photos" and "Site #2 Photos" for relevant photos taken at each site.

--Provided by Interior Trails, August 27, 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 #1

OPTION 1: RECOMMENDED: Combine Ditch & Elevate/Gravel Causeway

PART 1: Ditch & Elevate

- Materials: Native soil; Geotextile (2 rolls 17.5' x 309')
- Methods: Ditch & Elevate (D/E):
  1. Beginning at Waypoint "Site 1," D/E up middle of trail alignment. Lay Geotextile under all D/E.
  2. At "Wetter Start" move centerline of trail south so that center of existing trail becomes the northern ditch.
  3. Clear trees from south side of trail at 15' width to allow for tread surface and southern ditch.
  4. At "End Wetter," where two large braids merge from each side, realign centerline to center of existing trail.
  5. Continue D/E for 315' to "Pond 1."
- Total Distance: 560' (.10 miles)
- Width: 12' travel surface; 32' corridor
- Location: See GPS file
- Cross Sections: See Drawings "Site 1 Ditch & Elevate"
- Cost Estimate:

Material Estimate:
- Geotextile: 2 rolls (17.5' x 309'): $728

Total Material: $728

Labor Estimate:
- 44 excavator hours at $140/hr: $6160

Total Labor: $6160*

Total Estimate: $6888

Optional Gravel Cap: (not recommended immediately)
- D1 gravel (135 cy @ $20/y): $2700

- 27 hrs truck time (assuming 2 hr round trip from pit close to trailhead) at $155/hr = $4185
- 14 dozer hrs at $155/hr = $2170
- 58 excavator or loader hours/gravel cap at $140/hr: $8120
- 24 excavator hours/compact at $140: $3360
- Winter Cost Margin = $2542 (40%)

Optional Gravel Cap Total: $23,077*

PART 2: Gravel Causeway/Primitive Road

- Materials: Geotextile (6 rolls 17.5' x 309'); Pit Run (2370 cy); Culvert (3 @ 24"x24')
- 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. Taper/grade gravel down to native ground in between ponded areas (as indicated by GPS Waypoints).
  4. When snow melts, ground thaws and road settles, install culvert.
  5. Regrade surface and compact.

- Distance: 707'
- Width: 12' travel surface; 20' base
- Location: See GPS file
- Cross Sections: See Drawings for "Site 1 Gravel Causeway"
- Cost Estimate:

Material Estimate:

- Geotextile (17.5' x 309' per roll x 4 rolls): $1456
- Pit Run gravel (1676 cy @ $6/y): $10,056
- Culvert: (3 @ 24"x24'): $1680

Total Material: $13,192

Labor Estimate:

- 335 hrs truck time (assuming 2 hr round trip from pit close to trailhead) at $155/hr = $51,925
- 168 dozer hrs at $155/hr = $26,040
- Winter Cost Margin = $31,186 (40%)

Total Labor: $109,151*

Total Estimate: $122,343*

Total Part 1 & 2: $129,231 (including optional gravel cap: $152,308)

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

OPTION 2: Reroute w/ Ditch & Elevate, Corduroy & Gravel Cap

- Materials: Native soil from ditches; on-site timber; culvert (2 @ 24"x24'); D1 gravel cap (510 cy); Geotextile (6 rolls 17.5' x 309')

- Methods
  1. Recon for suitable alignment to the south, skirting both ponds.
  2. Identify and clear location for gravel delivery in winter.
  3. Flag centerline and clear 30' corridor where applicable, limb trees for corduroy and cut at 14', no stumps higher than 6" EXCEPT in first 50' without ditches, keep corridor as tight as possible (12' or <) and flush cut stumps.
  4. Lay Geotextile. Prepare and lay transverse corduroy in 14' or < lengths from trees 6" or < dbh EXCEPT in first 50'.
  5. Excavate ditches and build 12' tread with native material excavated from parallel ditches EXCEPT in first 50' where there are no ditches.
  6. Place 1-2 culverts at operator discretion to correspond with two lowest places where hydrology demands exchange.
  7. Cap with 6" imported D1 gravel (staged in winter)
  8. Compact with plate compactor or equivalent attachment in 2-4" lifts.
  9. Rejoin trail just west of intersection w/ private road. 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: est. 2112' (.4 miles)
- Width: 12' traveling surface, 32' corridor, 30' from outside edges of ditches.
- Location: See GPS file
- Cross Sections: See Drawing "Site 4 Ditch & Elevate" (w/ 12' width)
- Cost Estimate:

  Material Estimate:
  - Geotextile (17.5' x 309' per roll x 6 rolls): $2184
  - D1 gravel (510 cy @ $20/y): $10,200
  - Culvert: (2 @ 24"x24'): $1120

  Total Material: $13,504

  Labor Estimate:
  - 40 hrs recon & lay out alignment: $3000
  - 84 D/E excavator hrs at $140/hr = $11,827
  - 127 timber labor hrs at $53/hr = $6731
  - 20 site/gravel prep at $140/hr = $2800
  - 22 compacting hrs at $140/hr = $3080
  - 102 excavator/gravel transport hrs at $140/hr = $14,280
  - 102 hours gravel truck time/$155/hr=$15,810
  - Winter cost margin (40%)=$6324

  Total Labor: $63,852*

Total Estimate: $77,356*

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

Site #2

OPTION 1: RECOMMENDED: Ditch & Elevate Full Width w/ Gravel Cap & Culverts

- Materials: Native soil from ditches; Geotextile (17.5' x 309' per roll x 5 rolls); Culvert (8 @ 24"x24'); D1 gravel cap (408 cy).
- Methods:
  1. Clear trees as needed for corridor. Lay Geotextile.
  2. Beginning at Waypoint "Site 2," Ditch & Elevate up middle of trail alignment for 800', installing Culverts 1-5 at designated GPS Waypoints, until reaching "End DE".
  3. Traverse 128' of decent ground, then at "DE2" begin Ditch & Elevate again for 120', installing Culvert 6 at designated GPS Waypoint, until reaching "End DE2".
  4. Traverse 100' of decent ground, then at "Begin DE3", Ditch & Elevate for 332', installing Culverts 7-8 at designated GPS Waypoints.
  5. Spread gravel cap (staged in winter on frozen ground at east end of Site 2); compacting in lifts.

- Distance: 1472' (.28 miles); 1252' of Ditch & Elevate
- Width: 12' traveling surface, 32' corridor
- Location: See GPS file
- Cross Sections: See Drawings
- Cost Estimate:

Material Estimate:

- Geotextile (17.5' x 309' per roll x 5 rolls): $1820
- D1 gravel (408 cy @ $20/y): $8177
- Culvert: (8 @ 24"x24'): $4480

Materials Total: $14,477

Labor Estimate:

- Flag centerline, culvert locations at $53/hr: $106
- 20 timber labor hours at $53/hr: $1060
- 60 D/E excavator hours at $140/hr: $8400
- 82 hrs truck time at $155/hr: $12,710
- Winter cost margin=$5084 (40%)
- 30 excavator hours/gravel cap at $140/hr: $4200
- 20 excavator hours/compact at $140: $2800

Labor Total: $34,360*

Total Estimate: $48,837*

OPTION 2: Primitive Road/Gravel

- Materials: Geotextile (17.5' x 309' per roll x 5 rolls); Pit Run (3489 cy); Culvert (8 @ 24"x24')
- Methods:
  1. Mark culvert sites in summer at GPS points
  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.
  4. Install culvert in winter to prevent road failure during spring break-up.
  5. When snow melts, ground thaws and road settles, check culvert installation, re-grade surface and compact.

- Distance: 1472' (.28 miles)
- Width: 12' travel surface; 20' base
- Location: See GPS file
- Cross Sections: See Drawings for Site 1 Causeway
- Cost Estimate:

Material Estimate:

- Geotextile (17.5' x 309' per roll x 5 rolls): $1820
- Pit Run gravel (3489 cy @ $6/y): $20,934
- Culvert: (8 @ 24"x24'): $4480

Material Total: $27,234

Labor Estimate:

- 697 hrs truck time (assuming 2 hr round trip from pit close to trailhead) at $155/hr = $108,035
- 349 dozer hrs at $155/hr = $54,080
- Winter Cost Margin = $64,846 (40%)

Labor Total $226,961*

Total Estimate: $254,195*

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

--Provided by Interior Trails, August 28, 2013

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