LOCATION OF PROPOSED RESERVATION OF WATER:

Stream 2003, a tributary of the Chuitna River, is located approximately 7 miles northwest of Tyonek, AK. This reservation applies to stream flows within a reach of the main stem of Stream 2003, associated floodplain, side channels, spring systems and contributing wetlands between its confluence with tributary 200305 (approximately river mile 7.7) downstream to its confluence with the Chuitna River (river mile 0). See Appendices A-1, A-2 and A-3 for maps and aerial photos of the instream flow reservation boundaries requested in this application. This reach of stream 2003 is important to anadromous fish, particularly coho salmon as shown on the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (Appendices A-4 and A-5) and as documented in fish spawning surveys conducted in the area (Appendices A-6, A-7 and A-8).

Location of proposed reservation reach:

Sections 3, 10, 11, 13, 14, 24; Township 12 North; Range 12 West; Seward Meridian

Sections 26 and 35; Township 13 North; Range 12 West; Seward Meridian

U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4

Location of upstream point of proposed reservation reach:

The upstream point of the proposed reservation reach is located in section 26, Township 13 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4).

The latitude/longitude of the upstream point of the proposed reservation reach is N 61°11'22.29"; W 151°22'56.95", approximately river mile 7.7 of Stream 2003.

Location of downstream point of proposed reservation reach:

The downstream point of the proposed reservation reach is located in section 24, Township 12 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4).

The latitude/longitude of the downstream point of the proposed reservation reach is N 61° 6'55.82"; W 151°19'26.04", approximately river mile 0 of Stream 2003.

Location of flow gauging sites within proposed reservation reach:

Gauging Station 128 is located in section 26, Township 13 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4). The latitude/longitude of Station 128 is N 61°11'17.43"; W 151°22'59.70", approximately river mile 7.6 of Stream 2003. Gauging Station 128 is not currently active and has been replaced by Station 129.

Gauging Station 129 is located in section 26, Township 13 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4). The latitude/longitude of Station 129 is N 61°11'14.75"; W 151°23'0.35", approximately river mile 7.5 of Stream 2003.

Gauging Station 140 is located in section 3, Township 12 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4). The latitude/longitude of Station 140 is N 61° 9'48.03"; W 151°22'44.33", approximately river mile 6.4 of Stream 2003. Gauging Station is not currently active and has been replaced by Station 141.

Gauging Station 141 is located in section 35, Township 13 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4). The latitude/longitude of Station 141 is N 61°10'37.51"; W 151°22'11.19", approximately river mile 6.6 of Stream 2003.

Gauging Station 180 is located in section 13, Township 12 North, Range 12 West; Seward Meridian (U.S. Geological Survey, USGS 1:63,360 Topographic Map, Tyonek River A-4). The latitude/longitude of Station 180 is N 61° 7'29.88"; W 151°19'54.73", approximately river mile 1 of Stream 2003.

Note: Latitude/Longitude and river mile locations are approximate and were calculated using Google Earth. Google Earth uses Simple Cylindrical projection with a WGS84 datum for its imagery base.

Maps:

(1) Sections, townships, range, and meridians: Appendices A-1, A-2 and A-3
(2) The stream body in which the reservation of water is proposed: Appendices A-1, A-2 and A-3
(3) Specific points defining the boundary of the proposed reservation of water: Appendices A-1, A-2 and A-3
(4) Permanent, temporary, or planned locations of water measurement devices: Appendices A-1, A-2 and A-3
(5) Permanent, temporary, or planned bench marks- N/A

WATER USE:

Describe in detail the purpose(s) of the proposed reservation, including, when appropriate, species and life stage, type of recreation, vehicle, or water quality parameter, or other relevant information.

The primary purpose of the proposed reservation is for protection of fish and wildlife habitat, migration, and propagation in Stream 2003 and its watershed. Stream 2003 produces a variety of important fish species in this region, including Dolly Varden (*Salvelinus malma*), Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon, (*Oncorhynchus kisutch*), rainbow trout (O*ncorhynchus mykiss*), threespine stickleback (*Gasterosteus arculeatus*), and Pacific lamprey (*Entosphenus tridentatus*) (Oasis, 2008). Low numbers of sockeye salmon (*Oncorhynchus nerka*) and pink salmon (*Oncorhynchus gorbuscha*) were also identified in stream 2003 during the 2008 sampling campaign (Nemeth et al., 2009). Many of these species utilize Stream 2003 for a portion of, or all of, their spawning, incubation, rearing, and passage life phases (Figure 1) (Oasis, 2008).

The Alaska Department of Fish and Game (ADF&G) has included Stream 2003 in its Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (Appendices A-

4 and A-5) and Stream 2003 is afforded protection under AS 16.05.871 (ADFG, 2007). The species present in Stream 2003 contribute to sport, commercial, and subsistence fishing in the area (Oasis, 2008). It has been estimated that Stream 2003 contributes 20.8% of the coho salmon population to the Chuitna River, which is included in the Cook Inlet Regional Salmon Enhancement Plan (developed to achieve optimal production of wild and enhanced salmon stocks) (Oasis, 2008). Within this plan, the Chuitna is designated a "wild stock sanctuary" under ADF&G Genetics Policy for Chinook and Coho salmon based on escapement numbers (Oasis, 2008).

Salmon spawning surveys were conducted in the Chuitna River and tributaries (including Stream 2003) in 1982, 1983, 1984 and 2006 (Oasis, 2008). Appendices A-6, A-7 and A-8 show the distribution of Coho, Chinook and Pink salmon spawning in the area of the requested instream flow reservation.

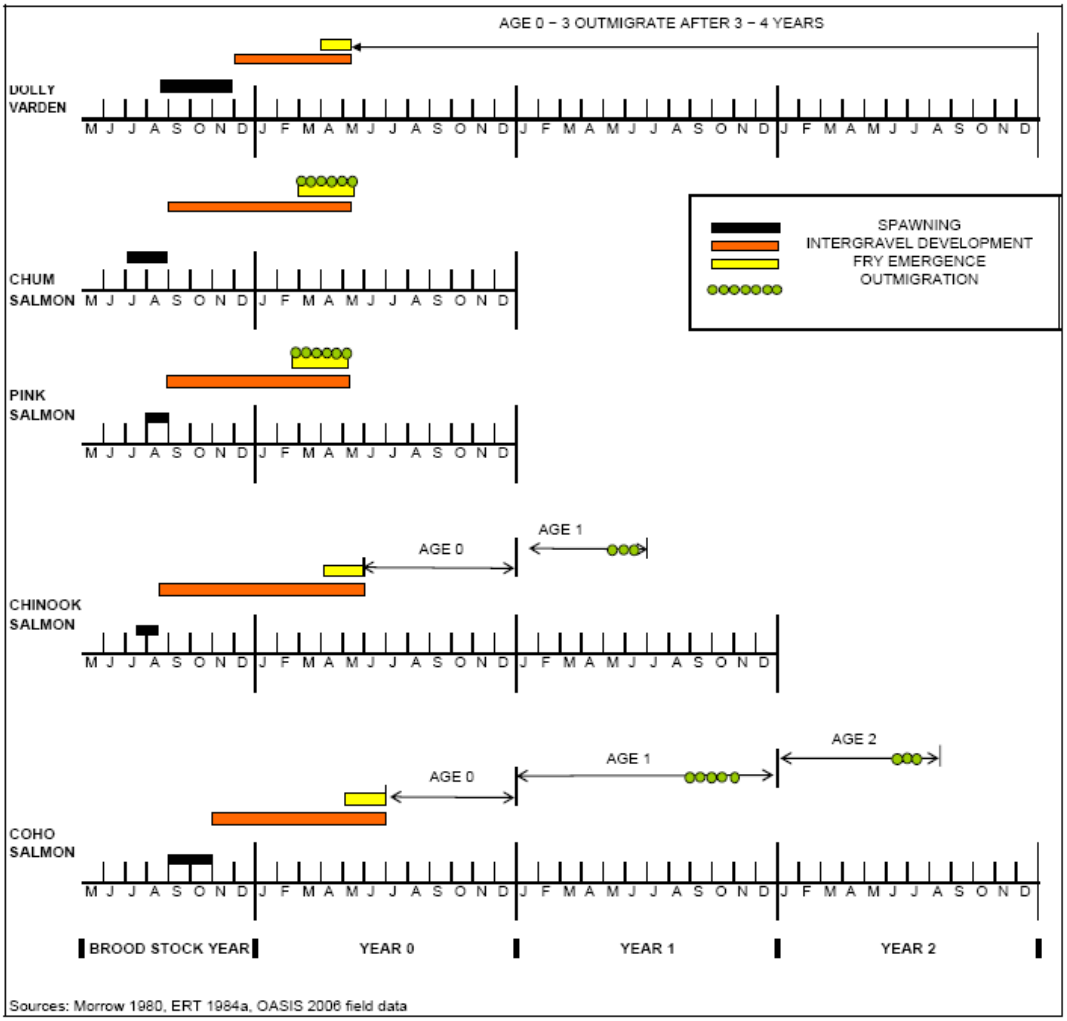

Figure 1. Life stage usage of salmonids in Stream 2003 (original reference Oasis, 2008).

Stream conditions such as temperature and flow are extremely important for migration, spawning and rearing of Pacific salmon. Each species of fish has a unique set of requirements which trigger their migration to spawning sites in nearby tributaries. If conditions are unsuitable, fish will often

wait near the stream mouth for weeks to months until more favorable conditions prevail (Groot and Margolis, 1991). As temperatures decrease and stream flow increases (as a result of rainfall and/or storm events), adult salmon, particularly coho, will make short trips upstream until there is a large increase in flow (usually in combination with high tides), which will initiate their upstream migration to small headwater tributaries (Groot and Margolis, 1991). In Stream 2003, the catch per unit effort (CPUE) increased for coho salmon smolts and juveniles as discharge decreased and water temperatures increased (Oasis, 2008). Groundwater contribution to Stream 2003 is particularly important for both base flow discharge and maintaining favorable local water temperature conditions. The instream flow reservation should include the maintenance of historical temperature and flow ranges to protect the migratory patterns of both adult and juvenile fishes, as the optimal conditions vary by species and age.

Table 1. Water Parameter Requirements for Coho, Chinook, and Pink Salmon Spawning (original reference Oasis, 2008).

	Temperature (°C)	Depth (feet)	Velocity (ft/sec)	Substrate Size (cm)
Coho Salmon	4.4 - 9.4	≥ 0.6	0.98 - 2.99	1.3 - 10.2
Chinook Salmon	5.6 - 13.9	≥ 0.8	1.05 - 3.58	1.3 - 10.2
Pink Salmon	7.2 - 12.8	≥ 0.5	0.69 - 3.31	1.3 - 10.2

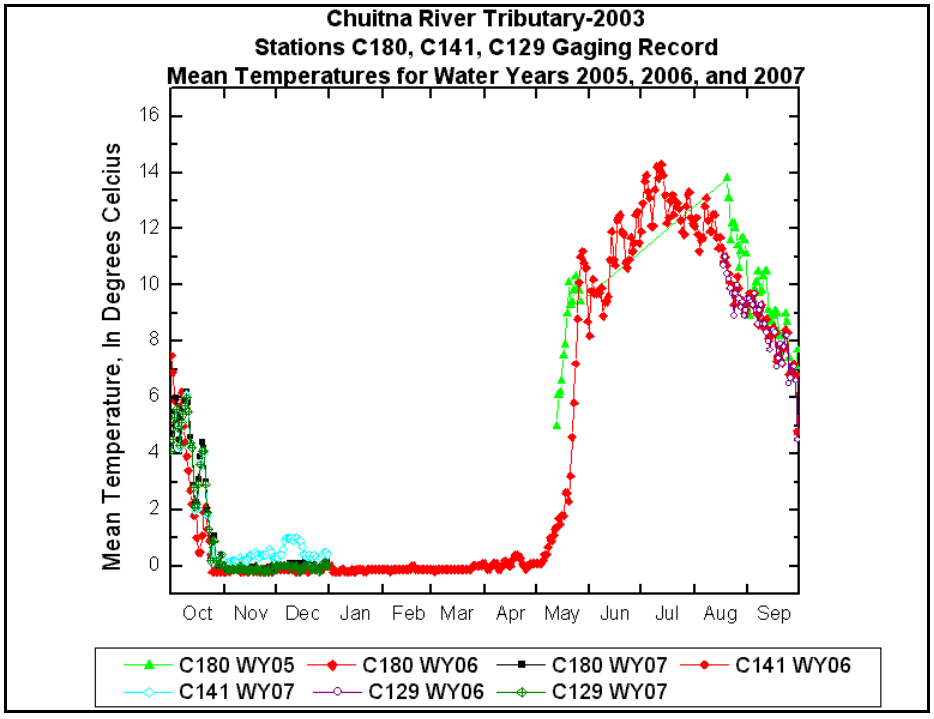

Figure 2. Mean Temperatures at Stations C180, C141, and C129 in Stream 2003 (Water Years 2005, 2006, and 2007).

WATER QUANTITY:

Quantify the specific amount of water requested to be reserved. Identify and quantify, as appropriate, flow rates, quantities, surface water elevations, depths, etc., as they relate to the requested time periods of the year during which the reservation is proposed. Include any flow release schedules from projects upstream of the proposed reservation that would be necessary.

This application was assembled using information from reports submitted by PacRim, LP, to the Alaska Department of Natural Resources (ADNR) and U.S. Environmental Protection Agency (EPA) in support of National Pollutant Discharge Elimination System (NPDES) and Alaska Surface Coal Mining Control & Reclamation Act (ASCMCRA) permit applications for the Chuitna Coal Project. The data presented in the permit applications are adequate for this instream flow reservation. However, the applicant reserves the right to update this application in the event that relevant information or new data becomes available at a future date.

The flows requested by this application are conservative when compared to the flows actually available throughout the main stem reach of Stream 2003. The quantity of flow requested is conservative as compared to the actual flow available because this request is based on flow data measured near the upstream boundary—Station 128—and data from downstream gauges show that Stream 2003 is a gaining stream (i.e. Stream 2003 gains flow as it passes downstream). Flow data from gauges located downstream of Station 128 (Stations 140, 141 and 180) show an increase in flow volume as Stream 2003 continues to its confluence with the Chuitna River. Due to the conservative nature of this instream flow reservation request; the reservation of additional quantities of flow may be required along reaches of the lower portions of Stream 2003 in order to more accurately reflect the gaining nature of flows in Stream 2003 and provide protection for fish and wildlife populations.

To ensure adequate protection for fish and wildlife habitat, migration and propagation, this application requests the following minimum average daily flows be maintained in the main stem, including any appropriate side channels, of Stream 2003 during the calendar months indicated below.

Requested Flows for the Main Stem of Stream 2003 by Calendar Month

Month	Requested Flow (cfs)
January	3.0
February	2.0
March	2.0
April	10.0
May	20.1
June	5.8
July	2.5
August	6.0
September	10.0
October	10.0
November	6.0
December	3.0

METHODOLOGY AND MONITORING:

Attach and submit with this application documentation or reports showing facts to support the following:

(a) The need for the proposed reservation of water, including reasons why the reservation is being requested.

This instream flow reservation is required for the protection of fish and wildlife habitat, migration, and propagation within Stream 2003. The ADF&G has included Stream 2003 in its Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (Appendices A-4 and A-5) and Stream 2003 is afforded protection under AS 16.05.871. The species present in Stream 2003 contribute to sport, commercial, and subsistence fishing in the area (Oasis, 2008). It has been estimated that Stream 2003 contributes 20.8% of the coho salmon population to the Chuitna River, which is included in the Cook Inlet Regional Salmon Enhancement Plan (developed to achieve optimal production of wild and enhanced salmon stocks) (Oasis, 2008). Within this plan, the Chuitna is designated a "wild stock sanctuary" under ADF&G Genetics Policy for Chinook and Coho salmon based on escapement numbers (Oasis, 2008).

Appendices A-6, A-7 and A-8 show the extent of Chinook, coho and pink salmon spawning distribution within Stream 2003 (Oasis 2008) in the years 1982, 1983, 1984 and 2006.

(b) Identify and describe the methodology, data, and data analysis used to substantiate the need for and the quantity of water requested for the proposed reservation of water, including:

1. Name and description of method used

Procedures were selected that complied with instream flow application instructions and requirements established by state law (AS 46.15.145), state regulations (11 AAC 93.141-146), and the *"State of Alaska Instream Flow Handbook"* (DNR 1985).

The Tennant Method (Tennant, 1975), also referred to as the Montana Method in earlier literature, was selected as an appropriate procedure for evaluating instream flow requirements for fish habitat in the main stem of Stream 2003 based upon the availability of hydrologic and biologic data and financial and personnel resources.

The Tennant Method is considered one of the simplest, yet most reliable, techniques for selecting and qualitatively evaluating instream flows for fish and wildlife habitat. This technique has been approved for use in court (*Tulkisarmute Native Community Council v. Heinze*, 898 P.2d 935 (Alaska 1995)), and has been successfully used to acquire instream flows for other water bodies in Alaska. It requires minimal expenditures of resources, and can be used with either limited or extensive hydrologic and fishery data bases. The selection of the Tennant Method to quantify instream flows for this and other Alaskan streams is also supported by the results of a research project conducted to evaluate and compare applications of different instream flow methods to the same stream reach (Estes, 1984a; Estes and Orsborn, 1986). The evaluation was sponsored by the U.S. Soil Conservation Service, ADF&G, ADNR, U.S. Geological Survey (USGS), and Washington State University. The results of that study indicated that the Tennant Method, and other instream flow techniques, can be applied to Alaskan streams to quantify instream flow requirements if adapted to local hydrologic and biologic characteristics and considerations.

Tennant established eight aquatic habitat categories by analyzing a series of field measurements and observations. Each category is assigned a percentage range of the average annual flow (QAA). QAA is the arithmetic mean of one year of mean daily flows as recorded at a gaging site and was calculated for the entire period of record for instream flow analyses. Seven of the categories characterize habitat quality for fish and wildlife and the eighth provides for a short term flushing flow to maintain channel substrate characteristics for suitable fish spawning and incubation and benthic invertebrate production. The percentages of QAA for habitat quality range from <10% (Severe Degradation) to 60-100% (Optimum Range). The flushing flow requirement equals 200% of the QAA for a duration of 24 hours once per year (Tennant 1975). The QAAs used for this analysis represented flow conditions for the main stem reach of Stream 2003 where a flow reservation is being requested. Natural flushing flow events (in unregulated streams and rivers) occur on an irregular basis. Estes (1984a; Reiser, 1985; et al.) suggests the flushing value should be increased to 400% or more over a three- to seven-day period to better mimic flows associated with the 1 in 2-year peak flood flow (QF2P). The flushing flow requirement may be even higher for this portion of the state.

2. Who conducted the study and analysis

The study and analysis was conducted by Geo-Watersheds Scientific. Geo-Watersheds staff have worked on watershed-scale hydrology projects in many parts of Alaska over the last 15 years. This includes ground-water and surface-water interaction modeling and analysis projects, watershed modeling on the North Slope, and lake and reservoir water use associated with water use activities. Fisheries-related projects include evaluation of spawning zones in inter-tidal environments on beaches in Prince William Sound, dissolved oxygen studies on North Slope lakes, and fish habitat studies in Interior Alaska.

3. Schedule of when data collection and analysis occurred

Flow data and gauge site descriptions used for delineating reach boundaries were obtained from reports submitted by Riverside Technologies, Inc., to DNR and EPA in support of NPDES and ASCMCRA permit applications for the Chuitna Coal Project.

There are currently three continuous flow gauging station sites located on Stream 2003 (see descriptions below). Data from Station 128 were used in support of this application; however, the other stations may be evaluated at a later date as new data becomes available.

Station 128, located in the upper reaches of Stream 2003 at approximately river mile 7.6, was active from 1985 to 1995 and has 10 complete years of daily discharge records. Station 128 was replaced by Station 129 in 2006 (see below).

Station descriptions below are **excerpted** from: Chuitna Coal Project - Hydrology Component Baseline Report - Historical Data Summary (Riverside Technologies, Inc., March 2007).

C128 – This site is found on Stream 2003 downstream of the confluence with Stream 200305. Flows at this site are thought to result from surface runoff and from the glacial hydrogeologic unit. This site is thought to be upstream of the exposure of the underlying coal units. The purpose of this site is to help understand where most of the water drains into 2003 Creek and from which hydrogeologic unit. Water quality analysis from this site will be compared with downstream sites to see if water draining primarily from the glacial hydrogeologic unit is significantly different

than water downstream. The site was abandoned in 2006 in favor of a site downstream (Station C129) not impacted by beaver dams.

C129 – This is a new site found on Stream 2003 downstream of the confluence with Stream 200305 and replaces C128. Flows at this site are thought to result from surface runoff and from the glacial hydrogeologic unit. This site is thought to be upstream of the exposure of the underlying coal units. The purpose of this site is to help understand where most of the water drains into 2003 Creek and from which hydrogeologic unit. Water quality analysis from this site will be compared with downstream sites to see if water draining primarily from the glacial hydrogeologic unit is significantly different than water downstream. A stream gage was installed here in 2006.

C140 – This site is found on Stream 2003 immediately downstream of the lease boundary. The purpose of this site is to help understand where most of the water drains into Stream 2003 and from which hydrogeologic unit. In addition, data from this site will be used to evaluate potential impacts from the mine operation. The station has periodically had problems with beaver dams and was abandoned in 2006.

C141 – This site is found on Stream 2003 immediately downstream of the confluence with 200304. The purpose of this site is to help understand where most of the water drains into Stream 2003 and from which hydrogeologic unit. The objective was to locate this station closer to the permit boundary, but there are too many beaver dams for a viable gage. This site was installed in 2006 to replace C140.

C180 – This site is the lowest site on Stream 2003 and is found immediately upstream of the Chuit River confluence. Data collected at this site are intended to characterize Stream 2003 and to help evaluate impacts from the mine operation. This site was renovated in 2006.

Note: The terms Chuitna River and Chuit River are used interchangeably. The text was not altered from the original citation, but for clarity, the different terminology should be noted.

4. Type(s) of instrument(s) used to collect and analyze data

See Appendix B for data collection and analysis methods.

Appendix B consists of section 3.5.1 Chuitna Coal Project - Hydrology Component Baseline Report - Historical Data Summary (Riverside Technologies, Inc., March 2007).

5. Description of data and how the data were collected, including when applicable, (A) selection of stream reach, study site and transect selection, (B) flow, survey, elevation, and depth measurements, (C) pertinent physical, biological, water chemistry and socio-economic data supporting the request for reservation of water

Stream reach boundaries for this application were selected to insure that flow, habitat, and fish periodicity (seasonal use of habitat for passage, spawning, incubation, and rearing) characteristics within the reach remain unaffected. Reaches were defined on USGS topographic maps after review of reports submitted by Riverside Technologies, Inc., and Oasis Environmental to DNR and EPA in support of NPDES and ASCMRA permit applications for the Chuitna Coal Project. Topography, watershed, channel patterns, fish periodicity, stream gage site descriptions and mean daily flow data were collectively analyzed as described in this application.

After review of the information listed above, flow data collected at Station 128 (between tributary streams 200304 and 200305) were selected as being representative of the water flow in the upper portions of the main stem of Stream 2003. The requested flows for the instream flow reservation are believed to be conservative for the reach boundaries. Station 128 is located near the upstream end of the requested reservation reach. As such, any flow contribution from surface water tributaries, wetlands and/or groundwater downstream of Station 128 is not included in the analysis and, because Stream 2003 is a gaining stream, prevents requesting more water for the reach than is available. The average baseflow at Station 128 appears to be about 2 cfs, which correlates with the requested flows for the months of February and March.

6. Description of how data were analyzed

The Tennant Method requires that a QAA be calculated from an existing or synthesized data base. A monthly flow recommendation for Stream 2003 was established by selecting the desired qualitative habitat classification and multiplying the QAA by the corresponding percentage or percentage range assigned to that classification.

Average Annual Flow Procedures:
Calculation of QAA from the existing mean daily flow records for the stream reaches involved first obtaining the mean of the mean daily flows within each water year (October 1-September 30). Next, QAA was calculated as the arithmetic average of the annual mean daily flow values over all complete years of record.

Mean Monthly Flow (QAM) Procedures:
The QAM was calculated by first taking the arithmetic average of the mean daily discharge for each complete calendar month in the record. Next, QAM was calculated as the arithmetic average of the monthly mean daily flow values for each calendar month over the period of record.

Duration Analysis Procedures:
Flow duration estimates were calculated as percentiles of the distribution of observed values within the time periods involved over the years of record. For example, flow duration estimates for the month of April were calculated by combining all mean daily flow values for April (for all years having complete April records). Then the empirically defined distribution (observed-combined mean daily flow values) was calculated.

Monthly instream flow requirements for individual life phases of fish for each stream reach were chosen by comparing the Tennant Method habitat flow percentages, fish periodicity data, QAM, and flow duration estimates. Excluding the flushing flows, monthly instream flow requirements were selected that corresponded to both fish presence during that time period and the highest of the Tennant Method habitat categories that did not exceed the QAM for that month.

Using this approach to derive the requested instream flow reservation values provided a basis to prevent requesting more water than is typically available. Based on the accepted practices and methods for stream flow analysis using the Tennant Method, this analysis supports the existing recommendations.

Although important to the fishery, a QF2P flushing flow was not specified within this application because the natural flow regime in Stream 2003 has not been disrupted. However, if future applications for water withdrawals or diversions would prevent the occurrence of the QF2P and the three to seven days of flows associated with this event, provisions will be required to insure these flushing flows are not eliminated (Estes, 1984a).

Appendix C contains the results of the Tennant flow analysis. A CD of the hydrologic data analysis (including daily flow data) is attached to this application for review.

7. Maps, photos, aerial photos, calculations, and any other documents supporting this application

See Appendix A, attached.

If there are provisions for monitoring this proposed reservation of water, include the following:

(a) Description of monitoring equipment (such as gaging stations, staff gages, weirs)

Continued monitoring of the current gauging stations along the main stem of Stream 2003 (Stations 129, 141 and 180) is expected during permit application and/or any potential future development activities. The primary purpose of this reservation is to ensure protection of fish and wildlife habitat, migration, and propagation within the Stream 2003 drainage. If activities that may affect fish habitat were to occur within the Stream 2003 drainage, it is assumed that these activities would require regulatory permits that ensure fish habitat protection and the permits would subsequently require adequate flow monitoring to assess compliance with the regulatory requirements.

(b) Location of monitoring equipment

See attached appendices.

(c) Provisions for payment for monitoring

It is expected that the current gauging stations along the main stem of Stream 2003 (Stations 129, 141 and 180) will continue to be monitored during permit application and/or any potential future development activities by the entity proposing to develop the coal resources in the area. If Stream 2003 remains in its natural condition (no disturbance within its drainage area), as it now is, it is assumed that flow monitoring is not necessary to ensure that adequate instream flows are being maintained.

(d) Reporting system

It is expected that the current gauging stations along the main stem of Stream 2003 (Stations 129, 141 and 180) will continue to be monitored during permit application and/or any potential future development activities. This data would be reported to the permitting agencies on a regular basis and should be made available to the public for review.

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