B.C. HYDRO & POWER AUTHORITY

# HAT CREEK PROJECT

# 1981 RECLAMATION REPORT

THERMAL GENERATIONS PROJECTS DIVISION

Report No. HC30

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HAT CREEK PROJECT

1981 RECLAMATION REPORT

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# SECTION 1.0 - INTRODUCTION

B.C. Hydro has been actively exploring the Hat Creek coal deposits since 1974. As described in previous years' reports this work has included surveying, road construction, extensive drilling and the excavation of three large trenches. All disturbances except those roads still in use have been reclaimed. In addition, several areas have been set aside for more extensive and detailed testing of reclamation practises.

During 1981 a Site Investigation Program was undertaken to further examine a wide variety of geotechnical factors of importance to the development of the proposed Hat Creek Mine and Powerplant. This program included the excavation and subsequent backfilling of small trenches, geotechnical drilling, groundwater supply exploration and surveying.

The reclamation test areas at Hat Creek have continued to be monitored during 1981. Additional studies have been undertaken on productivity and levels of trace elements in selected waste materials and vegetation.

This report provides details of exploration work carried out during 1981; Only a small portion of the work was carried out on coal licences. Hence the areas on these licences have been identified separately. Total areas disturbed are also reported. Details of the application of maintenance fertilizer and assessments of the progress of reclamation of previously disturbed areas is presented. The reports on productivity and trace element levels are not yet complete but will be forwarded at a later date.

# SECTION 2.0 - DISTURBANCES DURING 1981

## 2.1 ENVIRONMENTAL PROTECTION

Areas disturbed during the 1981 field exploration programs are identified on Fig. 1. As may be seen most of the work took place on land outside of B.C. Hydros' coal licences.

Two environmental officers were assigned full time to the site to ensure that disturbances were kept to a minimum, that environmentally sensitive areas were protected and that disturbed areas were rehabilitated at the completion of the program. Measures included the following:

1. Control of drainage, using ditches and/or culverts, to minimize erosion during road construction and exploration site preparation.

2. Off road travel was kept to a minimum.

3. Rubber tired vehicles were employed wherever possible to avoid track or skid mounted machinery.

4. Main access roads and trails in wet, low ground were surfaced with gravel from local borrow areas.

5. Clearing for roads and survey lines was restricted. All felled lumber was bucked and limbed before being set aside for burning in the fall.

## 2.2 SURFACE DISTURBANCE

Five types of disturbances occurred during the 1981 Site Investigations program, namely:

(a) road construction,

(b) surveying,

(c) drilling for geotechnical investigation and water supplies,

(d) test pit excavation, and

(e) trenching.

### (a) Roads

Main access roads were normally 6 to 7 m wide, with ditches and culverts placed where necessary. Secondary trails into work sites were kept to the width of the D6D cat blade; about 4 m. Roads were not constructed over open grassland where the 4 x 4 vehicles and backhoes could drive without obstruction to the work sites. Such travel was kept to a minimum.

### (b) Surveying

Surveying required long narrow tracts to be cleared for visibility. Brush and trees were removed, bucked and piled along these lines. Most of this work was required at the Powerplant site. Where possible survey lines were incorporated into the access roads.

(c) Drilling

Diamond and rotary drill rigs required fairly level areas upon which to operate. Thus, site preparation was required wherever these type of equipment were used.

The Bema drill, a small gas powered hand auger, caused negligible land disturbance. Access to these sites along the pipeline route was on foot.

(d) Test Pits

Most test pits were dug with a Case 580 backhoe. This versatile rubber tired vehicle did not require any site preparation and in all but one case did not require road construction.

A larger P & H 418 tracked shovel was used at the Powerplant site to excavate to bedrock. This machine required the construction of larger working areas and access roads.

(e) Trenching

Trenching was required for gravel and sub-surface investigations. A D6D cat, P & H 418 backhoe and a Wabco W/8 rubber tired front end loader were used for this work. Side cuts from road building were utilized as trenches where feasible. All but three of these trenches have been fully reclaimed. Two have been fenced off for later studies and the other is an active gravel pit.

# SECTION 3.0 - RECLAMATION

## 3.1 AREAS DISTURBED DURING 1981

The areas disturbed during the 1981 Site Investigation Program and subsequently reclaimed is given in Table 3-1. These areas refer only to those disturbed areas located on the B.C. Hydro Coal Licences. Since different types of disturbance occurred depending on the particular exploration program, site preparation and rehabitation were not necessarily the same for all areas.

Where site preparation required land to be cleared, all slash was bucked and limbed then piled for removal or burning. In some instances, e.g., when test pits were located in irrigated alfalfa fields reseeding was found to be unnecessary.

In general, drill sites were cleared of debris prior to being recontoured. The area was harrowed; seed and fertilizer added and then reharrowed to bury the seed. Where necessary drainage control structures were constructed.

As indicated previously, the 1981 Site Investigation Program involved a substantial amount of work in the vicinity of but off the Coal Licences. Total land areas disturbed are summarized in Table 3-2(a) and Table 3-2(b).

A single seed mix was applied to all areas reclaimed. Details of seed mix used and fertilizer added are given in Table 3-3. Approximate costs are given in Table 3-4.

TABLE 3-1

SUMMARY OF EXPLORATION AREAS DISTURBED AND REVEGETATED

DURING 1981 ON BCH COAL LICENCES

| Type of Disturbance | Length (km) | Area (ha) Disturbed | Revegetation | | | | Total Not Seeded |
|---|---|---|---|---|---|---|---|
| | | | Area (ha) Recontoured | Area (ha) Seeded | Area (ha) Fertilized | Total Area (ha) Receiving Work | |
| Roads | 14.49 | 6.33 | 0.02 | 4.43 | 4.43 | | 1.90[1] |
| | Number | | | | | | |
| Test Pits | 151 | 1.16 | 1.14 | 1.14 | 1.14 | | 0.02[2] |
| & Trenches | 0 | | 0 | 0 | 0 | | 0 |
| Drill Sites | 51 | 1.69 | 0.42 | 1.25 | 1.25 | | 0.44[3] |
| Gravel Pits | 2 | 1.70 | 0.20 | 0.20 | 0.20 | | 1.50[4] |
| TOTAL | | 10.88 | 1.78 | 7.02 | 7.02 | | 3.86 |

1 Made up of: (a) 0.02 ha gravelled and graded
(b) 0.03 ha in alfalfa field - grew in by itself
(c) 1.85 ha damage minimal - backhoe drove over once

many access roads still in use

2 See 1(b) - 0.02 ha

3 See 1(a) - 0.42 ha

4 Active borrow area - 1.50 ha

TABLE 3-2(a)

SUMMARY OF EXPLORATION AREAS DISTURBED AND REVEGETATED

DURING 1981 ALL AREAS

| Type of Disturbance | Length (km) | Area (ha) Disturbed | Revegetation | | | | Total Not Seeded |
|---|---|---|---|---|---|---|---|
| | | | Area (ha) Recontoured | Area (ha) Seeded | Area (ha) Fertilized | Total Area (ha) Receiving Work | |
| Roads* | 21.28 | 11.63 | N/A | 11.54 | 11.54 | | .09 |
| Survey Lines | 19.10 | | | | | | |
| | Number | | | | | | |
| Test Pits & Trenches | | 10.99 | N/A | 6.77 | 6.77 | | 4.22 |
| Adits | | 0 | N/A | 0 | 0 | | 0 |
| Drill Sites | | 1.83 | N/A | 1.77 | 1.77 | | .06 |
| Other | | | N/A | | | | |
| TOTAL | | 24.45 | | 20.08 | 20.08 | | 4.37# |

* Permanent roads not included.

\# Areas not reseeded are: borrow areas still active,
roads still in use, and
remaining drill sites will be reclaimed in 1982

TABLE 3-2(b)

SUMMARY OF ALL AREAS DISTURBED AND RECLAIMED TO 31 DECEMBER 1981

| Disturbance | Area (ha) Disturbed | Area (ha) Recontoured | Area (ha) Seeded/ Planted | Area (ha) Fertilized Area (ha) | Total Area (ha) Receiving Work | Area (ha) of Completed Reclamation |
|---|---|---|---|---|---|---|
| Roads | | (Many roads are still being used) | | | | |
| 1981 - | 11.6 | - | 11.5 | 11.5 | | 11.5 |
| Total to date - | 40.9 | - | 16.0 | 16.0 | | 16.0 |
| All Drill Holes and Trenches | | | | | | |
| 1981 - | 12.8 | - | 8.6 | 8.6 | - | 8.6 |
| Total to date - | 53.5 | 8 | 45.6 | 43.6 | | 45.6 |
| Waste Dumps | | | | | | |
| 1981 - | 0 | - | | 0 | (Experimental) | 0 |
| Total to date - | 14.0 | - | 14.0 | 14.0 | | 14.0 |
| Stockpiles | | | | | | |
| 1981 - | - | - | - | - | - | - |
| Total to date - | 1 | - | - | - | - | - |
| TOTAL 1981 - | 24.4 | - | 20.1 | 20.1 | - | 20.1 |
| TOTAL TO DATE - | 109.4 | | 75.6 | 73.6 | - | 75.6 |

TABLE 3-3

REVEGETATION SEED MIX

| Species (variety) | seeds/kg x 1000 | Mix % weight | Mix % seed | Application Rate (kg/ha) |
|---|---|---|---|---|
| Crested Wheatgrass (Nordan) | 385 | 29 | 30 | 7.25 |
| Smooth Bromegrass (Manchar) | 275 | 27 | 20 | 6.75 |
| Alfalfa (Drylander) | 469 | 24 | 30 | 6.0 |
| Streambank Wheatgrass (Sodar) | 375 | 20 | 20 | 5.0 |
| Totals | | 100 | 100 | 25 |

Fertilizer additions:

| N | P | K | |
|---|---|---|---|
| 13 | 16 | 10 | at 125 kg/ha |
| 11 | 48 | 16 | |

TABLE 3-4

APPROXIMATE COST FOR RECLAMATION

| | |
|---|---|
| Coal Licences Area $000's | |
| Labour | 5.0 |
| Equipment | 1.0 |
| Seed (7.5 ha) | 0.7 |
| Fertilizer | 0.5 |
| Total | 7.2 |
| Other Areas | |
| Labour | 15.0 |
| Equipment | 15.0 |
| Seed (13.1 ha) | 1.1 |
| Fertilizer | .7 |
| Total | 31.8 |
| Total | 40.0 |

## 3.2 MAINTENANCE OF PREVIOUSLY RECLAIMED AREAS

### (a) Soil Sampling and Fertilizer Additions

Soils samples were collected during late March 1981 from those areas reclaimed during previous years and presently being studied:

1. Trench A, B and C waste dumps.

2. Aleece Lake Reclamation Test Plots.

3. Medicine Creek and Houth Meadows Slope Test Plots.

Samples were collected as before: the ground was loosened with a shovel then sampled along the untouched side with a plastic ladle. Up to seven samples were collected from each material type or plot and composited. Samples were air dried overnight, mixed thoroughly and then a sub-sample sent for analysis to the Soil Testing Laboratory of the B.C. Ministry of Agriculture, Kelowna. Based on these analyses and the recommendations for soil amendment additions for grass/legume growth, fertilizer additions were made as shown on Table 3-5. As described previously five areas are being used in a five year evaluation of fertilizer requirements. Details of those areas fertilized and not fertilized to 1981 are shown in Table 3-6.

Fertilizer additions were made using a Cyclone hand broadcaster in early June.

TABLE 3-5

B.C. HYDRO

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MAINTENANCE FERTILIZER ADDITION RATES - 1981

| Test Area | Description | Addition Rates (kg/ha) N - $P_2O_5$ - $K_2O$ - B | | | |
|---|---|---|---|---|---|
| | | 11-48-0-0 | 34-0-0-0 | 0-0-62-0 | 0-0-0-21 |
| Houth Meadows | | | | | |
| Gravel Slopes | No Topsoil | 58 | 149 | 127 | 0 |
| Gravel Slopes | Topsoil | 92 | 135 | 35 | 0 |
| Parent Material* | Area 4 & 5 | 233 | 88 | 119 | 0 |
| Aleece Lake | | | | | |
| Bentonitic Clay | Total | 46 | 150 | 0 | 19 |
| Colluvium | Total | 117 | 126 | 0 | 5 |
| Baked Clay | Total | 46 | 150 | 0 | 14 |
| Carbonaceous Shale | Total | 188 | 103 | 0 | 0 |
| Coaly Waste | Total | 58 | 115 | 0 | 0 |
| Gritstone | Total | 46 | 150 | 0 | 0 |
| Glacial Gravel | Total | 188 | 103 | 0 | 0 |
| Fly Ash | Total | 46 | 150 | 108 | 0 |
| Trench 'A' | | | | | |
| Coaly Waste | Total | 177 | 108 | 71 | 0 |
| 3120 Gritstone* | Total | 210 | 97 | 0 | 19 |
| 3140 Baked Clay* | Area 4 & 5 | 108 | 130 | 0 | 6 |
| 3160 Carb. Shale | Total | 165 | 112 | 0 | 0 |

* 5 year maintenance fertilizer program.

TABLE 3-5 - (Cont'd).

| Test Area | Description | Addition Rates (kg/ha) N - $P_2O_5$ - $K_2O$ - B | | | |
|---|---|---|---|---|---|
| | | 11-48-0-0 | 34-0-0-0 | 0-0-62-0 | 0-0-0-21 |
| Trench 'B' | | | | | |
| Topsoil | Total | 188 | 103 | 0 | 14 |
| Subsoil | Total | 165 | 112 | 71 | 0 |
| Gravel* | Area 4 & 5 | 136 | 122 | 145 | 17 |
| Trench 'C' | | | | | |
| Bentonitic Clay-No Topsoil* | Area 4 & 5 | 81 | 139 | 0 | 24 |
| Topsoil* | Area 4 & 5 | 104 | 131 | 0 | 12 |
| Medicine Creek | | | | | |
| Slopes (Till) | Total | 165 | 112 | 0 | 0 |

* 5 year maintenance fertilizer program.

Addition rates from Soil Amendment Recommendations - Soil Analysis Report: B.C. Ministry of Agriculture, Soils Branch, Kelowna. 10 April 1981.

TABLE 3-6

5 YEAR FERTILIZATION PROGRAM AREAS

Trench 'A': 3140' Dump

| Year / Plot | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|
| 1 | yes | yes | no | no | no | no | no |
| 2 | yes | yes | yes | no | no | no | no |
| 3 | yes | yes | yes | yes | no | no | no |
| 4 | yes | yes | yes | yes | yes | no | no |
| 5 | yes | yes | yes | yes | yes | yes | no |

Trench 'A': 3120' Dump

Trench 'B': Gravel Pile, Houth Meadows: Parent Material

| Year / Plot | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|
| 1 | yes | no | no | no | no | no | no |
| 2 | yes | no | yes | no | no | no | no |
| 3 | yes | no | yes | yes | no | no | no |
| 4 | yes | no | yes | yes | yes | no | no |
| 5 | yes | no | yes | yes | yes | yes | no |

TABLE 3-6 - (Cont'd)

Trench 'C'

| Plot \ Year | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|
| 1 | no | yes | no | no | no | no | no |
| 2 | no | yes | yes | no | no | no | no |
| 3 | no | yes | yes | yes | no | no | no |
| 4 | no | yes | yes | yes | yes | no | no |
| 5 | no | yes | yes | yes | yes | yes | no |

(b) Vegetation Surveys

Growth in all reclaimed areas progressed well during the year. Rainfall during the early growing period was relatively high during 1981, Table 3-7 which undoubtedly contributed to the good performance. Qualitative assessments of waste dumps at Trenches A, B and C and slope test plots were made in September. Results are summarized below:

(i) Trench A

3160 Carbonaceous Shale

- Top

The furrowed area has continued to show excellent growth in the furrows proper. There appeared to have been some in-filling of the area between furrows and those plants above the edges of the vegetation islands seemed quite stunted.

On the bare nonfurrowed area apart from one or two very small patches there has been little growth.

On the topsoiled portion of the dump vegetation success has been mixed. Contrary to expectation this area has shown poor catches of individual species. Sainfoin and alfalfa had been well cropped presumably by deer. Areas where individual had not developed there were good catches of native weeds. The area planted with Seedmix IV .showed very poor species diversity with crested wheatgrass dominant. Total cover was in the range 75 to 100 percent.

- Slopes

No major changes were evident from last year. There remains a band of approximately 5 m at the top of the dump where vegetation is very sparse. Rill erosion is present in the very fine material of the 26° sloped area. The steeper (∿34°) area, because of the presence of coarser material shows better stability. Vegetation establishment is satisfactory (50 to 75 percent) and apparently stable below the upper band mentioned above.

3140 Baked Clay

- Top

The dump showed an excellent catch with essentially 100 percent cover and excellent species diversity existed with all species seeded in Seedmix IV present. Examination of fertilizer area 1, not fertilized since 1978, showed a reduced presence of the grasses. Also those grasses present showed a reduced level of maturity. This was in clear contrast to the areas 4 and 5 which have received maintenance fertilizer every year since 1978. Nevertheless cover on all areas remained 75 to 100 percent with a strong bias towards the 100 percent level.

- Slopes

These continue to show excellent growth with essentially 100 percent cover. Stability of both 34° and 26° slopes has been excellent.

3120 Gritstone

- Top

Although bare patches remain this dump has shown great improvement. In particular the area seeded with Tall Wheatgrass (Seedmix VI) shows very good growth. Alfalfa remains in short supply on the clay area. Cover in vegetated areas in 75 to 100 percent and biomass production is excellent.

The effect of fertilizer application is becoming evident with grasses being less abundent in the area only fertilized in 1978.

- Slopes

Cover has improved and plant size is much improved. Although some bare patches persist these are now of minor significance and the overall view from the east is of a relatively well revegetated dump.

(ii) Trench B

Gravel Dump

Vegetation across the dump showed very good cover, generally 75 to 100 percent, with very small patches of low cover. A dramatic difference in species composition was observed between areas fertilized every year since 1978 and that not fertilized since 1978. The area not fertilized since 1978 showed good legume catch and rather small, in many cases immature, crested wheatgrass. Where fertilizer has been applied every year the grass showed excellent abundance,

biomass and maturity; alfalfa was also present in good quantities.

It is now impossible to detect from casual observations the area which was harrowseeded in 1977.

Subsoil Dump

Overall cover was in the range 75 to 100 percent with a strong bias towards 100 percent. Although alfalfa is present in approximately equal quantities with the grasses the plants are quite small presumably due to competition. This dump remains one of the very few with a good catch of Canada Bluegrass.

Topsoil Dump

This dump continues to show substantial improvement in the catch of crested Wheatgrass. Alfalfa is not present in any significant quantities. Weeds which had previously been dominant now exist in relatively small discrete patches. Native grass is very much in evidence. Overall cover on the dump 75 to 100 percent.

(iii) Trench 'C' - Bentonitic Clay

Dump 1

- Top

With topsoil there has been excellent progress in reclamation with cover in the range 75 to 100 percent. Tall and slender wheatgrasses show very good stands.

The non-topsoil area remains markedly lower in overall cover than that with topsoil - in the 25 to 50 percent range.

As at other dumps where long term fertilizer tests are underway the area not fertilized since 1978 is showing an increased bias toward legume (alfalfa) development.

- Slopes

Topsoiled areas show good cover while non-topsoiled areas are significantly less successful. Overall cover would not be meaningful due to the patchy reclamation.

Dump 2

- Top

Topsoiled areas are well reclaimed with slender and tall wheatgrass prominent. Overall cover 75 to 100 percent. On the bare areas reclamation is impressive considering the material. Growth in the furrows is, as before, abundent. Overall the cover is estimated at approximately 50 percent.

- Slopes

Slopes continue to be anomalous with the short non-topsoiled areas doing very well. The topsoiled area show significant bare patches although improvements have been made.

Dump 3

- Top

The topsoiled area is well reclaimed with cover in the range 75 to 100 percent.

On the bare material some improvement is evident but the area is overall poor. Cover is estimated at <10 percent.

- Slopes

Cover is mixed with limited but improving growth on the bare material. The topsoiled areas are significantly more satisfactory.

(iv) Slope Test Plots - Houth Meadows

General

The entire area including all slopes had been grazed by cattle.

22° Slope

The topsoil side of the plot has improved in overall cover although it is still dominated by grasses. Cover near the slope top is approximately 50 percent due inpart to residual effect of weeds inhibiting the growth of agronomics. Weeds are now becoming of minor significance.

On the non-topsoiled areas cover is more consistent (75 to 100 percent) and species diversity (grass/legume) closer to 1:1.

26° Slope

Cover on both topsoiled and non-topsoiled areas are approximately equal (75 to 100 percent). However grasses dominate on the topsoiled half while without topsoil a more even mix of alfalfa and crested wheatgrass occurs.

30° Slope

Weeds appeared to be significant on the upper topsoiled slope only. The remainder of that slope showed much improvement.

On the non-topsoiled slope, cover (75 to 100 percent) and diversity (1:1 grass/legume) were most satisfactory.

Parent Material

Cover is excellent, close to 100 percent, with a much improved grass legume mix. Due to grazing it was not possible to determine if any differences in grass legume ratios were present on areas receiving different fertilizer treatments.

(v) Medicine Creek

22° Slope

This entire area has progressed very well. Alfalfa was significantly more abundent than in previous years although crested wheatgrass remained dominant.

26° Slope

Essentially the same as 22° slope.

30° Slope

Excellent cover with substantially greater quantities of alfalfa on the lower slope crested wheatgrass was dominant on the upper slope.

Overall the area showed excellent results with cover to 100 percent. Some alfalfa plants displayed red/purple colouration on the lower stems indicative of possible phosphorus deficiency. However the plants appeared in good condition, certainly not stunted and were mature.

## 3.3 RECLAMATION RESEARCH

Use was made of revegetation test areas to evaluate quantitatively two aspects of reclamation at Hat Creek.

### (a) Productivity

The plots at Aleece Lake were sampled twice during the year to obtain a measure of the productivity of vegetation grown on the various waste materials. These data were compared with similar data collected from native range in the Houth Meadows and Medicine Creek areas. The evaluation was undertaken to determine whether or not waste dumps, slated to be constructed in the Houth Meadows and Medicine Creek areas, could be returned to a productivity comparable with existing levels. Results obtained indicate that this would indeed be possible. When the report describing this work has been finalized it will be forwarded to the Ministry of Energy, Mines and Petroleum Resources.

(b) Trace Elements

Samples of soil and vegetation were gathered from selected test areas and analysed to determine concentrations of 18 trace elements. In addition, the distribution of trace elements between roots, stems and influoresences of grass was determined. These data were compared to literature data on levels of trace elements expected to be toxic or deficient in plants and toxic or deficient as forage for grazing animals. Comparisons were also made with range species growing at Hat Creek. Once finalized, this report will be forwarded to the Ministry of Energy, Mines and Petroleum Resources.

TABLE 3-7

MONTHLY PRECIPITATION IN HAT CREEK VALLEY 1981

MEASURED AT B.C. HYDRO AIR QUALITY
MONITORING TRAILER #2 - VALLEY SITE

| Monthly | Precipitation (mm) |
|---|---|
| January | 12 |
| February | 18 |
| March | 9 |
| April | 2 |
| May | 63 |
| June | 15 |
| July | 49 |
| August | 2* |
| September | 0* |
| October | 1 |
| November | 10 |
| December | 12 |
| Total Precipitation | 193 |

* Partial record