TABLE OF CONTENTS

List of Figures i
List of Tables iv
List of Appendices v
List of Plates vi

PREFACE 1

A-1 INTRODUCTION TO CONTRARY RUN SECTION OF THE REPORT 3

A-2 CONTRARY RUN WATERSHED CHARACTERIZATION 3

A-2.1 Geology 3

A-2.2 Hydrology 11

A-2.3 Land Use 12

A-3 CONTRARY RUN WATERSHED WATER QUALITY CHARACTERIZATION .. 14

A-3.1 Water Quality Survey 14

A-3.2 Water Quality Assessment 15

A-3.2.1 pH Levels and Acidity Concentrations 15
A-3.2.2 Total Iron Concentrations 21
A-3.2.3 Total Manganese Concentrations 25
A-3.2.4 Total Aluminum Concentrations 27
A-3.2.5 Mean Sulfate Concentrations 31
A-3.2.6 Summary of Impacts of Contrary Run Water Quality on Sandy Run Water Quality 34

A-4 IDENTIFIED SOURCES OF CONTRARY RUN DEGRADATION 38

A-4.1 Surface Mines 38

A-4.2 Deep Mines 69

A-4.3 Coal Refuse 72

A-4.3.1 Coal Refuse Impacts on Contrary Run Water Quality 78

A-5 CONCEPTUAL DESIGN OR RESTORATIVE MEASURES FOR WATER QUALITY DEGRADATION ABATEMENT 82

A-5.1 Review of Current State of the Art Restorative Practices 82

A-5.2 Conceptual Restorative Plan for Contrary Run Watershed 84

A-5.3 Reclamation Detail and Priorities 89

5.3.1 High Priority – Critical Restorative Measures 90
5.3.2 Intermediate Priority – Essential Restorative Measures 94
5.3.2 Low Priority – Non-Essential Restorative Measures 98

A-5.4 Watershed Remining and Reclamation 99

B-1 INTRODUCTION TO BUTTS RUN SECTION OF THE REPORT 100

B-2 BUTTS RUN WATERSHED CHARACTERIZATION 100

B-2.1 Geology 100

B-2.2 Hydrology 103

B-2.3 Land Use and Potential Sources of Butts Run Degradation 104

B-2.3.1 Interstate Route 80 Corridor 105
B-2.3.2 Sandstone Borrow Area 107
B-2.3.2 Carlin Coal Tipple 108

B-3 BUTTS RUN WATERSHED WATER QUALITY CHARACTERIZATION 110

B-3.1 Water Quality Survey 110

B-3.2 Water Quality Assessment 112

B-3.3 Evaluation of Potential Sources of Butts Run Degradation 113

B-3.3.1 Interstate Route 80 Corridor 113
B-3.3.2 Sandstone Borrow Area 115
B-3.3.2 Carlin Coal Tipple 115

B-3.4 Butts Run Watershed Areal Assessment and Impacts on South Fork 117

B-3.4.1 pH Levels and Mean Acidity Concentrations 117
B-3.4.2 Total Iron Concentrations 121
B-3.4.3 Total Manganese Concentrations 121
B-3.4.4 Total Aluminum Concentrations 126

B-3.4.5 Sulfate Concentrations 126

B-3.5 Impacts of Butts Run on South Fork Water Quality 131

B-4 PROPOSED GROUND WATER QUALITY MONITORING PLAN 132

B-5 PROPOSED CONCEPTUAL RESTORATIVE MEASURES 133

REFERENCES 135

APPENDICES

PLATES

List of Figures

1	Beech Creek Watershed Stream Diagram with Designation of Contrary and Butts Run Watersheds (modified from Gannet Fleming, 2000)	1
A-1	Contrary Run Watershed Delineation	4
A-2	Geologic Map, Contrary Run Watershed	7
A-3	Water Quality Areal Assessment Map for Median pH Levels, Contrary Run Watershed	20
A-4	Time Series Plots for Field pH Levels Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	22
A-5	Time Series Plots for Net Acidity Concentrations Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	23
A-6	Water Quality Areal Assessment Map for Mean Total Iron Concentrations, Contrary Run Watershed	24
A-7	Time Series Plots for Total Iron Concentrations Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	26
A-8	Water Quality Areal Assessment Map for Mean Total Manganese Concentrations, Contrary Run Watershed	28
A-9	Time Series Plots for Total Manganese Concentrations Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	29
A-10	Water Quality Areal Assessment Map for Mean Total Aluminum Concentrations, Contrary Run Watershed	30
A-11	Time Series Plots for Total Aluminum Concentrations Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	32
A-12	Water Quality Areal Assessment Map for Mean Sulfate Concentrations, Contrary Run Watershed	33
A-13	Time Series Plots for Sulfate Concentrations Measured at Contrary Run (CT01), Sandy Run above Confluence with Contrary Run (SD8141) and Sandy Run (SD7932) below Confluence with Contrary Run	35
A-14	Impoundment in Lower Kittanning Mine Spoil, Mine Area SM-3C	41
A-15	Discharge from Lower Kittanning Mine Spoil, Mine Area SM-3C, Sample Point CT14	42
A-16	Coal Refuse Pile in Mine Area SM-3C	43
A-17	Impoundment in Abandoned Box Cut in Brookville Mine Spoil, Mine Area SM-5, Upgradient from Sample Point CT39	45
A-18	Discharge at Toe of Brookville Mine Spoil, Mine Area SM-5, Sample Point CT39	46

A-19 UT-C after Receiving Base Flow Recharge of Brookville Mine Spoil Water near Sample Point CT37 47
A-20 UT-C after Receiving Base Flow Recharge of Brookville Mine Spoil Water near Sample Point CT11 47
A-21 Drainage Channel in Clarion Mine Spoil, Mine Area SM-6A 49
A-22 Clarion Highwall, Southwest of Sample Point CT16, Mine Area SM-6B 50
A-23 Flow in Stream Diversion Channel (UT-A) near Sample Point CT17, East of Mine Area SM-6B 51
A-24 Breach of Stream Diversion Channel (UT-A) near Sample Point CT17, East of Mine Area SM-6B with Inflow to Mine Area SM-7 51
A-25 Clarion Highwall and Impoundment near Sample Point CT20, Mine Area SM-6C 52
A-26 Clarion Mine Spoil near Sample Point CT20, Mine Area SM-6C 53
A-27 Brookville Highwall, 500 feet Southwest from Impoundment between Mine Areas SM-7 and SM-8 54
A-28 Inflow into Mine Area SM-7 from Breached Stream Diversion Channel (UT-A) Downstream from Sample Point CT17 55
A-29 Impoundment between Mine Areas SM-7 and SM-8 55
A-30 Brookville Mine Spoil Covered with Coal Refuse and View of Brookville Highwall, Mine Area SM-8 58
A-31 Brookville Spoil Area with Coal Refuse Piles, Mine Area SM-8 58
A-32 Clarion Highwall, Mine Area SM-9 59
A-33 Brookville Clay Mine Spoil Pile, Mine Area SM-11 61
A-34 Brookville Clay Mine Spoil Pile, Mine Area SM-11 62
A-35 Discharge from Brookville Clay Mine Spoil, Sample Point CT27, Mine Area SM-11 62
A-36 Brookville Clay Mine Highwall, Mine Area SM-11 63
A-37 Reclaimed Brookville Mine Area SM-12A with Collapsed Deep Mine Entries 64
A-38 Brookville Mine Spoil Covered with Coal Refuse, Mine Area SM-12B 66
A-39 Clarion Highwall, Mine Area SM-13A 67
A-40 Clarion Highwall, Mine Area SM-13B 68
A-41 Mining Refuse from Brookville Clay Deep Mine at D-39 Deep Mine Entry 70
A-42 Mining Refuse from Brookville Clay Deep Mine at D-39 Deep mine Entry 70
A-43 Coal Refuse Bank RB-1 with Auger Drilling Equipment 75
A-44 Discharge CT07 from Coal Refuse Bank RB-1 75
A-45 Plan and Cross-Sections for Coal Refuse Bank RB-1 77
A-46 Coal Refuse Bank RB-2 in Contrary Run Valley 76
A-47 Coal Refuse Bank RB-2 Viewed from Contrary Run Valley 78
A-48 Plan and Cross-sections for Refuse Bank RB-2 79
B-1 Butts Run Watershed Delineation 101
B-2 Geologic Map, Butts Run Watershed 102

B-3 Land Use Map, Butts Run Watershed 106
B-4 View of Carlin's Tipple (Permit No. 1483203) 109
B-5 Water Quality Areal Assessment Map for Median pH Levels, Butts Run Watershed 118
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) 119
B-7 Time Series Plots for Net Acidity Concentrations Measured at Butts Run (BT02), South Fork above Confluence with Butts Run (SF 7745) and South Fork below Confluence with Butts Run(SF7458) 120
B-8 Water Quality Areal Assessment Map for Mean Total Iron Concentrations, Butts Run Watershed 122
B-9 Time Series Plots for Total Iron Concentrations Measured at Sample Point on Butts Run (BT02), South Fork above Confluence with Butts Run (SF 7745) and South Fork below Confluence with Butts Run (SF7458) 123
B-10 Water Quality Areal Assessment Map for Mean Total Manganese Concentrations, Butts Run Watershed 124
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) 125
B-12 Water Quality Areal Assessment Map for Mean Total Aluminum Concentrations, Butts Run Watershed 127
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) 128
B-14 Water Quality Areal Assessment Map for Mean Sulfate Concentrations, Butts Run Watershed 129
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) 130

List of Tables

A-1	Stratigraphic Column Nomenclature (modified from Edmund, 1968)	5
A-2	Summary of Exploratory Drilling	6
A-3	Summary of Overburden Analyses	10
A-4	Contrary Run Watershed Water Quality Summary	16
A-5	Threshold Values for Water Quality Ranking	19
A-6	Coal Refuse Quality Testing Summary	74
A-7	Summary of Contrary Run at CT01 and Refuse Bank RB-1 Discharge CT07 Loadings for AMD Parameters	81
A-8	Alkaline Addition Ranks for Surface Mine Area Reclamation	88
B-1	Butts Run Watershed Water Quality Summary	111
B-2	Threshold Values for Water Quality Ranking	113
B-3	Summary of Butts Run at BT06 Loadings for AMD Parameters	134

List of Appendices

A-1 Lithologic Logs and Overburden Data for Exploration Wells Drilled in Contrary Run Watershed in June 2004.

A-2 Overburden Analyses Spreadsheets, DH-1 through DH-6.

A-3 Water Quality Data Base for Contrary Run Watershed.

A-4 Pennsylvania Fish and Boat Commission Stream Survey and Correspondence.

A-5 Lithologic Logs for Exploration Auger Holes Drilled in Contrary Run Watershed in May 2004.

A-6 Laboratory Data Sheets for Coal Refuse Quality Testing.

B-1 Lithologic Log for Upgradient Well, Maps with Locations of Monitoring Wells 1, 3, and 4, R. S. Carlin, Inc., Tipples No. 1 and No. 3, I. W. No. 1483203, DEP Files, Moshannon District Office.

B-2 Selected Pages from Soil Survey Report and Profile, Legislative Route 1009, Section 38, 1963, Penn DOT Files, Engineering District 2-0, Clearfield, Pennsylvania.

B-3 Overburden Analyses Laboratory Sheets, Sandstone Samples.

B-4 Water Quality Data Base for Butts Run.

B-5 Water Quality Data for Monitoring Wells 1, 3, and 4, R. S. Carlin, Inc., Tipples No.1 and No. 3, I. W. No. 1483203, DEP Files, Moshannon District Office.

List of Plates

PLATE A-I Land Use/Mine Map - Contrary Run Watershed, Centre County, Pennsylvania

PLATE A-II Conceptual Restorative Plan, Contrary Run Watershed, Centre County, Pennsylvania

I. PREFACE

The Beech Creek Watershed Association in cooperation with state and local agencies has undertaken a comprehensive Beech Creek watershed restoration project with surface water quality cleanup as its main goal. The Contrary Run and Butts Run (Tributary "K") watersheds were identified in the Beech Creek Watershed Restoration Plan as two of the Beech Creek contributing watersheds with high restorative potential. A plan was prepared for the Beech Creek Watershed Association and the Clinton County Conservation District by Gannett Fleming in June, 2000.

The Beech Creek watershed that lies in northcentral Pennsylvania covers approximately 172 square miles; the Contrary Run and Butts Run sub-watersheds are located in the western portions of the Beech Creek watershed and represent drainage from 1.1 square miles and 0.7 square miles, respectively (see Figure 1).

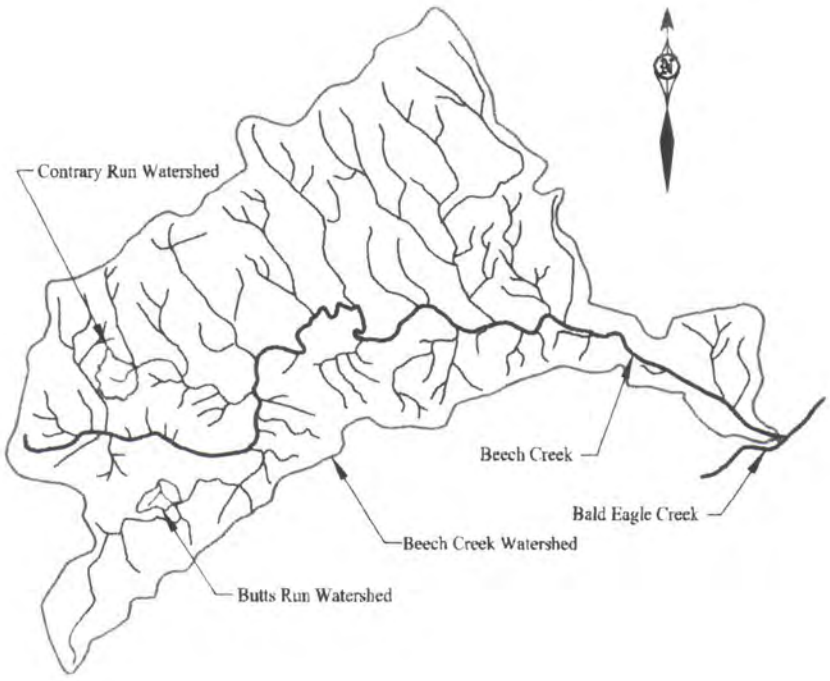

Figure 1. Beech Creek Watershed Stream Diagram with Designation of Contrary and Butts Run Watersheds (modified from Gannett Fleming, 2000).

The contamination of Beech Creek and its tributaries is caused by AMD (acid mine drainage), associated with discharges from abandoned coal mine workings. There are also some instances where the source of stream contamination originates in highway fills, when these were constructed with borrow materials containing pyrite, e.g. in the Jonathan Run watershed.

The study of the Contrary Run and Butts Run watersheds is presented in two separate sections (Sections A, and B). The assessments of the watersheds are different, due to local hydrologic and geologic conditions, specific to each watershed, and also, because the information available for each area is not the same. While the source of contamination of the Contrary Run watershed originates with the past surface coal and clay extraction, the sources of water contamination are less well defined in the Butts Run watershed. Subsequently, the proposed remedial measures reflect the status of the knowledge of the local conditions, but always with the ultimate goal of water quality cleanup in mind.

The funding for the project is provided by the Department of Environmental Protection, Growing Greener Grants Center, Grant Number ME#350329 awarded to the Beech Creek Watershed Association on March 31, 2001.