B-1 INTRODUCTION TO BUTTS RUN SECTION OF THE REPORT

Section B of the report deals with the Butts Run watershed which, like the Contrary Run watershed, is included in an overall effort of Beech Creek water quality cleanup headed by the Beech Creek Watershed Association. Butts Run is a tributary of South Fork of Beech Creek, classified as CWF (cold water fishery). The project is supported by the Growing Greener funding.

The Butts Run watershed is located to the east of Snow Shoe, Centre County, Pennsylvania; the watershed boundary as delineated on 7½ minute topographic map (Snow Shoe Quadrangle) is shown in Figure B-1.

This report provides information needed for the assessment of water quality degradation and sets priorities for further watershed investigations and subsequent remedial action.

B-2 BUTTS RUN WATERSHED CHARACTERIZATION

B-2.1 Geology

The Butts Run watershed is underlain by the strata of the Mauch Chunk Formation and the Burgoon sandstone. Figure B-2, Geologic Map shows where the sedimentary strata of the two formations underlie the watershed area.

The Mauch Chunk Formation consists of interbedded shale, claystone, sandstone and siltstone. Geologic log for a well located within the area of Mauch Chunk Formation and located upgradient from Carlin coal tipple (information obtained from R. S. Carlin, Inc., Tipples No.1&3, I.W. # 1483203, DEP files, Moshannon District Office) is given in Appendix B-1. The well record provides a description of the local strata, characterized by a succession of sandstone with interbeds of clay, shale, mudstone and siltstone. the approximate location of the well is shown in Figure B-2, Geologic Map. The Burgoon sandstone underlies the valley of Butts Run and its unnamed headwater tributaries UT-A and

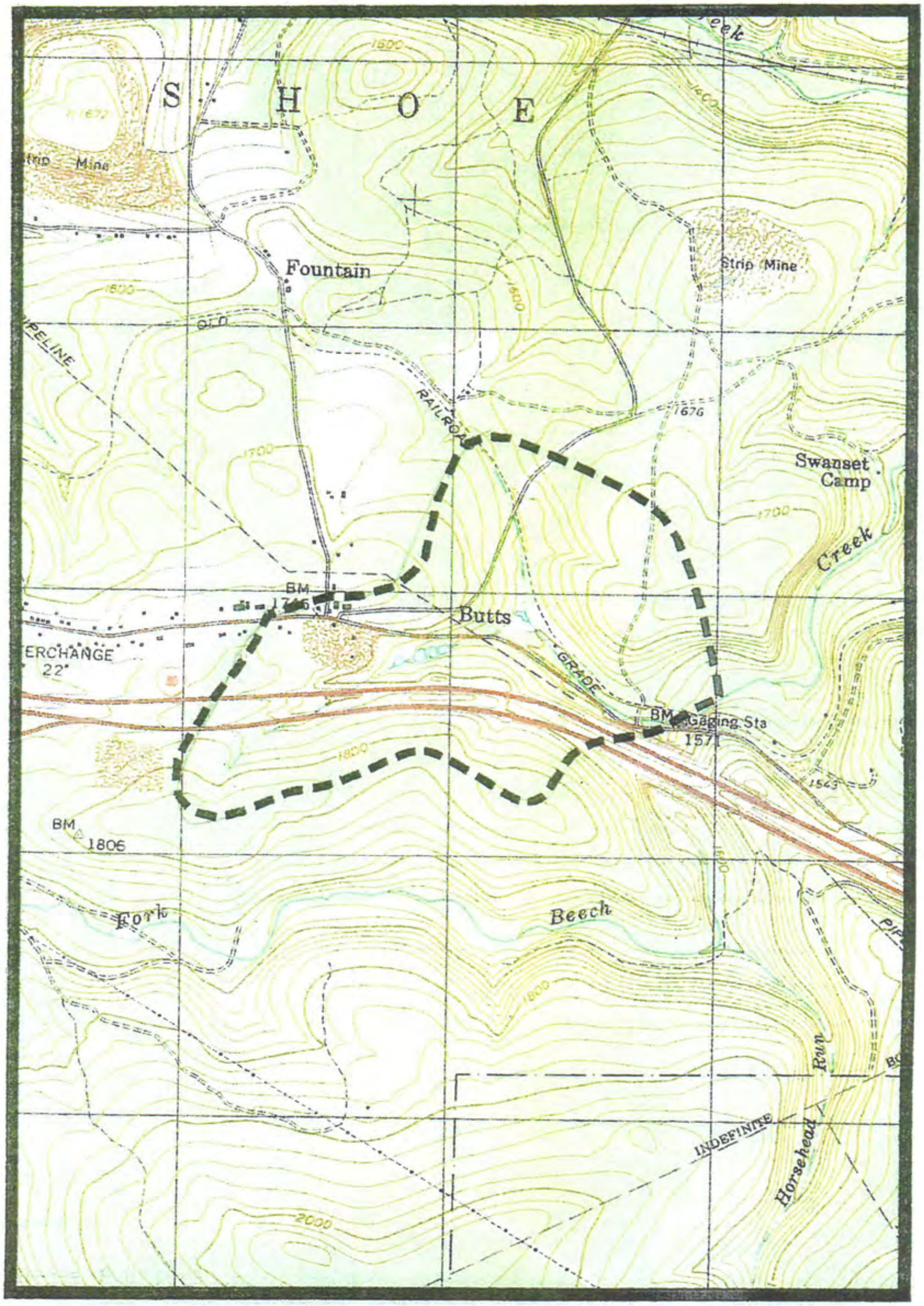


Figure B-1. Butts Run Watershed Delineation.

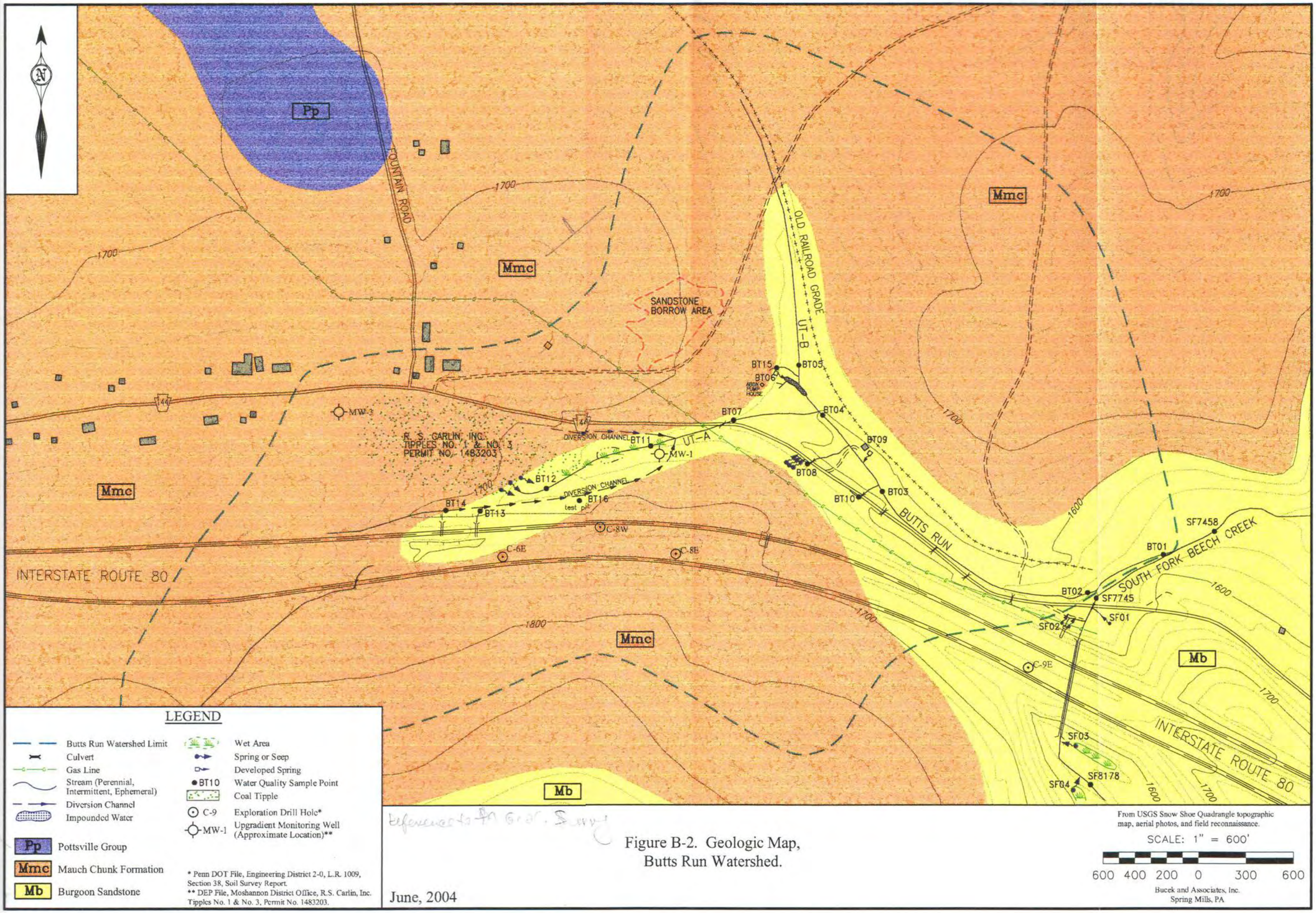


Figure B-2. Geologic Map, Butts Run Watershed.

UT-B. The sandstone is described as medium gray to light gray, medium-grained, containing locally small-pebble conglomerate.

Several exploratory drill holes from the Interstate Route 80 corridor study by the Pennsylvania Department of Transportation provide information on the site specific lithologies of both the Mauch Chunk Formation and the Burgoon sandstone. Lithologic logs for the exploration holes are given in Appendix B-2. The locations of the drill holes are given on the Geologic Map, Figure B-2.

The exploration borehole Bor. No. C-9 (eastbound lane) penetrates 100 feet of Burgoon sandstone described as brownish gray and gray sandstone with thin interbeds of sandy shale. The exploratory boreholes Bor. No. 6 and Bor. No. 8 (eastbound lane) penetrate both formations with the younger Mauch Chunk strata not distinctly different by its lithological make up from the underlying Burgoon sandstone. The majority of the lithologic types in the local strata are represented by brown and gray sandstone.

Structurally, the local strata are part of the southeastern limb of the Snow Show syncline that lies approximately 2.7 miles to the northwest; the dip of local strata toward the synclinal low is to the northwest.

B-2.2 Hydrology

Butts Run is a first and second order stream, a tributary to the South Fork of Beech Creek. The stream that collects drainage from approximately 420 acres is a perennial stream downgradient from its headwater spring (BT06) that contributes a large portion of the stream flow. The flows in the unnamed headwater tributary streams (UT-A and UT-B) are intermittent. The measured volume of the discharge from the headwater spring (BT06) during the period of record (2001-2004) ranges from 7 to 274 gpm with an average of 95.3 gpm. The flow volume in Butts Run near its confluence with South Fork at BT02 ranges from 13 to 1,280 gpm with an average of average 414 gpm.

The Mauch Chunk Formation is described as it has been extensively developed for water supplies. Joints in the strata provide abundant secondary porosity; reported median yield of the strata is 55 gpm. The water derived from the formation may have elevated iron content, otherwise the water quality as a source of drinking water is rated as good (A.R. Geyer and J. Peter Wilshusen, 1982). The Burgoon sandstone is known as an excellent aquifer, sometimes with artesian heads and yields over 300 gallons per minute. It has high secondary porosity and generally high permeability.

As the majority of the flow in the Butts Run originates in a large headwater spring (BT06), the evaluation of the potential sources of Butts Run degradation must consider ground water as well as surface water degradation. The headwater spring originates at the contact of the Mauch Chunk Formation and Burgoon sandstone; both formations are characterized by relatively high secondary porosity and may deliver high discharge volumes as observed in the headwater spring. The degree of the contamination suggests an AMD source with a short flow path and limited dilution potential. The water quality assessment as presented in this report deals mostly with surface water quality data; the planned installation of monitoring wells could not done as no access permission to the properties needed for monitoring well placement was granted.

B-2.3 Land Use and Potential Sources of Butts Run Degradation

Unlike in the Contrary Run watershed, no coal-bearing strata with extractable coal thickness or reserves occur in the Butts Run watershed. As there is no record of past coal or clay mining in the Butts Run watershed, the search for the origins of Butts Run degradation has been focused on other land uses which might have a potential for acid mine drainage formation. These sources were identified as follows: the presence of road fill in the corridor of Interstate Route 80, past sandstone removal from a shallow pit to the northwest of the Butts Run headwater spring, and the presence of the Carlin coal tipple in the unnamed headwater tributary UT-A to Butts Run (see Figure B-3, Land Use Map, Butts Run Watershed).

The investigation of the potential sources of AMD degradation as part of this project was somewhat hindered by the lack of cooperation of the property owners who wouldn't grant access to their land.

B-2.3.1 Interstate Route 80 Corridor

Figure B-3 shows the location of the Interstate Route 80 corridor within the watershed and the areas where road fill was used in the roadway construction. The road fill borrow often originates in close proximity to the construction site and may include pyrite containing rocks that produce acid drainage. As no record of the origin of the road borrow materials was found and no testing of the acid forming potential of the fill was performed, the examination of the road fill impacts is based on its position relative to the impacted streams and the quality of discharges downgradient from the fill areas.

There are two areas within the watershed where the road construction required filling topographic lows of local stream valleys. The information on the thickness of the road fill as shown on Figure B-3 was obtained from the Soil Survey Report and Profile, Legislative Route 1009, Section 38, Centre County, 1963, as prepared for the Commonwealth of Pennsylvania, Engineering District 2-0, Department of Highways (see Appendix B-2 for documentation).

The road fill area RF-A is located in the western portion of the watershed, approximately between stations 510 and 525 of the eastbound lane and 517 and 531 of the westbound lane of the corridor. The maximum thickness of the fill in the eastbound lane is 22 feet near station 516 and 29 feet in the westbound lane near station 522. It was constructed in the valley of unnamed headwater tributary UT-A to Butts Run.

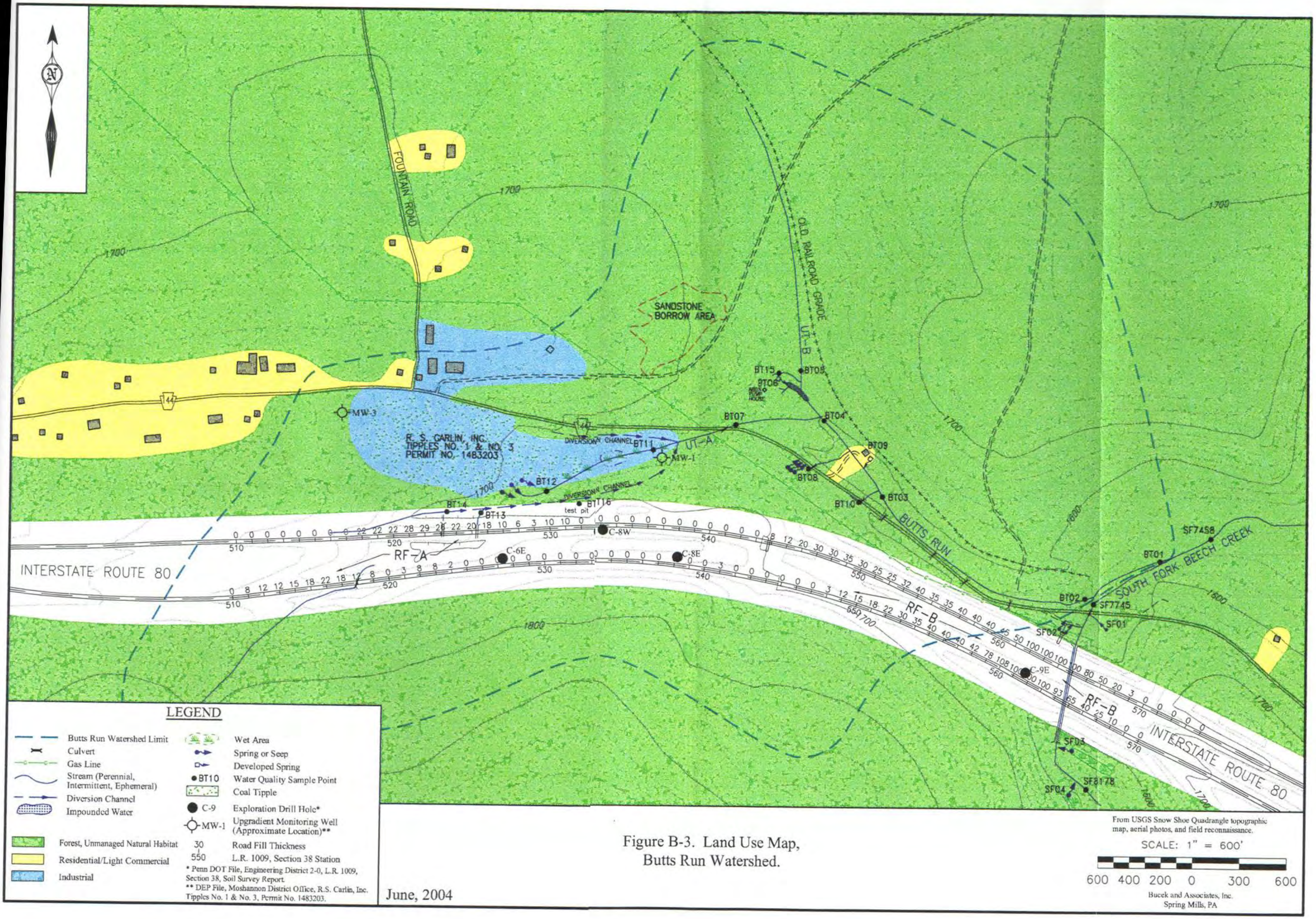


Figure B-3. Land Use Map, Butts Run Watershed.

The road fill area RF-B is located in the eastern portion of the watershed, between stations 548 and 569 of the eastbound lane and stations 543 to 570 in the westbound lane of the corridor. The maximum thickness of the fill is 108 feet in the eastbound lane, 22 feet near station 560, and 100 feet in the westbound lane between stations 562 and 565. The fill was placed in the valley of the South Fork of Beech Creek, with its thickest portion coinciding with the area of the stream bed and its floodplain.

The surface runoff and stream flow from the upper portions of the UT-A crossed by the Interstate Route embankments, is conveyed through large culverts placed at the bottom of the road fill. The surface runoff from the roadway is collected in ditches and returned to the watershed as direct runoff or is diverted through drain pipes back into the watershed. Neither one causes a depletion of water recharge volume to the watershed.

B-2.3.3 Sandstone Borrow Area

Regolith and sandstone were removed from a small area located along a private road, approximately 1,500 feet east of Fountain Road. The depth of the excavation is about 5-10 feet; the area remains un-reclaimed, with limited volunteer vegetation. The mined sandstone was used as fill for construction of a private road.

To assess the acid forming potential of the extracted sandstone, two sandstone samples were analyzed for overburden analysis parameters. The results of the tests are given in the Appendix B-3. The determined total sulfur in the samples was less than 0.04 percent; acid drainage producing potential of the sandstone is negligently small.

As vegetation in the borrow extraction area was stripped and as the area remains sparsely vegetated, the surface runoff from the area has increased, with some potential for increased siltation in surface runoff in the immediate vicinity. However, as the immediate vicinity of the site is vegetated, there are no immediate impacts on the local stream quality.

B-2.3.3 Carlin Coal Tipple

Figure B-4 shows the Carlin coal tipple as it operated in the valley of UT-A to Butts Run, east of Snow Shoe Borough. Four treatment ponds were located downgradient from the tipples in the valley of UT-A to Butts Run. The operation of the tipples ceased and biosolids were used to augment site re-vegetation. It is reported that some coal and coal refuse was removed from the site. The treatment ponds were closed and the area regarded. However, the available information on the site cleanup is anecdotal and sketchy at best. A thorough site inspection as part of the project was not possible as access to the property was not granted.

The review of the existing DEP files and correspondence indicates that three monitoring wells were installed at the site. The information about the wells is sketchy; no information with respect to their depth, construction detail, or closure was found.

The upgradient well (monitoring point 3) is believed to have been located to the west of the tipple, side gradient well (monitoring point 4) to the north of Route 144, and the downgradient well (monitoring point 1) in the last treatment pond embankment. The depth of the wells is unknown with the exception of the upgradient one, reported to be 90 feet (copy of drill log is given in Appendix B-1). Water quality data for samples from the wells gathered between 09/1988 and 01/1992 given in Appendix B-5 will be discussed in section B-4 of the report.

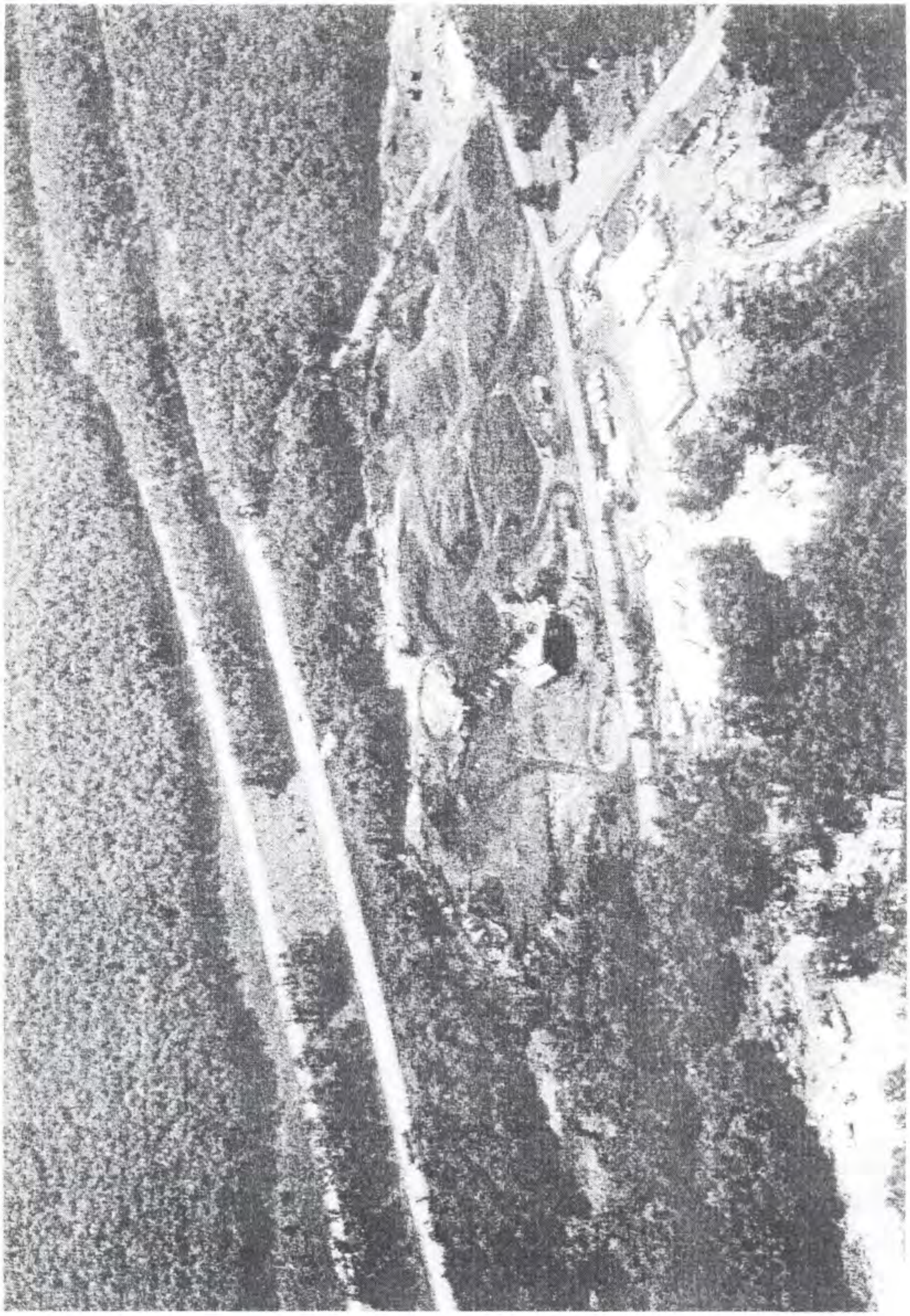


Figure B-4. View of Carlin Coal Tipple (Permit No. 1483203), photo taken in the early 1980's
(Reprinted with the permission of Hess and Fisher Engineers, Clearfield, Pennsylvania)

B-3 BUTTS RUN WATERSHED WATER QUALITY CHARACTERIZATION

B-3.1 Water Quality Survey

A field investigation of the watershed was performed in order to identify surface water features such as seeps, springs, streams, and ponds, and to collect water samples and flow data at 23 sampling locations from September 2001 to May 2004. The identified surface water features and sampling locations are shown in Figures B-2 and B-3.

At each sampling location field measurements included flow, pH, and temperature. Flows were measured by means of a stainless steel portable 1⅜" flume or Global Water velocity probe; where measurements could not be taken, flows were visually estimated. Field pH and temperature were measured with Hanna HI-9025C pH and temperature meter. Collected samples were analyzed for the following parameters: laboratory pH, specific conductance, alkalinity, acidity, iron, manganese, aluminum, sulfate, and suspended solids. Chemical analyses were performed by Mahaffey Laboratory Ltd, Grampian, Pennsylvania.

Collected field data and chemical analysis results were compiled into a series of individual spreadsheets set up for each of the sampling sites with information on sampling site description, latitude/longitude, and surface elevation. In addition, various sources were examined for historic sampling records in the Butts Run watershed and where current and historic sampling locations could be correlated, the spreadsheets were complemented with available historic information. Sources of information include Operation Scarlift, Project No. SL-111, 1970, Gannett Fleming Corddry and Carpenter, Inc., Beech Creek Watershed Restoration Plan by Gannett Fleming in 2000, and DEP sampling records. In addition, water quality data was obtained for three monitoring wells constructed at the Carlin coal tipple.

A water quality database for Butts Run Watershed is provided in Appendix B-4; a compilation of basic statistical data for tested water quality parameters, such as concentration ranges, median (pH) and mean values, are given in Table B-1.

TABLE B-1. BUTTS RUN WATERSHED WATER QUALITY SUMMARY

Sample	Field pH		Acidity		Alkalinity		Iron		Manganese		Aluminum		Sulfate	
Point ID	median	range	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range
BT01	4.5	4.4 - 4.9	47	32 - 70	5	4 - 7	0.3	0.06 - 0.70	2.18	1.18 - 3.18	7.48	6.09 - 9.75	83	51 - 122
BT02	4.5	4.0 - 5.7	53	3 - 128	4	0 - 8	0.28	0.05 - 2.00	2.4	0.71 - 5.88	7.56	1.32 - 17.40	92	30 - 249
BT03	4.1	3.7 - 4.5	58	30 - 86	3	0 - 6	0.14	0.06 - 0.21	2.42	1.32 - 3.52	11.2	11.2 - 11.2	104	59 - 149
BT04	3.6	3.3 - 4.0	125	92 - 190	0	0 - 0	0.13	0.09 - 0.23	4.78	3.09 - 7.46	19.03	14.0 - 26.0	165	119 - 195
BT05	5.8	5.4 - 6.6	0	0 - 0	23	16 - 36	0.15	0.08 - 0.31	0.02	0.01 - 0.04	0.19	0.10 - 0.38	26	7 - 45
BT06	4.0	3.2 - 5.3	102.5	53.0 - 134.0	0	0 - 0	0.1	0.1 - 0.3	4.1	2.2 - 6.6	13.8	6.6 - 19.7	160	99 - 227
BT07	4.6	4.2 - 6.4	54.4	0 - 156	12.8	0 - 74	0.58	0.12 - 1.88	2.63	0.08 - 5.08	3.95	0.09 - 6.29	129	14 - 289
BT08	6.0	5.5 - 6.7	0	0 - 0	22	14 - 32	0.04	0.01 - 0.07	0.03	0.01 - 0.08	0.05	0.01 -0.08	16	10 - 32
BT09	5.0	4.1 - 5.0	8	4 - 10	7	6 - 9	0.01	0.01 - 0.01	0.41	0.25 - 0.60	0.83	0.55 - 1.13	25	20 - 36
BT10	6.0	5.9 - 6.9	0	0 - 0	37	15 - 128	0.04	0.04 - 0.04	0.02	0.01 - 0.02	0.05	0.05 - 0.05	12	20-Aug
BT11	4.3	3.6 - 5.5	96	36 - 230	1	0 - 6	2.73	0.07 - 8.05	3.72	2.27 - 5.42	8.14	5.86 - 16.5	233	95 - 500
BT12	3.9	3.0 - 5.2	180	77 - 426	0	0 - 0	4.8	1.04 - 14.20	3.72	1.92 - 6.32	8.9	5.16 - 21.70	247	95 - 619
BT13	6.8	6.7 - .6.8	0	0 - 0	41	34 - 54	1.85	0.03 - 5.43	1.33	0.62 - 2.17	0.47	0.38 - 0.56	32	30 - 35
BT14	6.1	5.6 - 6.4	0	0 - 0	36	27 - 47	0.21	0.05 - 0.41	0.59	0.25 - 1.38	0.3	0.18 - 0.58	28	14 - 70
BT15	4.6	4.5 - 4.7	18.5	18 - 19	3.5	2 - 5	0	0 - 0	0.71	0.63 - 0.78	1.96	1.7 - 2.22	34.5	32 - 37
BT16	6.4	6.4	0	0 - 0	10	10 - 10	0.1	0.10 - 0.10	0.36	0.36 - 0.36	0.21	0.21 - 0.21	22	22 - 22
SF01	5.9	5.4 - 6.7	5	0 - 22	25	8 - 46	1.38	0.11 - 4.07	1.32	0.13 - 3.99	1.21	0.01 - 3.49	36	10 - 57
SF02	4.5	3.6 - 5.1	178	63 - 900	2	0 - 4	0.25	0.05 - 1.50	11.9	5.43 - 24	16.01	8.12 - 25.30	196	103 - 405
SF03	6.0	5.2 - 7.0	0	0 - 0	16	10 - 28	0.14	0.04 - 0.42	0.14	0.05 - 0.23	0.19	0.10 - 0.23	23	11 - 31
SF04	6.0	4.1 - 7.2	4	3 - 6	8	6 - 10	0.17	0.06 - 0.40	0.03	0.02 - 0.03	0.17	0.08 - 0.25	8	6 - 11
SF7458	5.5	4.6 - 6.6	5.3	0 - 12	7.75	4 - 14	0.09	0.05 - 0.14	0.33	0.18 - 0.44	0.7	0.45 - 1.06	18	12 - 21
SF7745	5.9	5 - 7	2	0 - 6	11	4 - 19	0.1	0.04 - 0.22	0.11	0.06 - 0.19	0.12	0.08 - 0.14	11	4 - 30
SF8178	6.5	4.7 - 7.2	1	0 - 4	13	8 - 15	0.09	0.05 - 0.12	0.01	0.01 - 0.02	0.04	0.03 - 0.04	11	7 - 20

B-3.2 Water Quality Assessment

As in the Contrary Run watershed assessment study, the evaluation of water quality in Butts Run and its impact on the South Fork of Beech Creek is based on the stream's viability to support aquatic life. The main chemical components known to have a negative impact on stream ecological health are low pH levels and elevated concentrations of acidity and metals, all parameters typical of AMD. The critical conditions, with significant impact on aquatic life arise when elevated total aluminum is present in an environment with low pH levels; the trout abundance in streams was reported to be reduced and acid sensitive fish species were absent from the streams with water quality characterized by median levels of pH less than 5.0-5.2 and aluminum concentrations exceeding 0.1-0.2 mg/l (J. P. Baker et al., 1996).

Therefore, the evaluation of the surface water quality and its changes throughout the watershed is based on the measured median value of field pH, and mean concentrations of total iron, total manganese, total aluminum and sulfate (see Table B-1). A series of maps were prepared for each listed parameter as given in Figures B-5 (page 118), B-8 (page 122), B-10 (page 124), B-12 (page 127), and B-14 (page 129). The mapped discharges and streams are color coded to show water quality of each of the above parameters and their level of impact. The levels of impacts are ranked in three categories, with not impacted water quality shaded green, moderately impacted water quality shaded yellow, and impacted water quality shaded red. A summary of threshold limits for each of the chemical parameter is given in Table B-2, Threshold Values for Water Quality Ranking. The background information used in the selection of the threshold values is given in section A of the report.

TABLE B-2 THRESHOLD VALUES FOR WATER QUALITY RANKING			
PARAMETER	THRESHOLD LEVEL	IMPACT LEVEL	SHADED COLOR
pH	≥6.0	no impact	green
	>5.0 - <6.0	moderately impacted	yellow
	≤5.0	impacted	red
Iron	≤0.3 mg/l	no impact	green
	>0.3 - <3.0 mg/l	moderately impacted	yellow
	≥3.0 mg/l	impacted	red
Manganese	≤0.05 mg/l	no impact	green
	>0.05 - <2.0 mg/l	moderately impacted	yellow
	≥2.0 mg/l	impacted	red
Aluminum	≤0.2 mg/l	no impact	green
	>0.2 - <0.5 mg/l	moderately impacted	yellow
	≥0.5 mg/l	impacted	red
Sulfate	≤40 mg/l	no impact	green
	>40 - <250 mg/l	moderately impacted	yellow
	≥250 mg/l	impacted	Red

B-3.3 Evaluation of Potential Sources of Butts Run Degradation

B-3.3.1 Interstate Route 80 Corridor

There were no springs or seeps found at the toe of the road fill RF-A in the western portion of the watershed area when inspected in May 2004. A drainage pipe placed into the road fill RF-B (sample point SF02) lies outside the watershed, beyond its southeastern limit where it discharges directly into South Fork.

Sample points BT13 and BT14 are culvert discharges that represent drainage from the area upgradient of the roadway and also from the area between the eastbound and westbound lanes. Sample point BT16 is an excavation impoundment that represents the quality of the shallow ground water system directly downgradient from the interstate roadway. The quality of the discharges as ranked according to the water quality thresholds are given below.

Water Quality Parameter	BT13	BT14	BT16
pH	Not impacted	Not impacted	Not impacted
Total iron	Moderately impacted	Not impacted	Not impacted
Total manganese	Moderately impacted	Moderately impacted	Moderately impacted
Total aluminum	Moderately impacted	Moderately impacted	Moderately impacted
Sulfate	Not impacted	Not impacted	Not impacted

The impacts of the road fill may be reflected in the elevated concentrations of manganese and aluminum; there is no impact on the concentrations of sulfate or pH levels. The levels of total iron remain low and near the threshold limit.

The shallow ground water system downgradient from the roadway is also represented by two discharge areas at the headwaters of two short tributary streams of Butts Run, sampled at points BT08 and BT10. No water quality impacts were observed in the collected water quality data measured as shown in the table below.

Water Quality Parameter	BT08	BT10
pH	Not impacted	Not impacted
Total iron	Not impacted	Not impacted
Total manganese	Not impacted	Not impacted
Total aluminum	Not impacted	Not impacted
Sulfate	Not impacted	Not impacted

The quality of the piped discharge SF02, derived from the road fill RF-B where it crosses the valley of South Fork, is impacted mostly in terms of low pH levels, total manganese and aluminum concentrations. The mean concentration of sulfate reported at 196 mg/l suggests impacts typical of acid mine drainage. As mentioned above, the discharge flows directly into South Fork but has a minimal impact on the stream quality because of its low flow rate. Water quality ranking for the discharge is given below.

Water Quality Parameter	SF02
pH	Impacted
Total iron	Not impacted
Total manganese	Impacted
Total aluminum	Impacted
Sulfate	Moderately impacted

B-3.3.2 Sandstone Borrow Area

No seeps or springs were found around the periphery of the abandoned borrow area. The unnamed tributary UT-B to Butts Run that crosses the private road for which the borrow materials were used, and lies downgradient from the area, represents the background water quality of the area. It is unlikely that the borrow area has had any impact on the Butts Run water quality even though it lies directly upgradient from the headwater spring BT06.

B-3.3.3 Carlin Coal Tipple

The surface water quality monitoring record downgradient of the Carlin coal tipple contains sample point BT12, a discharge that lies directly downgradient from the past tipple area, and sample point BT11, surface flow in the area of the former stream bed of UT-A to Butts Run. The valley of UT-A was modified by the installation of treatment ponds that currently are closed and the area of the pond location is regraded.

The measured flow in the discharge BT12 for the period of record ranges from 1 to 81 gpm. The quality of the discharge shows the greatest degree of degradation of all the points measured in the watershed, followed by the water quality sampled downgradient at sample point BT11. Water quality ranking for the two sample points is given below.

Water Quality Parameter	BT12	BT11
pH	Impacted	Impacted
Total iron	Impacted	Moderately impacted
Total manganese	Impacted	Impacted
Total aluminum	Impacted	Impacted
Sulfate	Moderately impacted	Moderately impacted

The surface water monitoring downgradient from the tipple is complemented by about six years of ground water quality monitoring data obtained for monitoring well No.1 constructed downgradient of the tipple and sampled from September 1988 to February 1994. The water quality data reporting sheets are given in Appendix B-5.

Similarly to the surface water degradation downgradient from the tipple, the ground water monitoring also shows a considerable degree of quality degradation in the ground water reservoir underlying the treatment pond area (the well was constructed in the pond embankment). The water quality record of the last two years of available ground water monitoring data (1/1992 to 2/1994) shows the median pH levels at 4.7, the mean concentrations of net acidity at 40.7 mg/l, dissolved iron at 0.43 mg/l, dissolved manganese 2.42 mg/l and sulfate at 331.3 mg/l. The last two years of the record were chosen for the water quality representation as the data set, albeit over ten years old, best represents the most recent conditions.

B-3.4 Butts Run Watershed Areal Assessment and Impacts on South Fork

A review of the areal representation of the water quality distribution throughout the watershed as presented in the color shaded maps (Figures B-5, B-8, B-10, B-12, and B-14) and the time-series plots given in Figures B-6, B-7, B-9, B-11, B-13, and B-15, provide an insight into the role of the three potential sources of AMD degradation on Butts Run and South Fork water quality.

B-3.4.1 pH Levels and Mean Acidity Concentrations

The main sources of low pH levels and acidity observed in Butts Run originate downgradient from the Carlin tipple and at the headwater spring BT06 (see Figure B-5). Butts Run remains impacted (shaded red) for the entire length up to the point of confluence with South Fork, with a temporary improvement downgradient from two small tributary streams (sample points BT08 and BT10).

Water quality of the upgradient portion of the South Fork is not impacted (shaded green) until it passes through the road fill RF-B and receives flow from point SF02. It remains moderately impacted (shaded yellow) also below its confluence with Butts Run with median pH levels of 5.5 as measured at sample point SF7458.

Figure B-6 is a time-series plot of the field pH levels measured at the BT02 (Butts Run before confluence with South Fork), SF7745 (South Fork above confluence with Butts Run) and SF7458 (South Fork below confluence with Butts Run). It show the relative pH levels and their changes through the period of record.

Changes in net acidity concentrations at the three stream points are shown in a time-series plots in Figure B-7. Mean net acidity of Butts Run is 51 mg/l higher than that of the upstream point (SF7745).

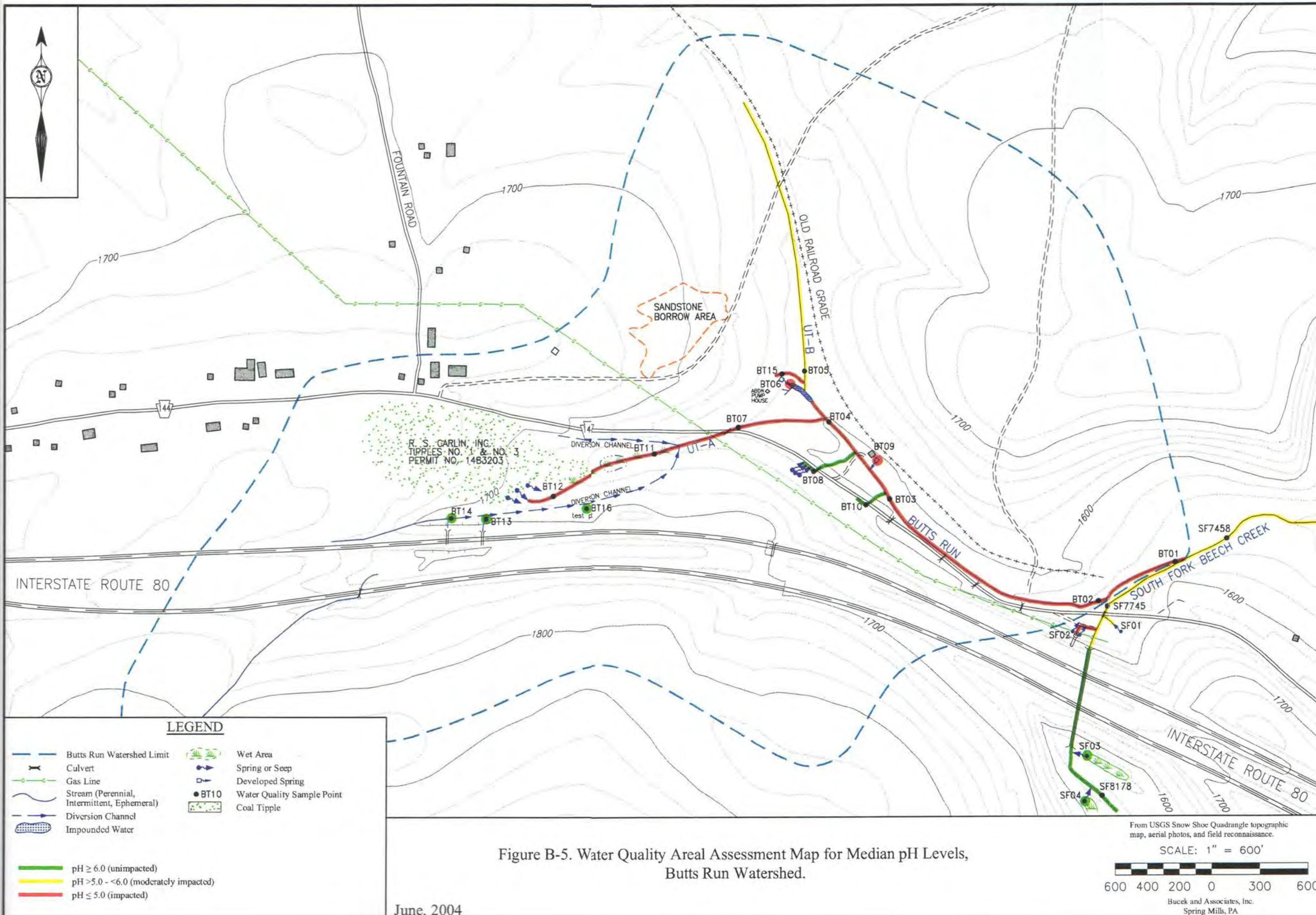


Figure B-5. Water Quality Areal Assessment Map for Median pH Levels, Butts Run Watershed.

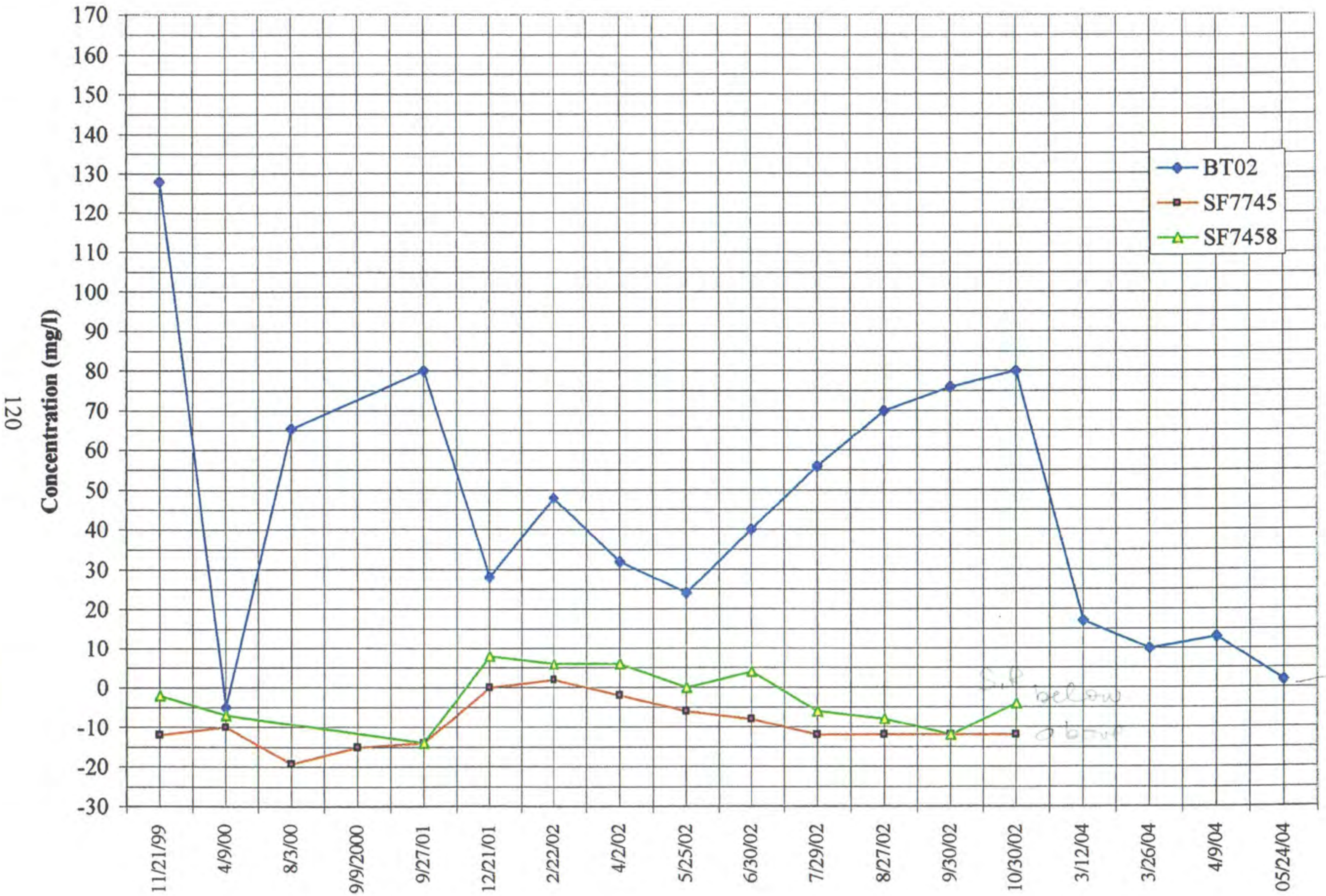
June, 2004

From USGS Snow Shoe Quadrangle topographic map, aerial photos, and field reconnaissance.

Bucek and Associates, Inc.
Spring Mills, PA

Figure B-6. Time Series Plots for Field pH Levels, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)

Figure B-7. Time Series Plots for Net Acidity, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)



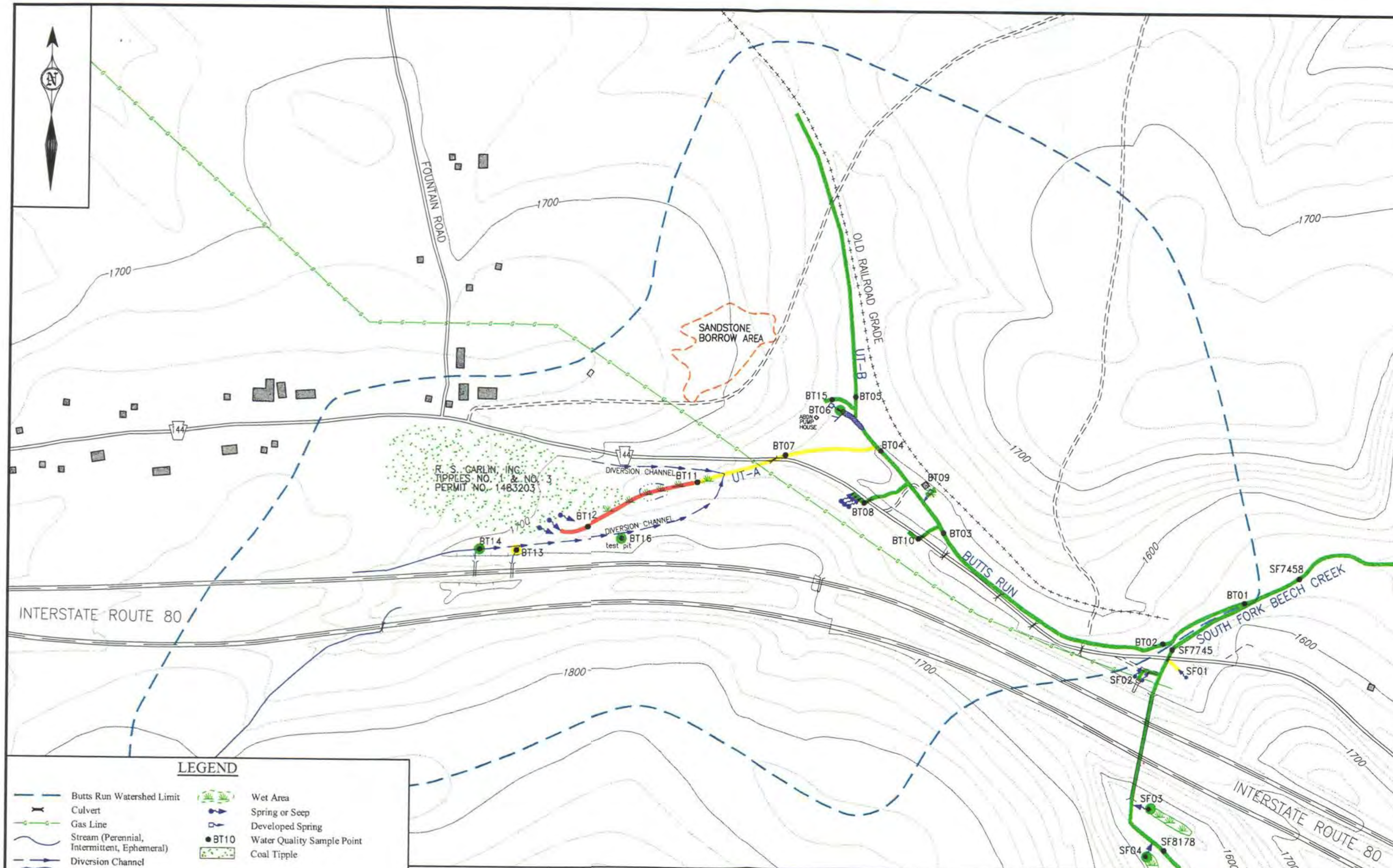
B-3.4.2 Total Iron Concentration

Stream quality impacts measured by total iron concentrations higher than 3.0 mg/l as shown in Figure B-8, occur only downgradient from the Carlin coal tipple, in the stream segment between sample points BT11 and BT12 (shaded red). The majority of the streams and point discharges are classified as not impacted (shaded green). No significant impact on the quality of South Fork is observed; the mean concentrations of total iron in the South Fork sample point SF7745 (above confluence) and sample point SF7458 (below confluence) for the period of record are 0.1 mg/l and 0.09 mg/l, respectively. A time-series plot of the total iron concentrations measured at sample points BT02, SF7745 and SF7458 is shown in Figure B-9.

B-3.4.3 Total Manganese Concentrations

A review of the total manganese ranking within the watershed, given in Figure B-10 shows impacted water quality in Butts Run but not in its unnamed tributary UT-B. The water quality of the unnamed tributary UT-B to Butts Run (sample point BT05) and South Fork, before it passes under Interstate Route 80 and receives flow from discharge SF02 is not impacted (shaded green). UT-A, which originates at the Carlin coal tipple is impacted, with mean manganese concentration of 2.63 mg/l (BT07). Likewise, BT06, the headwater spring, is impacted, with a mean manganese concentration of 4.11 mg/l. The quality of South Fork below its confluence with Butts Run is moderately impacted (shaded yellow).

The impact of the inflow from Butts Run, with a 2.4 mg/l mean manganese concentration (BT02) into South Fork is marked with an increase of total manganese from 0.11 mg/l (upgradient point SF7745) to 0.33 mg/l at the sample point SF7458, downgradient from the two stream confluence. Figure B-11 is a time-series plot of the manganese concentrations for the sample points BT02, SF7745 and SF7458.



LEGEND

- Butts Run Watershed Limit
- Culvert
- Gas Line
- Stream (Perennial, Intermittent, Ephemeral)
- Diversion Channel
- Impounded Water
- Wet Area
- Spring or Seep
- Developed Spring
- BT10 Water Quality Sample Point
- Coal Tipple

- Total Iron ≤ 0.3 mg/l (unimpacted)
- Total Iron >0.3 - <3 mg/l (moderately impacted)
- Total Iron ≥ 3 mg/l (impacted)

Figure B-8. Water Quality Areal Assessment Map for Mean Total Iron Concentrations, Butts Run Watershed.

June, 2004

From USGS Snow Shoe Quadrangle topographic map, aerial photos, and field reconnaissance.

SCALE: 1" = 600'

600 400 200 0 300 600

Bucek and Associates, Inc.
Spring Mills, PA

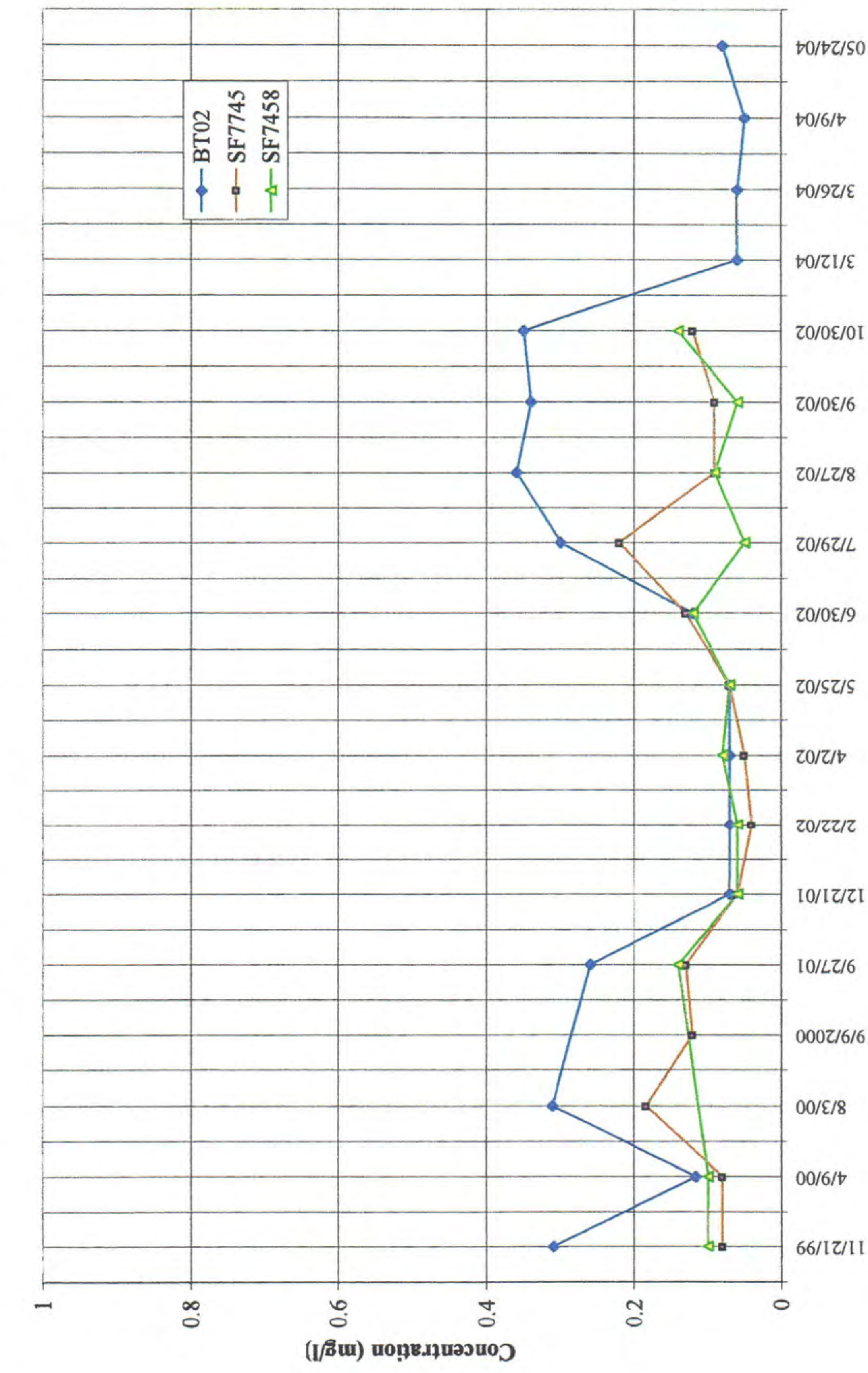


Figure B-9. Time Series Plots for Total Iron Concentrations, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)

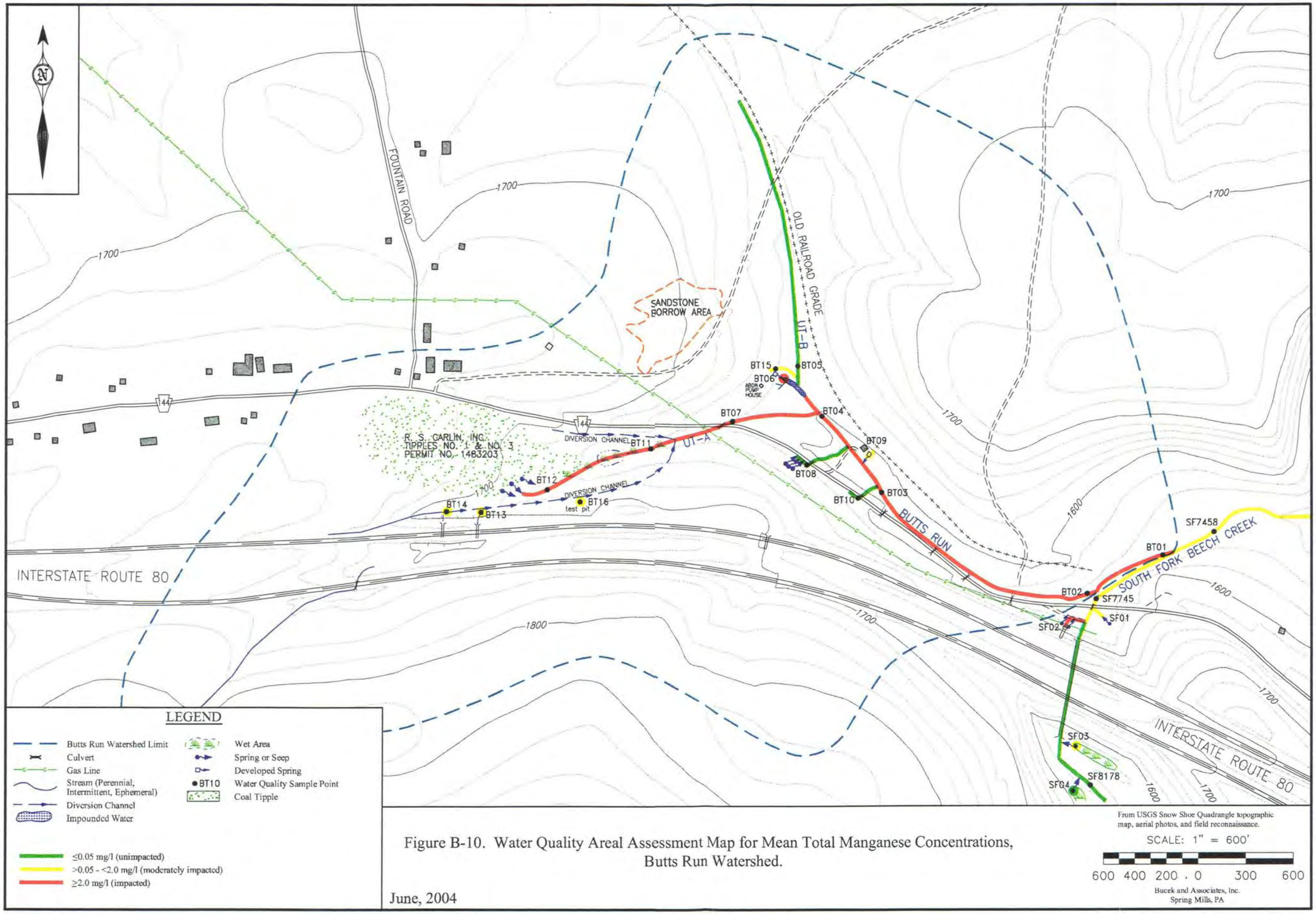
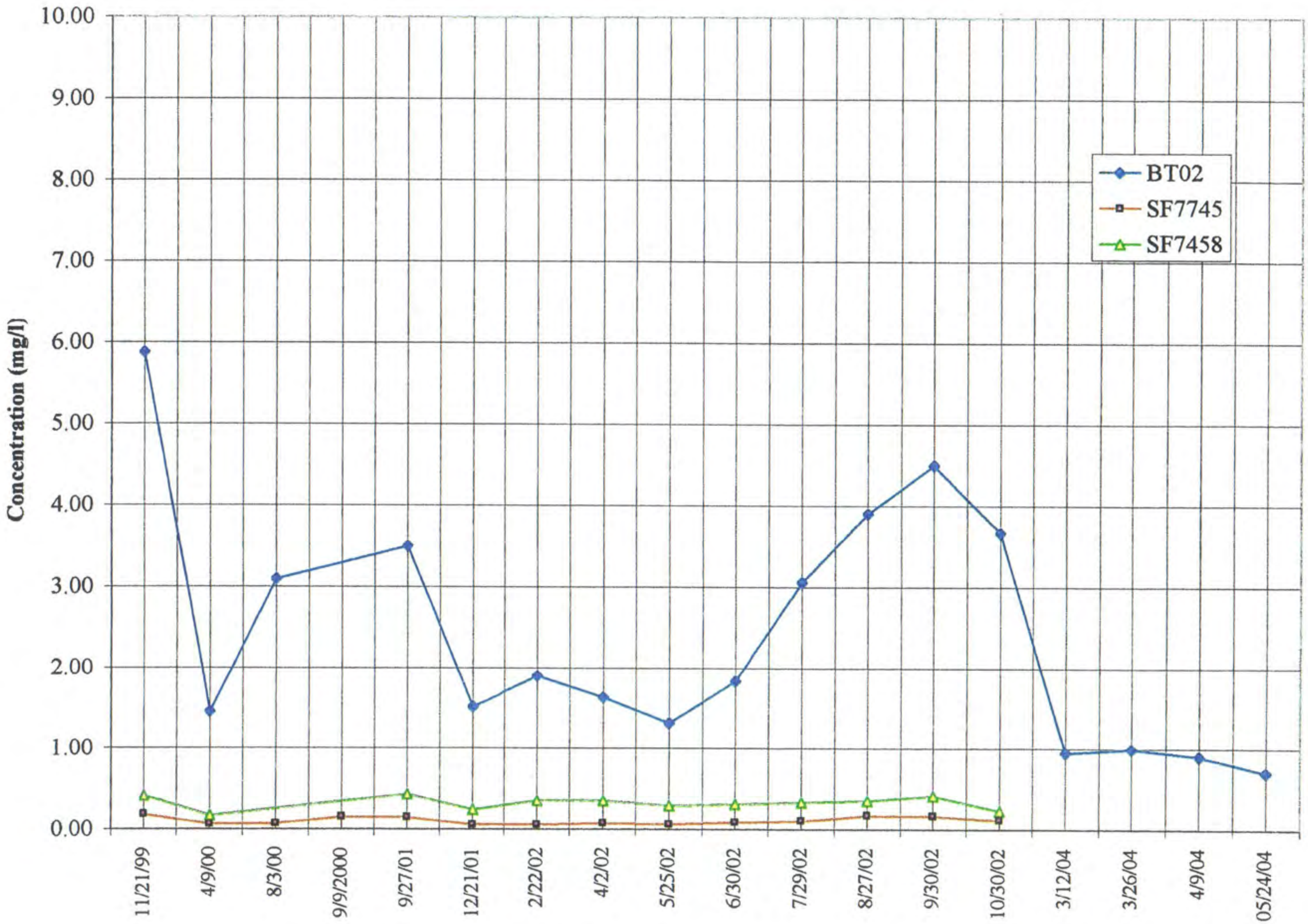


Figure B-10. Water Quality Areal Assessment Map for Mean Total Manganese Concentrations, Butts Run Watershed.

June, 2004

Figure B-11. Time Series Plots for Total Manganese Concentrations, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)



B-3.4.4 Total Aluminum Concentrations

Like the median pH levels and total manganese concentrations, the total aluminum levels show impacted water quality in the entire length of Butts Run and the portion UT-A below Carlin coal tipple (see Figure B-12). The quality of UT-B at sample point BT5 remains not-impacted (shaded green). South Fork stream water quality is not impacted up to the point of confluence with Butts Run where the water quality status changes to impacted.

The impact of the inflow from Butts Run with 7.56 mg/l mean total aluminum concentration (BT02) into South Fork is marked with an increase of total manganese from 0.12 mg/l (upgradient point SF7745) to 0.70 mg/l at the sample point SF7458, downgradient from the two stream confluence. The time-series plot for total aluminum concentrations for sample points BT02, SF7745 and SF7458 is given in Figure B-13.

B-3.4.5 Sulfate Concentrations

A review of the distribution of sulfate concentrations within the watershed expressed as water degradation ranking, as shown on the areal assessment map (Figure B-14), indicates that the main sources of elevated sulfate are the Carlin coal tipple and the headwater spring BT06. The moderately impacted status (shaded yellow) of Butts Run with mean sulfate concentration of 92 mg/l (BT02) does not affect the quality of South Fork, although the mean sulfate concentration increases by 7 mg/l, when comparing the sulfate concentrations measured upgradient and downgradient of the South Fork confluence with Butts Run. Figure B-15 is a time-series plot of sulfate concentrations measured at the BT02 (Butts Run before confluence with South Fork, SF7745 (South Fork above confluence with Butts Run) and SF7458 (South Fork below confluence with Butts Run).

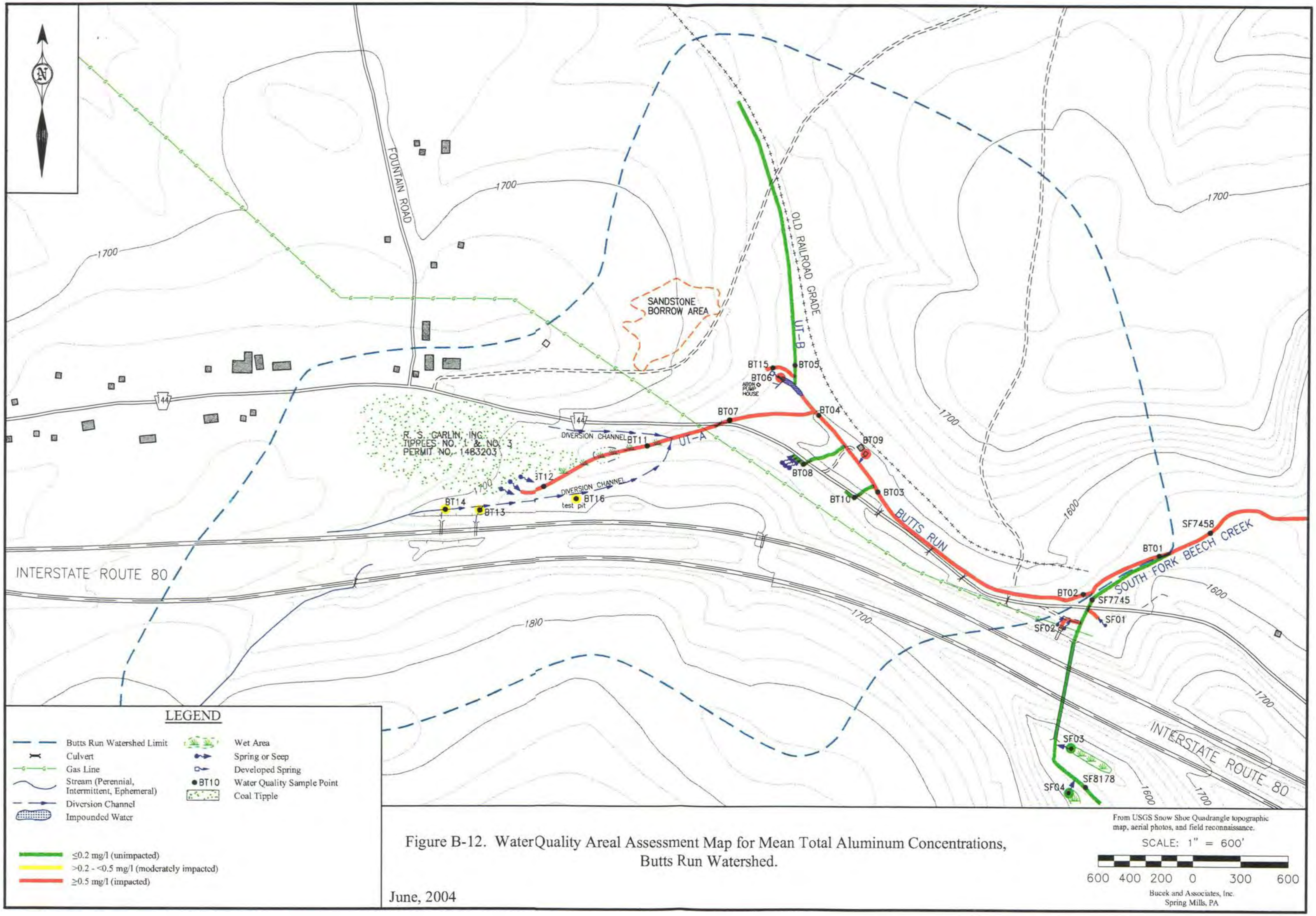


Figure B-12. WaterQuality Areal Assessment Map for Mean Total Aluminum Concentrations, Butts Run Watershed.

June, 2004

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Figure B-13. Time Series Plots for Total Aluminum Concentrations, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)

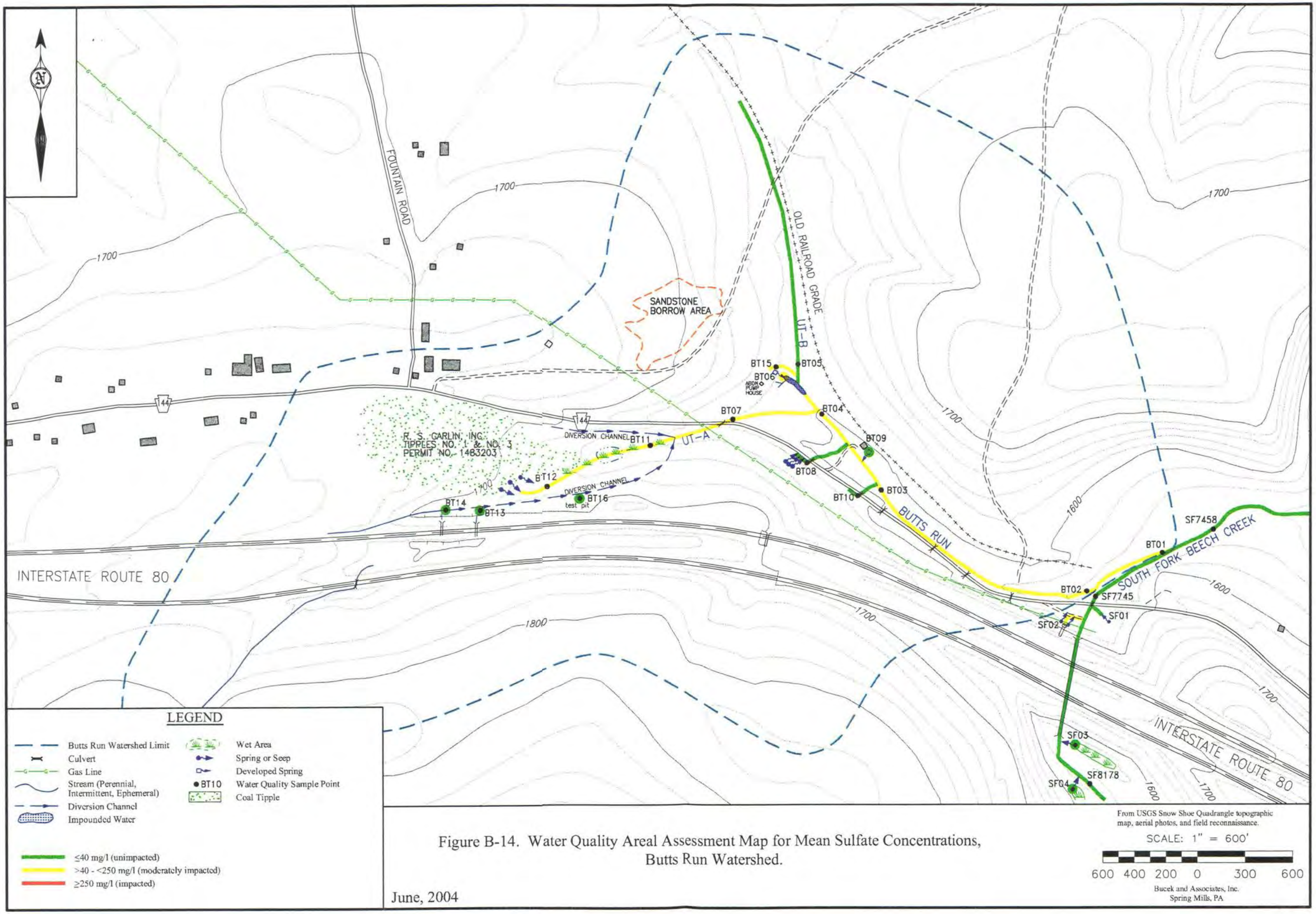
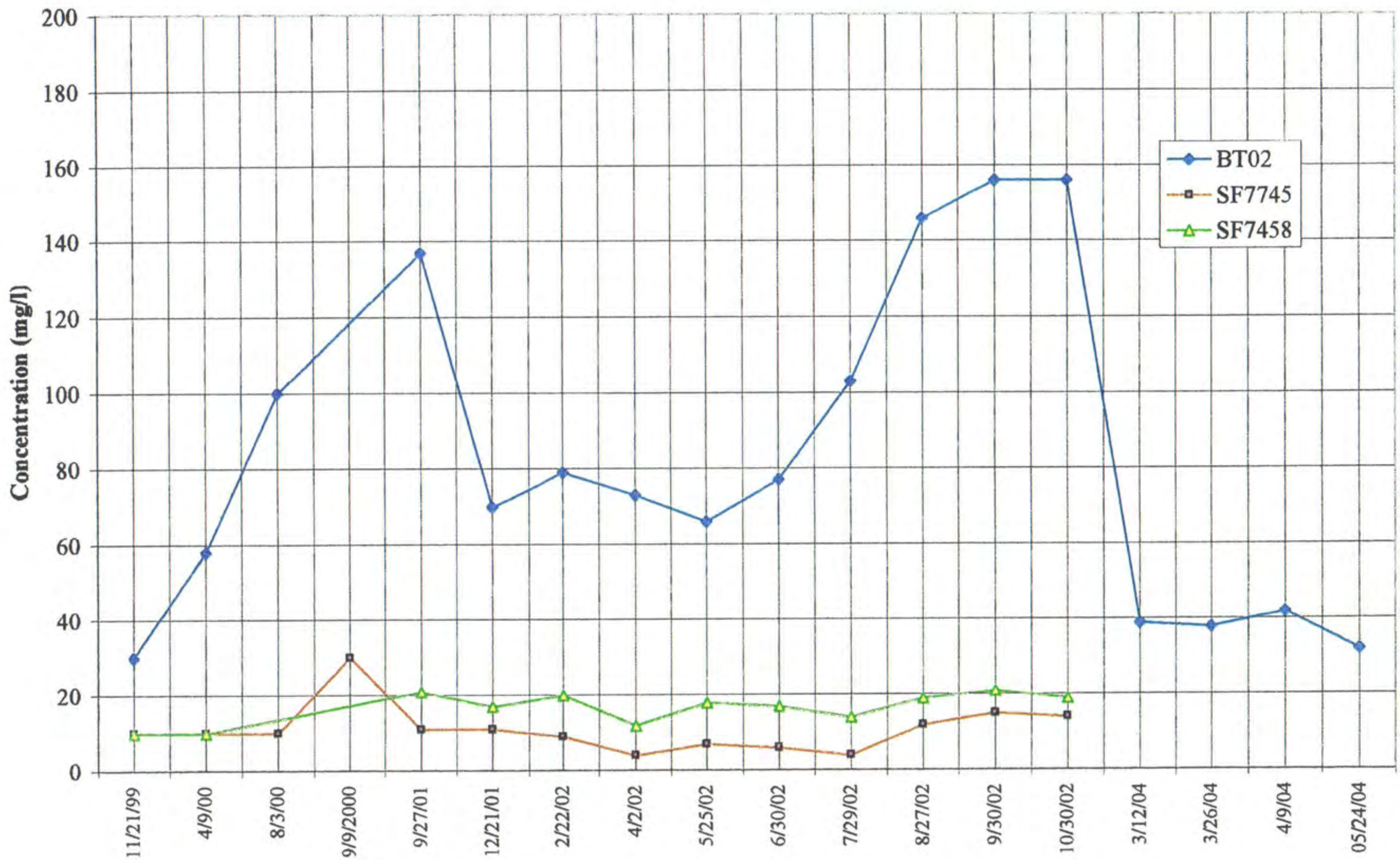


Figure B-14. Water Quality Areal Assessment Map for Mean Sulfate Concentrations, Butts Run Watershed.

Figure B-15. Time Series Plots for Sulfate Concentrations, Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF7745) and South Fork below Confluence with Butts Run (SF7458)



B-3.5 Impacts of Butts Run on South Fork Water Quality

The impact of Butts Run degradation on the South Fork water quality is lessened by the effects of dilution, since the Butts Run flow volume is at least an order of magnitude lower than that of South Fork. Nonetheless, the South Fork water quality is degraded by Butts Run inflow with higher concentrations of acidity, manganese, aluminum and sulfate. The greatest impact is observed in the total aluminum concentrations when the South Fork water quality reaches levels toxic to fish.

The sources of contamination of Butts Run, especially those significant in maintaining stream health in terms of aquatic biota (pH levels and total aluminum) originate in the area of the Carlin coal tipple and at the headwater spring BT06. A comparison of water quality data from the monitoring well located downgradient from the tipple that shows ground water contamination and the headwater spring suggests a potential hydraulic connection of the two water quality degrading sources. Both have a similar suite of ground water contaminants; the high degradation levels of BT06 also suggests a relatively short contaminant plume path from its source.

The measurements of water quality and flow at sample points BT07 and BT11, which show improved water quality downstream (BT07) compared to upstream (BT11) on UT-A, indicate a loss of contaminated water from the stream bed to the ground water reservoir. The ground water contamination downgradient from Carlin coal tipple presents a case where remedial measures to alleviate the stream degradation may not be effective, unless the contamination plume is well defined and the source of degradation isolated or removed (see below).

The contribution of the road fill placed in the western portion of the road corridor to Butts Run degradation is not significant, as evident from the collected water quality data, even as the water quality ranking of sample points downgradient from the fill indicates a moderate impact in terms of total aluminum and total manganese concentrations. The observed improvement of water quality between sample points BT11 and BT07 is attributed to the surface water flow and ground water recharge from the area of the fill.

B-4 PROPOSED GROUND WATER QUALITY MONITORING PLAN

There are two sources of Butts Run degradation, namely the Carlin coal tipple and the Butts Run headwater spring BT06. Construction of ground monitoring wells as proposed for the project was not possible as permission to access the properties in the vicinity of the tipple and the headwater spring was not granted.

The observed water quality degradation downgradient from the Carlin coal tipple impacts surface water quality, as manifested at sample points BT11 and BT12, and the ground water quality as manifested by water quality sampling data from a downgradient monitoring well installed in a treatment pond embankment. As the water quality data reporting for the well to the Department stopped in 1994, it is assumed that the well was abandoned and the water quality monitoring ceased at the same time (no abandonment record for the well was found). It is therefore proposed that at least two monitoring wells be constructed in the valley downgradient from the tipple to assess the current water quality. If found contaminated, further ground water contamination assessment will be needed to delineate the areal extent and depth of the contaminants plume, and its influence on the quality of base flow recharge to Butts Run.

The identification and mapping of the ground water plume contributing to the contamination of the headwater spring BT06 will also require installation of monitoring wells in the vicinity of the spring. As the Carlin coal tipple is currently the only known potential source of the contamination, monitoring wells will have to be installed in the area between the tipple and the spring. The depths of the wells should be such as to reach the base of Mauch Chunk Formation and also the Burgoon sandstone as the headwater spring issues at the contact of the two formations.

It is anticipated that the ground water monitoring plan will be implemented in successive steps, depending on the success of identifying the contaminant plume. A plume that develops in fractured rocks and follows a fracture zone may be too narrow and consequently hard to find. It is suggested that the initial step in the plume mapping starts with installation of wells, followed by water quality monitoring. If no plume is identified by the initial wells, the well network may need to become more extensive.

Any installation of monitoring wells, however, should be preceded by a thorough investigation of the spring and its immediate vicinity for identification of any other potential venue of contamination transport to the spring, such as pipes. It will require access to the property and cooperation of the owners.

B-5 PROPOSED CONCEPTUAL RESTORATIVE MEASURES

The preparation of a conceptual restorative design for the Butts Run watershed is hindered by the fact that the main source of Butts Run contamination, a case of ground water contamination, could not be investigated without subsurface exploration, i.e. without installation of monitoring wells and ground water quality monitoring. The approach taken in section A of the report preferring the "at source" restorative measures recommended for Contrary Run watershed, cannot be thus used in Butts Run watershed as the source of ground water contamination is not known.

It is therefore suggested that passive treatment of the discharge be considered if the source of the ground water contamination is not determined. Even then, unless the source of the contamination can be removed or mitigated, the option of a clean up of the polluted ground water plume is not realistic, as it is usually requires a long term commitment and if accomplished by ground water pumping, requires a water treatment facility nearby. Passive treatment could include the installation of vertical flow ponds in combination with constructed wetlands and ponds.

Table B-3 provides a summary of water quality for the headwater spring with calculated loading for net acidity, total iron and total aluminum needed for selection of a passive treatment system suitable for the site. It may be necessary before the treatment system is designed to collect additional water quality data and install a flow measuring device to measure spring flows.

As the surface and ground water contamination measured at sample points BT11 and BT12, and indicated by monitoring wells, originates at the Carlin coal tipple, the permanent solution to the water degradation is in removing its source. The amount of coal refuse left in the area of the tipple is not known and testimonials about the amounts of coal refuse at the site are uncertain.

Further investigation of the tipple and treatment pond area and identification of coal refuse (amounts and quality) to be removed will be needed before any further plans for site cleanup can be made. This will require cooperation of the Beech Creek Association with state agencies and the owners.

TABLE B-3 SUMMARY OF BUTTS RUN AT BT06 LOADINGS FOR AMD PARAMETERS

Date Sampled	Flow (gpm)	Alkalinity (lb/day)	Acidity (lb/day)	Net Acidity (lb/day)	Iron (lb/day)	Manganese (lb/day)	Aluminum (lb/day)	Sulfate (lb/day)
09/27/01	58	0	73.9	73.9	0.0	2.7	8.8	107.4
12/21/01	165	0	206.3	206.3	0.1	6.9		247.9
02/22/02	147	0	212.0	212.0	0.1	7.1		277.4
04/02/02	274	0	441.3	441.3	0.3	16.1		599.4
05/25/02	224	0	274.6	274.6	0.2	11.0		495.4
06/30/02	68	0	71.9	71.9	0.0	2.6		109.5
07/29/02	26	0	31.9	31.9	0.0	1.2		39.7
08/27/02	7	0	9.3	9.3	0.0	0.4		16.2
09/30/02	48	0	57.7	57.7	0.0	2.5	7.6	101.5
10/30/2002	60	0	86.5	86.5	0.1	3.4	11.2	138.5
Average:		0	146.5	146.5	0.1	5.4	9.2	213.3