United States
Environmental Protection Agency
Region 10
Office of Water
1200 Sixth Avenue
Seattle, Washington 98101

Total Maximum Daily Load For Turbidity in Upper Birch Creek, Alaska

In compliance with the provisions of the Clean Water Act (CWA), 33 U.S.C. § 1251 et seq., as amended by the Water Quality Act of 1987,P.L. 100-4, the Environmental Protection Agency (EPA) is hereby issuing a Total Maximum Daily Load (TMDL) that establishes the loading capacity, load allocation, and wasteload allocations for total suspended solids to meet water quality standards for turbidity in Upper Birch Creek, Alaska. Future actions must be consistent with this TMDL.

This TMDL shall become effective immediately.

Signed this 10th day of October, 1996.

Roger K. Mochnick
Philip G. Millam for
Director
Office of Water

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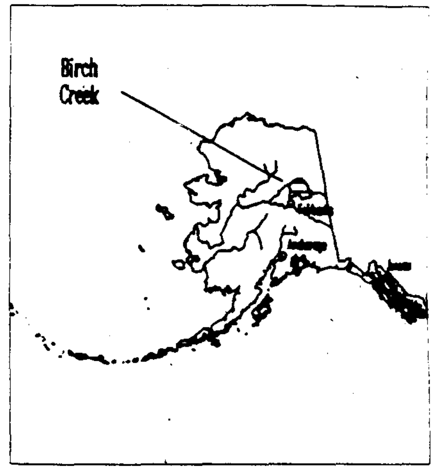
Upper Birch Creek

DRAFT TMDL AT A GLANCE

Water Quality-limited?	*Yes*
Segment Identifier:	*40402-001*
Parameters of Concern:	*Turbidity, Sediment*
Uses Affected:	*Drinking Water*
	Recreation
	Aquatic Life
Sources:	*Placer Mining*
Loading Capacity:	*9,610 lbs/day TSS*
Load Allocation:	*3,980 lbs/day TSS*
Wasteload Allocation:	*930 lbs/day TSS per mine*
Margin of Safety:	*960 lbs/day TSS*



Executive Summary

Alaska has adopted water quality standards (WQS) which specify the degree of degradation that may not be exceeded in a water body as a result of human activities (18 AAC 70.010). A number of water quality parameters have criteria values which have been adopted as regulatory standards for Birch Creek. Parameters specifically identified with criteria values include turbidity and fine sediment. Ambient water quality monitoring data has shown that segments within the upper Birch Creek drainage are water-quality limited due to turbidity.

Water quality in Birch Creek is affected by both point and nonpoint source discharges throughout the watershed. Point sources include active placer mining discharges. Potential nonpoint sources in the watershed include streambank erosion, resuspension of deposited sediment, and runoff from abandoned mine sites.

During the 1970's, Alaska experienced a resurgence of mining . During this time, the use of settling ponds was not common for treatment of placer mining discharges. Those ponds that were constructed were generally poorly designed. By the early 1980's roughly half the placer miners had settling ponds. Some of these were quite effective and others were simply wide spots in the creek. Consequently, some miners discharged water with little, or no, settleable solids, while other miners discharged water directly form the sluice box. By the mid- to late-1980's, only flagrant violators discharged water exceeding the settleable solids criterion of 0.2 milliliters per liter (ml/L).

It was noted that where settling ponds or recycle was used, discharged wastewater had a low settleable solids concentration. To address water quality concerns, various studies have been funded by various agencies which focus on water pollution control technologies, water use reduction, and settling pond design. The Alaska Departments of Environmental Conservation (ADEC), Natural Resources (ADNR), Fish and Game (ADF&G), the U.S. Environmental Protection Agency (EPA), and the U.S. Bureau of Land Management (BLM) applied the results of these studies with more agency field personnel. Their activities included providing technical assistance, the enforcement of National Pollution Discharge Elimination System permit (NPDES) and the enforcement of reclamation requirements. These activities coupled with cooperation of the mining industry improved mining practices resulting in better wastewater treatment and improved water quality.

Placer operations discharging wastewater into surface waters are required to obtain a federal NPDES permit. In Alaska, the NPDES permit program is administered by EPA. These NPDES permits establish effluent limitations for Arsenic, Settleable Solids, and Turbidity in placer mining discharges. Effluent limitations for the Alaska Placer Mining Industry have changed numerous times since their inception in 1975. Details of these changes are described by Peterson (1993). Over time, these regulations led to widespread incorporation of settling ponds by miners and reduced settleable solids significantly; however, Turbidity still remains a problem.

Beginning in 1989, the NPDES permit required that the volume of wastewater that could be discharged could not exceed the volume of infiltration and drainage water entering the system. This condition effectively requires 100 percent process water recycle except when excess water is collected from groundwater releases or precipitation runoff. The implementation of these permit conditions and best management practices resulted in improvement in water quality in the upper Birch Creek drainage.

Recent data indicate that the majority of the WQS exceedances in the 1990's are related to runoff which occurs during storm events and occasional violations of NPDES permit conditions for active mine sites.

The approach which will be used to address Turbidity concerns is development of a TMDL and implementation of a water quality management plan for the upper Birch Creek basin. Plan development began in 1995 under the authorities of Alaska's WQS (18 AAC 70) and the federal Clean Water Act. The plan identifies preventative and remedial actions which will reduce sediment loadings to upper Birch Creek.

The program areas identified for action include NPDES permits and non-point source (NPS) reclamation plans.

The water quality management plan for upper Birch Creek focuses on three interim objectives:

- Continued NPDES inspection and enforcement activity to reduce discharges from active mine sites, particularly during storm events.
- Full attainment of Alaska's WQS at key sites in the drainage (e.g. the turbidity standard for recreation at Birch Creek above Twelvemile Creek) so that the various water uses are protected.
- Continued implementation of reclamation activities in key areas to address high priority nonpoint source problems.

A critical element for success of this plan is continued ambient water quality monitoring in the upper Birch Creek drainage by the State of Alaska. The monitoring program by ADEC and ADNR documented major improvements in water quality due to efforts of agencies and the mining community. This monitoring program also provides vital information needed to focus future sediment reduction efforts.

Part 1 BACKGROUND INFORMATION

1.a General Water Body and Watershed Description

The Birch Creek watershed is located approximately 100 miles northeast of Fairbanks and encompasses nearly 2,200 square miles. Birch Creek itself is formed at the confluence of Eagle and Ptarmigan Creeks near Porcupine and Mastodon Domes. In the upper reaches, the surrounding terrain is semi-mountainous. In these headwater areas, it is a high gradient, quick flowing stream. Birch Creek then moves out onto a relatively high segment of the Yukon Flats southeast of Circle Hot Springs in the Medicine Lake area.

The approximate length of Birch Creek is 340 miles from its headwaters to its mouth at the Yukon River west of Fort Yukon. Major tributaries in the upper reaches of Birch Creek include: Butte Creek, Eagle Creek, Fish Creek, Bear Creek, Gold Dust Creek, Ptarmigan Creek, Twelvemile Creek, Harrington Fork, Clums Fork and the South Fork Birch Creek.

Birch Creek is a moderately swift, shallow stream surrounded in the upper reaches by rolling hills and low mountains. The lower reaches of the stream are slow and shallow, surrounded by flat land and some hills. From mid-October through April, Birch Creek and its tributaries are frozen. Like most interior Alaskan streams, Birch Creek generally opens up in mid-May, following spring breakup. Birch Creek and its tributaries remain free-flowing until mid-September when the streams begin to close up with falling temperatures.

1.b Study Area Boundries

The area included the Upper Birch Creek drainage from its headwaters to the confluence of Birch Creek and Twelvemile Creek. The segment of Birch Creek downstream from the confluence of Twelvemile Creek and the Steese Highway has been designated as part of the National Wild & Scenic River system. The Upper Birch Creek drainage is illustrated in Figure 1.

1.c Hydrology

Discharge from many of the tributary streams into Birch Creek is highly variable. Peak stream flow for these tributaries usually occurs during the spring breakup period. However, due to the influence of permafrost, impermeable or saturated ground conditions, and the lack of surface storage in the upper basin, large floods can occur in response to heavy summer storms. Intense thunderstorm activity generating an inch or more of precipation can cause localized flooding in the smaller drainages.

1.d Impaired Waterbody Listing

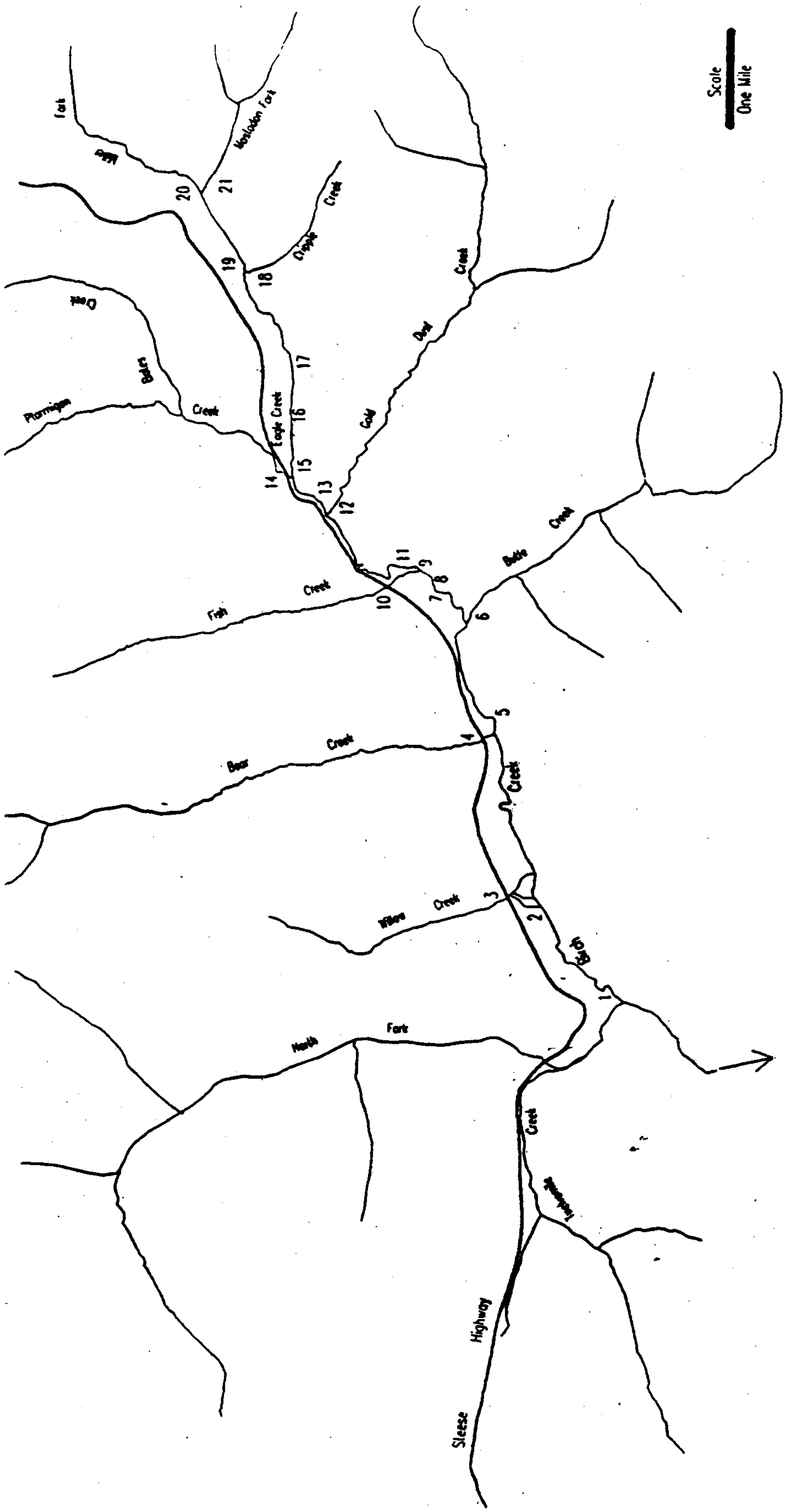
The CWA § 303(d)(1)(A) and (B) requires states to submit to the United States Environmental Protection Agency (EPA), every two years, a list of waters which persistently exceed water quality criteria and/or exhibit impairment of uses. The Alaska Department of Environmental Conservation submitted 303(d) lists to the EPA in April 1992, June 1995, and April 1996. The State's criteria for placing waters on the 303(d) list is modeled directly after the requirements of EPA's regulation in 40 CFR 130.7.

Segments within the Birch Creek drainage are covered in Alaska's WQS under freshwater uses. Three segments in the upper Birch Creek drainage have been identified as water quality-limited in Alaska's Statewide Water Quality Report [April 1992,July 1995, and June, 1996] and include:

Alaska ID Number	Waterbody-Segment
40402-001	Birch Creek Drainage - Upper Birch Creek - Eagle Creek - Gold Dust Creek

Available data indicate that these waters persistently exceed the criteria for Turbidity. NPDES permits authorized the discharge of pollutants from five placer mines on these

Figure 1. Upper Birch Creek



stream segments in 1994 and 1995. Non-point pollution sources such as inactive mines along the streams also add fine sediment to these waters.

In 1992 the State of Alaska and EPA jointly developed a Memorandum of Understanding (MOU) to establish a process for addressing waters on the 303(d) list, and prepare a 5-year priority schedule of waterbodies to be addressed. This priority schedule was accepted by the federal District Court pursuant to the "Ace v. Reilly" litigation. The key to the State's TMDL process, expressed in the MOU, is that a candidate water is first to undergo a "TMDL assessment" to determine whether additional enforceable controls are necessary to achieve WQS. The MOU described upper Birch Creek as a high priority waterbody targeted for the assessment/TMDL process.

In 1993, prior to the assessment, the ADEC contracted RZA AGRA Alaska, Inc., to conduct a study of the impact of placer mining regulatory controls on downstream water quality. This study reviewed the existing sediment data from selected streams affected by placer mining, federal and state regulatory controls in effect since the 1970's. The study also determined the impact of federal and state regulatory controls on receiving water quality of impaired streams from the 303d list (TMDL candidate streams) and the Chatanika River; as well as estimated the impact of current regulatory controls on stream water quality to the TMDL candidate streams over the next 2 to 5 years.

A watershed assessment was jointly prepared by ADEC and EPA in April, 1993, in accordance with a MOU for the upper Birch Creek. A watershed assessment represents a starting point for determining whether or not segments of concern need additional water quality-controls. The assessment concluded that a waterbody management plan for the upper Birch Creek basin was warranted.

Part 2 APPLICABLE WATER QUALITY STANDARDS

2.a Beneficial Uses Affected

Within the State of Alaska, WQS are published pursuant to Title 46 of the Alaska Statutes (AS). The ADEC, under authority vested by AS 46.03.010, 46.03.020, 46.03.070, 46.03.080, 46.03.100, and 46.03.110, can adopt rules, regulations, and standards as are necessary and feasible to protect water quality. Regulations dealing with water quality, to implement AS 46.03.020 and 46.03.080 are found in Title 18, Chapter 70, of the Alaska Administrative Code (AAC). Through the adoption of WQS, Alaska has defined the beneficial uses to be protected in each of its drainage basins and the criteria necessary to protect these uses.

Table 2. Uses Protected by Alaska's Water Quality Standards

70.020(1)	18 AAC Freshwater Uses
(A)	Water Supply
(i)	• drinking, culinary, and food processing
(ii)	• agriculture, including irrigation and stock watering
(iii)	• aquaculture
(iv)	• industrial
(B)	Water Recreation
(i)	• contact recreation
(ii)	• secondary recreation
(C)	Growth and propagation of fish, shellfish, other aquatic life, and wildlife

Much of the Birch Creek drainage downstream from mining is used by residents of villages and communities in the region for subsistence purposes. Traditional activities include hunting, fishing, and trapping. Residents of Birch Creek Village also use the river for drinking water and as a transportation route. In the mid-1980's, downstream residents reported to be adversely affected by poor water quality and sedimentation. They attributed their concerns to historic upriver mining activities.

In the past, the main stem of Birch Creek was important habitat for arctic grayling. Historic (unregulated) mining activities in the Birch Creek basin resulted in physically altered stream channels, cementing of streambeds, increased turbidity and siltation, and removal of streamside vegetation. Limited data are available on placer mining effects on physical habitat, water quality, and fish populations. However, studies indicate that these physical alterations to the stream system led to a reduction of available fish habitat as well as a downward trend in fish populations. Data on use of fish by sport anglers is generally not available for the Birch Creek drainage. Dames & Moore (ADEC 1986) reported that increased mining activities in the Birch Creek drainage, especially since the late 1970's, reduced the use of the river by recreational users.

In the late-1970's through the mid-1980's, sediment infiltrated or covered gravels in some areas of the drainage historically used by resident aquatic life. Limited studies have been conducted on specific effects on fish populations in upper Birch Creek. Elevated sediment deposition can result in mortality of fish eggs from the effects of either deposition or scouring as well as depletion of oxygen. Rearing areas in portions of Birch Creek may also be affected by sediment. Young fish are dependent upon pools and pockets between rocks and boulders to protect them from predators.

Spaces between rocks and gravel also support aquatic organisms use by fish as a food source. Sediment may fill pools and spaces between rocks used as habitat for newly emergent fry.

2.b Turbidity and Sediment Criteria

A number of water quality parameters have criteria values which have been adopted as regulatory standards for Birch Creek. These WQS specify the degree of degradation that may not be exceeded in a water body as a result of human activities (18 AAC 70.010).

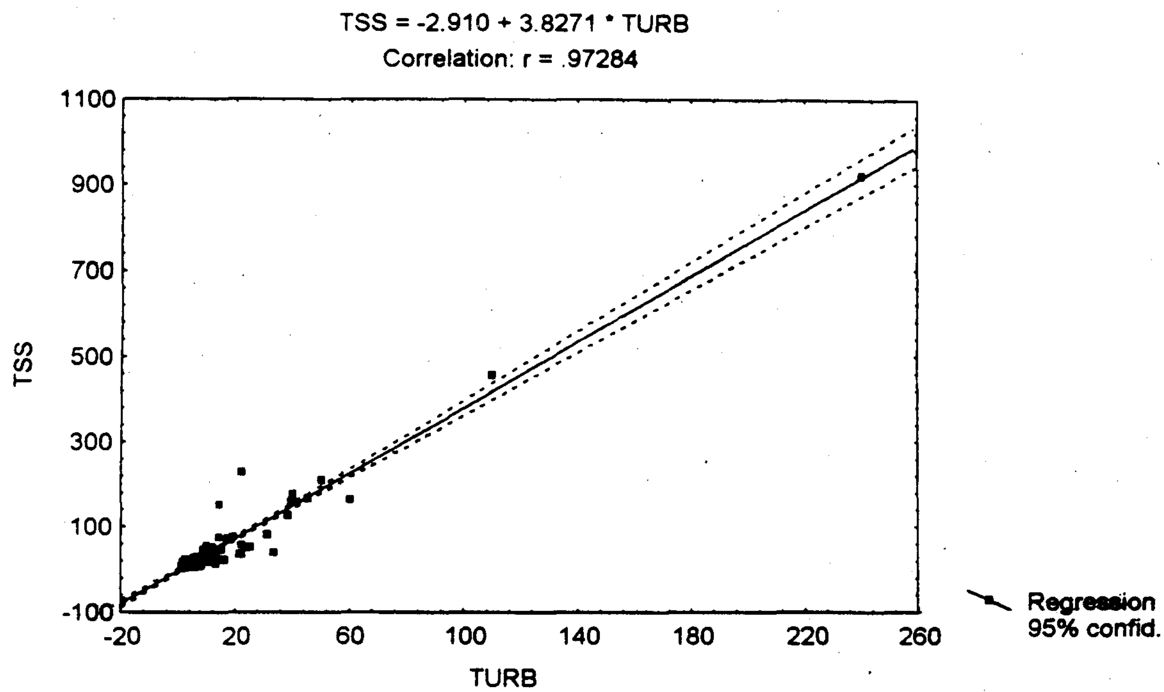
The standards require attainment with a number of water quality and habitat criteria that relate to solids, both suspended in the water column and settling through the water column to the creek bed. Excessive turbidity in the water column impacts drinking water sources, diminishes fish rearing success, and impairs recreational use.

The pertinent criteria for water column turbidity are:

Use	Criterion
Drinking Water	"May not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU."
Water recreation	"May not exceed 5 NTU above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU."
Aquatic Life	"May not exceed 25 NTU above natural conditions."

In order to establish mass-based values for the assimilative capacity and wasteload allocation, the relationship between simultaneous turbidity and TSS samples for Birch Creek above the confluence with Twelve Mile Creek were analyzed. EPA performed a linear regression analysis to establish the incremental relationship between the two parameters. The allowable increase in turbidity (5 NTU) could then be converted to a TSS increment. This increment, combined with the natural background TSS and the creek flow, allows the determination of the TSS loading capacity of the waterbody. Discharge loadings associated with permit limits for the mines can also be converted to TSS and compared to the loading capacity.

Figure 2: TSS-Turbidity Linear Regression



The best estimate of the natural turbidity of Birch Creek is derived from the turbidity data at the station on Miller Fork in the uppermost part of the watershed, located above the areas which have been disturbed by mining activity. The median turbidity at the Millier Fork station for the period July 17 to September 5 was 0.85 NTU. The state standard is equal to this value plus 5 NTU, or 5.85 NTU. Using the regression equation for turbidity/TSS, this value translates to a TSS target of 20 mg/l.

Settled deposits of fine sediment on creek beds diminish fish spawning habitat. The pertinent criterion for such deposits is:

Use	Criterion
Aquatic Life	"The percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions (as shown from grain

> size accumulation graph). In no case may the 0.1 mm to 4.0 mm fine sediment range in those gravel beds exceed a maximum of 30% by weight (as shown from grain size accumulation graph). In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life; their reproduction or habitat may be present."

The primary focus of this TMDL is Turbidity in the Birch Creek mainstem, based on the 303(d) listing and the available monitoring information. Based on concerns about aquatic life habitat, sediment monitoring recommendations are also provided herein.

2.c Parameters of Concern

Waters within the upper Birch Creek drainage have been identified as water quality-limited due to violations of the turbidity standard. In addition, EPA and ADEC have also identified concerns related to deposited fine sediment, which changes substrate conditions and diminishes spawning habitat. Stream segments disturbed by mining are characterized by loss of riparian vegetation and associated soils, elimination of stream banks when overburden is removed, and diversion of stream channels followed by loss of pools, meanders, and other habitat features.

PART 3: POLLUTANT SOURCES

3.a Point Sources

Point source influences from active placer mining have occurred on Eagle Creek, Ptarmigan Creek, Gold Dust Creek, Butte Creek, and on the mainstem of Birch Creek. Five active placer mines operated in the upper Birch Creek drainage during the summer of 1994 and 1995. All of these mines operated with the approved plans and permits as required by the appropriate State and Federal agencies.

Placer mining has played an important part in Alaska's history and economy since the late 19th century. In placer mining, flakes and nuggets of gold are removed from alluvial deposits in ancient or contemporary creek beds. Layers of overburden (vegetation, soil, and gravel) are stripped away to gain access to the placer gravels. The gold-bearing gravels are then washed through a sluice box to recover the gold. Large volumes of water generally are used in washing, resulting in muddy wastewater which typically flows into a settling pond before being recycled or discharged to stream.

Because of the transient nature of placer mining, it is difficult to predict the extent of future mining in a given location. In addition, the quality and quantity of wastewater discharge from a given mining operation is dependent upon the nature of the substrate mined, groundwater characteristics, and surface water characteristics of a given site.

Discharges from active mining are regulated under the EPA's general NPDES permit for Alaska placer miners. The permit requires the use of settling ponds and wastewater recycling, and therefore allows no discharge of wastewater except in instances of excess groundwater inflow or precipitation inflow to the settling ponds. The effluent limits for turbidity are summarized in Table 2 below.

In addition, a set of best management practices identified in these permits since 1989 require:

- Bypassing surface water around the active mine area.
- Constructing berms and other water retention structures so that they reject the passage of water.
- Storing pollutant materials (e.g. sediment) so they are not released to streams.
- Using 100 percent process water recycling.
- Maintaining dikes and diversion structures to protect them from failure.
- Stabilizing all mine areas to prevent degradation of receiving waters.

The NPDES permit also requires surface water in the active mine area to be controlled. The flow of surface water must be diverted from the site to prevent incursion. The treatment system must be designed, constructed, and maintained to contain surface runoff introduced by precipitation. This includes runoff from associated activities that could be construed as NPS. Very little documentation is available to quantify such diffuse sources in comparison to the process wastewater discharge. Because the NPDES permit requires treatment of surface runoff as well as process wastewater, all pollution from an active mine site is a point source covered by the NPDES permit.

The ADEC regulates water quality and wastewater discharges through ensuring compliance with WQS. One of the ADEC's primary functions is the enforcement of the federal Water Pollution Control Act, as adopted in 1972, and amended in 1977 and 1987 (The Clean Water Act). Working in conjunction with the EPA the agency reviews and/or issues permits for activities that involve the use of, or result in discharge into state waters.

Table 2: NPDES Permit Limitations for Turbidity

Circumstance	Turbidity Limit
Zero inflow from Groundwater & Precipitation	Zero discharge
Default Limit	5 NTU above natural background (instantaneous maximum)
Site-specific Modification	$$\frac{(Q_3)(C_3) - (Q_1)(C_1)}{Q_2}$$ where, C_1 = upstream turbidity C_2 = effluent turbidity C_3 = downstream turbidity after mixing (C_1 + 5 NTU) Q_1 = upstream flow (below any diversion) Q_2 = effluent flow (default = 10 gallons/minute) Q_3 = total stream flow after mixing
Storm Exemption	No limits if discharge is during a 5-year, 6-hour precipitation event

3.b Nonpoint Sources (NPS)

NPS include sediment loads due to natural erosion processes as well as resuspension of deposited sediments. Erosion from unvegetated, disturbed areas such as runoff from inactive or abandoned mine sites is also considered a nonpoint source. Mine sites not reclaimed or stabilized have the potential to affect water quality. Erosion of abandoned mine sites by active stream flow, high water flow, and surface runoff can cause increased sediment loads. Sources of sediment include abandoned settling ponds, cutbanks, overburden piles, and disturbed areas that have not been stabilized.

Abandoned settling ponds frequently wash out, releasing accumulated sediments to streams. Re-establishment of diverted stream channels can also temporarily increase sediment loads. Upland surface erosion and runoff occur where sites have not been adequately reclaimed or stabilized. This can include roads, camps, overburden, and disturbed areas.

Reclamation

The Bureau of Land Management (BLM) oversees placer mining activity on federal land. Although BLM does not regulate downstream water quality, their field personnel have worked with EPA and ADEC in reporting possible violations. BLM personnel review and approve mining plans. A major part of this review is the reclamation plan, which may have an indirect, positive effect on downstream water quality. BLM has published a handbook of mitigation and reclamation for surface disturbing activities in Alaska. BLM began writing environmental assessments on operations exceeding 5 acres of disturbance in 1988.

BLM has required reclamation at placer mines on federal claims since 1981. In October 1991, the State of Alaska adopted regulations requiring reclamation and bonding for all mining activities on public and private land. Enforcement of these regulations is expected to reduce the downstream impact of active placer mining. However, a large number of abandoned placer mine sites in Alaska are not covered under current reclamation guidelines.

The Alaska Department of Natural Resources (ADNR), Division of Mining and Water Management, oversees placer mining activity on state land. The ADNR has responsibility for subsurface mineral claims and surface management of land use on state mining claims (AS 38.05.185-280), water rights for water use associated with mining (AS 46.15), and surface use of state land for access to claims (AS 38.05.330). Although ADNR does not regulate downstream water quality, their field personnel have worked with EPA and ADEC in reporting possible violations. ADNR personnel review and approve mining plans, including reclamation plans.

In 1993 the ADEC began to investgate methods for reducing nonpoint source runoff from abandoned placer mines by land and stream reclamation. An intitial project on Birch Creek, using accepted methods at the time, provided important information into the benefits and problems with reclamation. In 1996 a committee of interested parties was formed to further address the reclamation issue. The committee includes representatives from industry, academia, and state and federal agencies. A survey of various sites is planned, intended to provide insight into how stream hydrology and geomorphic processes have responded to past reclamation practices. This information will then be used to design further reclamation projects and, in turn, to provide guidelines for reclamation methods that reduce nonpoint souces of pollution from placer mines. This project is being funded through CWA, § 319 or the Nonpoint Source Control Program. The expected time table for this project is 5 or 6 years.

404 Permits

The Corps of Engineers regulates those placer mining activities which require a 404 permit. These activities include dredging (when it occurs in navigable waters of the U.S.), construction of roads, berms or dikes, site development fills, stream realignments, stream diversions, temporary stockpiling of dredged material prior to processing, streambed rehabilitation work, and various activities related to rehabilitation of previously mined areas. Placer mining is invariably conducted in or in close proximity to streams and rivers. Thus, there is a high probability that a 404 permit is needed. The U.S. Fish & Wildlife Service (FWS) reviews the proposed work of applicants for 404 permits. Their primary concern is the conservation of wildlife resources by preventing loss of or damage to such resources.

PART 4: AVAILABLE MONITORING DATA

Water quality data for Birch Creek and its tributaries have been collected since 1969. Most of this information was gathered to study the effects of placer mining on water quality. Increased sediment loads are known to alter channel morphology by sediment deposition (Dames and Moore, 1986), to limit subsurface and surface water exchange (Bjerklie and Laperriere, 1985), and to decrease the average particle size of the stream bottom substrate (Weber and Post, 1995)

4.a Historical Studies- Aquatic Biology

Surveys by State and federal agencies have compared fisheries data collected since 1977 with historical reports of fish presence in several streams within the overall Birch Creek drainage, which includes both the upper Birch Creek and Crooked Creek drainages. Weber & Post (1985) found that arctic grayling were virtually eliminated from actively mined and clear water streams above mining activities in the Crooked Creek drainage. The information suggested that poor water quality combined with extensive channel disturbance acted as a barrier for migration to the headwater tributaries. Dames and Moore (ADEC 1986) analyzed fish distribution data and noted that the greater the length of disturbed channel that must be traversed, the lower the fish density above the disturbance.

Data on aquatic invertebrates was also gathered by Weber & Post (1985) for the unmined portion of the Crooked Creek watershed. They collected aquatic beetles, crane and black flies, mayflies, amphipods, aquatic earthworms, stoneflies, and caddis flies. They also found that mayfly and stonefly rarely occurred in areas downstream from mining [an average of fewer than 0.5 invertebrates per sample was found]. It was also noted that invertebrate population numbers in previously mined sites were lower than population numbers in unmined sites. In streams which had experienced previous mining activity, invertebrate densities were about 37 percent lower than unmined streams. In streams below active mining, invertebrate densities were reduced by nearly 90 percent compared with segments upstream of mining activity. The aquatic insects appeared to successfully recolonize disturbed areas that have been restored.

4.b Recent Investigations- Aquatic Biology

The Alaska Department of Fish and Game (ADF&G) sampled mined and unmined streams in the Birch Creek drainage for the presence/absence of fish in 1984 and 1990. According to Townsend, 1991, Arctic grayling were found in more streams and in greater numbers in 1990 and in 1984. Substantial improvement in water quality and mining practices resulted in lower turbidity in streams during 1990. The report postulated that improvements in water quality resulted in the increased use of the upper Birch Creek drainage by arctic grayling.

4.c Historical Studies: Water Quality

Routine monitoring of interior Alaska streams affected by placer mining was initiated in 1984 as a combined effort of the ADNR, ADF&G, and ADEC. Results of activities conducted during each field season can be found in Ray (1993), Ray (1992), Ray (1991), Ray (1990), Ray (1989), Mack et.al. (1988), Mack et.al (1987), Mack & Moorman (1987), and Mack & Moorman (1986). Information from these efforts included both streamflow data (using water level recorders) as well as turbidity and total suspended solids (TSS) data using ISCO automatic water samplers.

Information is summarized in Table 3. The data for upper Birch Creek above Twelvemile Creek shows dramatic improvement towards reduction of median values for Turbidity and TSS between 1984 and 1994. This reflects efforts of both the regulatory agencies and the mining community in implementing sediment controls for point source discharges. However, several concerns remain, as evidenced by maximum values for both parameters, due to both nonpoint and point source inputs during rain storms.

Table 3. Water Quality: Birch Creek Above Twelvemile Creek

Year	# of Samples	Median Turbidity (NTU)	Median TSS (mg/L)	Maximum Turbidity (NTU)	Maximum TSS (mg/L)
1982	10	3,380	NA	5,050	NA
1983	45	680	1,052	2,050	1,251
1984	2	610	1,727	740	2,880
1985	4	163	431	450	603
1986	120	230	214	600	1,390
1987	114	151	305	1,500	17,300
1988	114	110	74.3	200	294
1989	93	50	41.3	240	1,120
1990	99	6.6	30.6	380	1,220
1991	131	6.1	24.7	5,200	5,720
1992	91	5.3	13.8	240	921
1993	89	12	98.6	65	867
1994	65	5.2	22.8	1600	10,900

4.d Recent Investigations-Water Quality

In March 1993, the ADNR released a report entitled "Investigation of Stream Sediment Loads Related to Placer Mining in the Upper Birch Creek Basin, Alaska: Preliminary TMDL Data Collection." This report is the most comprehensive monitoring study of the Birch Creek watershed to date, and it is the foundation for most of the quantitative analysis in this TMDL (it is attached as Appendix B).

The monitoring study included two types of monitoring. First, automated samplers were installed to sample TSS, turbidity, and flow on a daily basis, throughout the summer of 1992, at eight locations in the basin. Second, on one day per month during the same period, 21 sites, including active placer mines, were grab-sampled for the same parameters. (See site maps in the report in Appendix B).

Average Turbidity for the period monitored (July 17 through September 5) at the 8 sites ranged from 54 NTU to less than 1 NTU. Six of the eight sites had average values less than 20 NTU. The study found that although the unmined creeks comprise approximately 50 percent of the total basin area, they contribute only a small percentage of the total load at Birch Creek above Twelvemile Creek.

Table 4: The load, discharge and basin area for seven automatic sample sites for the period of July 17 through September 5, 1992. The basin area percentage refers to the basin area above the site divided by the area of the Birch Creek above Twelvemile Creek site.

Site	Total Load tons	%	Sediment Yield tons/mi^2	Average Discharge cfs	%	Basin Area %
Birch Cr ab 12 Mile Cr	1156	100	13.0	46.6	100	100
Birch Cr ab Butte Cr	878	76	15.8	30.4	65	63
Birch Cr ab Fish Cr	610	53	12.8	27.7	59	54
Gold Dust	67.6	5.8	5.68	8.40	18	13
Eagle Cr ab Ptarmigan Cr	578	50	47.4	10.8	23	14
Eagle Cr ab Cripple Cr	89.2	7.7	8.75	5.72	12	11
Miller Fork	2.95	0.3	0.82	3.48	7.5	4.1

In summary, the 1993 study identified the following key points:

- Most of the sediment load transported by the streams occurred over a short period of time. For example, 84 percent of the total sediment load for the entire study period was transported in one day for Birch Creek at Twelvemile Creek.

- During the reporting period, median turbidity for a historically mined tributary, Gold Dust Creek, was higher than the undisturbed stream, Miller Fork (1.8 and .85 NTU, respectively). Nevertheless, the WQS of 5.85 NTU was exceeded only twice during the reporting period at Gold Dust Creek. It was exceeded once at Miller Fork.

- Active mining operations had the greatest effect on downstream water quality (Birch Creek above Twelvemile Creek). In July, three mines were not in compliance with their NPDES permit limits and the downstream turbidity was 15 NTU. In September, two mines were not in compliance and the downstream

Turbidity was 5 NTU. In August, only one mine was not in compliance and the downstream turbidity was 1.5 NTU.

Table 5 . Birch Creek above Twelvemile Creek: Turbidity Frequency 1994

NTU Interval	Frequency Days	Cumulative Frequency	Percent	Cumulative Percent
0-5	32	32	49.2%	49.2%
5-10	9	41	13.9%	63.0%
10-15	9	50	13.9%	76.9%
15-20	0	50	0%	76.9%
20-50	7	57	10.7%	87.6%
50-100	4	61	6.2%	93.9%
100-500	2	63	3.1%	97.0%
500-1000	1	64	1.5%	98.5%
>1000	1	65	1.5%	100%

As shown in the Table 5 turbidity values in Birch Creek above Twelvemile Creek were less than 5 NTU for 49 % of the days that were sampled in 1994 and less than 15 NTU 77 percent of the days. The highest turbidity values, over 50 NTU, occurred on only 6 % of the days. Most of these experiences are associated with storm events and are usually of short duration.

Part 5 TMDL Evaluation

5.a General Approach

Turbidity impairment in the Birch Creek watershed is directly related to precipitation events, which drive erosion and supply excess runoff to active placer mines. ADNR's 1993 monitoring report indicates that infrequent, major precipation events are particularly important. For example, ADNR estimated that up to 90% of the sediment load to Birch Creek during the 1992 monitoring season was delivered in a single storm event.

In order to differentiate between watershed dynamics at varying flow conditions, this analysis focuses separately on low, moderate, and high flow conditions in Birch Creek.

5.b Low Flow Conditions

During low flow conditions of less than 25 cfs above Twelvemile confluence, Birch Creek generally meets the 5.85 NTU turbidity criterion. It is also expected that active mines, if properly operated, would produce less (if not zero) wastewater discharge during low flow periods. This notion is supported by the fact that even under moderate flow conditions in 1992, two of the three active mines were achieving zero discharge. Because low flow does not represent the critical condition for creek turbidity or point source discharge, no further quantitative analysis has been performed.

5.c Moderate Flow Conditions

Most of the water quality data available for analysis of both point and non-point sources falls within moderate flow regimes. This information can be used to derive the average loading capacity of the creek and the relative magnitude of point and non-point source contributions.

5.c.i Loading Capacity

The average flow in Birch Creek above the Twelve Mile confluence during the nine seasons on record between 1986 and 1994 is 89 cfs. The average loading capacity in pounds per day TSS, associated with the target of 20 mg/l TSS, is calculated as follows:

Loading capacity = (Flow in cfs) x (TSS target in mg/l) x (5.4),

where 5.4 is the conversion factor from cfs-mg/l to lbs/day

Average loading capacity = 89 x 20 x 5.4 = <u>9610 lbs/day TSS</u>

5.c.ii. Adequacy of Point Source Controls

In order to determine whether existing limitations for placer mines in the Upper Birch Creek watershed are adequately protective of water quality, it is useful to compare the allowable discharge loadings from the mines with the overall average loading capacity for Birch Creek. As described earlier, the NPDES permit for the mines contains a default limitation (5 NTU above background conditions) and an allowance for a modified limit based on a mass balance equation. The modified limits are granted by

EPA to a given mine on a site-specific basis, using effluent flowrate information supplied by the facility and stream flow supplied by the Alaska Department of Natural Resources .

The effluent flowrate is an critical factor in assessing and controlling TSS loadings from placer mines. There is limited available flow data for the mines in upper Birch Creek. Throughout this analysis, the maximum flowrate from the mines included in the 1993 grab sampling study (1.8 cfs) is assumed to be the maximum effluent flowrate for all mines in the drainage.

The following tables provide comparisons between the estimated permitted discharge loadings and the total loading capacity. The tables demonstrate the affect varying numbers of mines on potential discharge loadings. Based on permitting and inspection records, 5 mines or less have operated in the area over the last three years (1994-1996).

Table 6 : Loadings Associated with Default Effluent Limitation (5 NTU above background)

Number of Permitted Mines	Turbidity Limit (NTU)	TSS Equivalent (mg/l)	Effluent Flow[1] (cfs)	Permitted Loading (lbs/day)	% of Loading Capacity
1	5.85	20	1.8	194	2%
2	5.85	20	1.8	388	4%
5	5.85	20	1.8	970	10%
10	5.85	20	1.8	1940	20%

Note: [1] Maximum effluent flow for all facilities in the 1993 study (grab sampling)

Turbidity modifications have been granted in the past to placer mines in upper Birch Creek. These modified limits have ranged between 341 and 565 NTU. It appears that the modified limits are not protective, because they were derived using an underestimated maximum effluent flowrate in the mass balance equation. The following table illustrates the worst case loadings that could be reflected by the turbidity modifications for upper Birch Creek. The table assumes a varying number of mines, each with a maximum modified limit (565 NTU) and an effluent flowrate of 1.8 cfs.

Table 7: Potential Worst-Case Loadings Associated with Site-Specific Turbidity Limits

Number of Permitted Mines	Turbidity Limit (NTU)	TSS Equivalent (mg/l)	Effluent Flow[1] (cfs)	Permitted Loading (lbs/day)	% of Loading Capacity
1	565	2159	1.8	21,000	219%
2	565	2159	1.8	42,000	437%
5	565	2159	1.8	105,000	1093%

Note: [1] Maximum effluent flow for all facilities in the 1993 study (grab sampling)

Based on the observed discharge flowrates from placer mines in the area, it is clear that turbidity modifications should be revised to conform with the loading capacity of upper Birch Creek. A new turbidity limitation for placer mines in this watershed is proposed herein based on the loading capacity and wasteload allocation, using an equal allocation to each mine (see below).

5.c.iii Proposed Load Allocation for Non-Point Sources

NPS loadings to Birch Creek can be divided into two categories, areas of historic mining activity and unmined areas. As discussed above, the unmined tributaries can be characterized by the sampling of Miller Fork in the uppermost part of the watershed, while data from Gold Dust Creek above an active mine can be used to characterize historically mined creeks.

While unmined tributaries (Willow, Bear, Fish, Miller, and Ptarmigan Creeks) were not sampled over the entire 1992 study period, they were grab sampled on three days during the study period. Using the median turbidity at Miller Fork and an estimate of the percentage of total Birch Creek flow from these creeks during the grab sampling, the following average TSS load from the unmined stretches is calculated as follows:

Median Miller Fork turbidity = .85 NTU	= .3 mg/l TSS
Average total flow of 3 unmined creeks (3 grab samples)	= 14 cfs
Average flow of Birch Creek (3 grab samples)	= 34 cfs
Percentage of Birch Creek flow = 14/34	= 41%
Average Birch Creek flow (1986-1994)	= 89 cfs
Estimated Avg unmined creek flow= (.41)x(89)	= 36 cfs

Average load of unmined creeks = 36 cfs x .3 mg/l x 5.4 = 58 lbs/day

Historic mining has occurred on Eagle, Gold Dust and Butte Creeks. In a manner similar to that described above for unmined creeks, water quality data for Gold Dust Creek was assumed to represent water quality in historically mined creeks, and flowrate ratios were derived from the grab sampling results. This calculation is derived as follows:

Median Gold Dust turbidity (1989-1992) = 4.35 NTU	= 13.7 mg/l TSS
Percentage of Birch Creek flow = total - unmined	= 59%
Average Birch Creek flow (1986-1994)	= 89 cfs
Estimated Avg mined creek flow = (.59)x(89)	= 53 cfs

Average load of hist. mined creeks = 53 cfs x 13.7 mg/l x 5.4 = 3920 lbs/day

The estimated average background loads from natural and mined areas fall below the average loading capacity for the waterbody. This suggests that under moderate flow conditions, upper Birch Creek can meet turbidity standards in the absence of a placer mining discharge. Therefore, the current estimated loading from mining and unmined areas (3,980 lbs/day) can form the load allocation for non-point sources, with the remainder allocated to the point sources.

5.c.iv. Proposed Wasteload Allocation

Setting aside the load allocation and a 10% margin of safety (see below) leaves 4,670 lbs TSS per day to allocate to the placer mining facilities. An equal allocation to each permitted facility is the proposed method to divide the allowable load among individual point sources. Other options considered but rejected due to lack of site-specific information included allocation methods based on mine characteristics such as area of disturbance or estimated worst-case effluent flow.

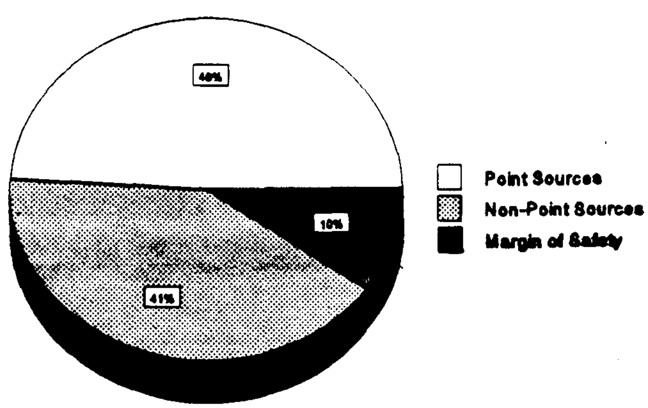
Assuming a maximum of 5 active placer mines in a given year, each facility would be granted an equal wasteload allocation of 930 lbs/day. At the worst-case discharge flowrate observed in 1992 (1.8 cfs), this allocation would translate to a TSS limit of 96 mg/l and a turbidity limit of 26 NTU. The same wasteload allocation translates to a higher turbidity limit for reduced discharge flowrates, as indicated in Table 8.

Table 8: Affect of Effluent Flowrate on Turbidity Limitations

Effluent Flowrate (cfs)	Turbidity Limit (NTU)
1.8	26
1.0	46
.5	91
.1	451
.05	900

As part of the implementation of this TMDL, it is proposed that the NPDES permits program translate the wasteload allocation for each facility (930 lbs TSS/day) into permit limitations based on site-specific flow conditions.

Figure 4: Allocation Breakdown



5.c.v Margin of Safety

In this evaluation, a 10% margin of safety is proposed to account for uncertainty in the data and assumptions used in establishing the loading capacity. Since the wasteload allocation assumes continued placer mining activity (5 active mines) at 1996 levels, an additional margin will be provided when mining activity is lower than this level in a given year.

It should also be noted that the wasteload allocation assumes no loss (settling) of turbidity-TSS from the water column during transport downstream. A review of the three grab sampling days in which point sources were sampled indicates that TSS inputs to the upper Birch Creek system exceeded the TSS loads observed at the TwelveMile confluence by 16%, 71%, and 94% on the three sampling days.

5.d High Flow Events

As described earlier, major storm events cause significant sediment transport through the upper Birch Creek watershed. The available monitoring information is not sufficient to separate point source inputs from non-point source inputs during such events. Therefore, an evaluation of loading capacity and wasteload allocations for high flow events has not been developed at this time.

A phased approach to turbidity, focused first on concerns about average conditions and later on high flow conditions, allows additional time for collection and analysis of monitoring information that is focused on high flow events. This additional information can be used to generate sediment budget estimates associated with high flows for the watershed. From these estimates, additional controls or management recommendations targeted on the sources of greatest concern (point and/or non-point sources) could follow from these analyses.

PART 6 : IMPLEMENTATION

6.a Goals and objectives

The goal of the project is to continue to improve the water quality of the upper Birch Creek as measured by the turbidity of Birch Creek above the confluence of Twelvemile Creek.

The water quality management plan for upper Birch Creek focuses on three interim objectives:

- Continued NPDES inspection and enforcement activity to reduce discharges from active mine sites, particularly during storm events.
- Full attainment of Alaska's water quality standards at key sites in the drainage (e.g. the turbidity standard for recreation at Birch Creek above Twelvemile Creek) so that the various water uses are protected.
- Continued implementation of reclamation activities in key areas to address high priority nonpoint source problems.

6.b. Lead agency(s)

The two lead agencies for turbidity controls are the EPA and the ADEC. Accomplishing the goals in the plan is a joint cooperative effort. The ADNR Division of Mining and Water Management and the ADEC will continue the joint effort to monitor water quality in the watershed.

The lead agencies for reclamation requirements would be BLM and ADNR Division of Mining and Water Management for federal and state lands respectively.

6. c. Permit Compliance Monitoring

ADEC, in cooperation with EPA, will inspect each operating mine in the upper Birch Creek drainage at least once each year and perform at least one follow-up inspection of any mines found to be in violation of NPDES permit requirements.

BLM personnel inspect each mine in the Upper Birch Creek drainage several times each field season for compliance with the approved mine plan and approve reclamation on of the federal lands. ADNR personnel perform similar activities on state lands.

COE personnel inspect 404 permits for complaince at their discretion and as the budget and priorities of the agency allow. The ADEC certifies 404 permits under section 401 of the Clean Water Act and may enforce permit conditons.

6.d Inter-agency Water Quality Monitoring Program

The ADNR Division of Geological and Geophysical Surveys (DGGS) initiated a program of ambient water quality monitoring in 1984 to develop background information on selected drainages. ADEC and ADNR cooperatively maintain a water quality monitoring program to determine turbidity, total suspended solids and stream stage at selected sites. Birch Creek above Twelvemile Creek has been monitored during the open water season since 1984 as shown in Table 3. The agencies plan to continue this monitoring to document that improvement actually occurs and assist in the identification of problems.

6.e Schedule:

1996

January-March	Meet with State and Federal Agencies to discuss strategy
March-May	Meet with each of the 5 Mine operators to review operating plans
May and June	Install automatic water samplers on Upper Birch Creek
May 15-July 15	Inspect operating placer mines to determine compliance with NPDES permit limits; land management agencies will make additional inspections
July 15-Aug 15	Follow up inspection of problems identified by initial inspections
Aug 15 Sept 30	Perform additional inspections if resources allow
September	Remove automatic water samplers
Oct-Dec	Prepare water quality monitoring data
Oct-Dec	Review/Revise Monitoring Plan
Oct-Dec	Revise turbidity modification based on TMDL

1997

January	Review water monitoring data to determine impact of 1995 efforts.
March-May	Meet with each of the 5 Mine operators to review operating plans
May and June	Install automatic water samplers on Upper Birch Creek
May 15-July 15	Inspect operating placer mines to determine compliance with NPDES permit limits
July 15-Aug 15	Follow up inspection of problems identified by initial inspections
Aug 15 Sept 30	Perform additional inspections if resources allow
September	Remove automatic water samplers
Oct-Dec	Prepare water quality monitoring data

1998

January	Review and adjust strategy as necessary to continue progress

PART 7 MONITORING PLAN

7.a Introduction

The ADNR, DGGS, initiated an ambient monitoring program in 1984 to develop background information on selected drainages impacted by placer mining including Birch Creek. This program has expanded over the years and is currently a combined effort by the ADECand ADNR. The Water Resources section of DGGS is now the Alaska Hydrologic Survey in the Division of Mining and Water Management.

Useful data comes from sites that have automated water samplers and water level recorders operating throughout the field season. This permits the sampling of possible diurnal variation and to collect samples during infrequent events, such as floods. In addition, ADEC and ADNR will explore the practical hurdles involved in collecting grab samples of TSS and turbidity (as well as flow) in the watershed and at active mines during or soon after heavy storm events.

7.b. Parameter Selection

Along with Turbidity, TSS, and flow monitoring, concerns about fish habitat warrant monitoring of sediment accumulation over time, for comparison with the fine sediment standard. It is recommended that monitoring sites be established in locations of Birch Creek that represent a range in spawning habitat potential. Periodic monitoring of the creek bed sediments will allow the agencies to compare the quality of sediment habitat in Birch Creek to the standard, and provide helpful information about habitat trends.

Sediment monitoring could be structured to coincide with the placement and retrieval of automated samplers for the ongoing turbidity monitoring. If appropriate and feasible, sediment monitoring stations could be in the same location as several automated samplers. This would provide two samples per year at multiple locations, one before and one after the mining season.

Monitoring of sediment accumulations has been recommended in the TMDL for Sediment and Turbidity in Vanderbilt Creek, Alaska (September 1995). Additional information about sampling methods and holding times for this type of monitoring are described in that document.

7.c Station Selection

The current objectives are to maintain monitoring of turbidity, total suspended solids, and discharge at a few important sites in the Birch Creek drainage. The sites within the Upper Birch Creek drainage monitored in 1993 and 1994 include: Eagle Creek above Ptarmigan Creek, Birch Creek above Gold Dust Creek, and Birch Creek above Twelvemile Creek. Birch Creek at the Steese Highway, a site downstream of all industrial activity is also monitored ; however, this site is outside the Upper Birch Creek drainage. These locations are shown in Figure 2 of the 1993 study (Appendix B).