Chuitna Coal Project
PacRim Coal, LP

Overview of Water Balance and Mine Water Control Plan

Presented to:

Cooperating Agencies

April 17, 2009

Meeting Objectives

- Review Site Baseline Hydrology, Hydrogeology and Water Quality
- Review Mine Site Water Balance and Approach
- Review Conceptual Mine Water Control Plan
- Receive Agency Input on Water Management Concepts

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CHARACTERISTIC FLOW AND TEMPERATURE REGIMES IN CHUITNA AND TRIBUTARIES

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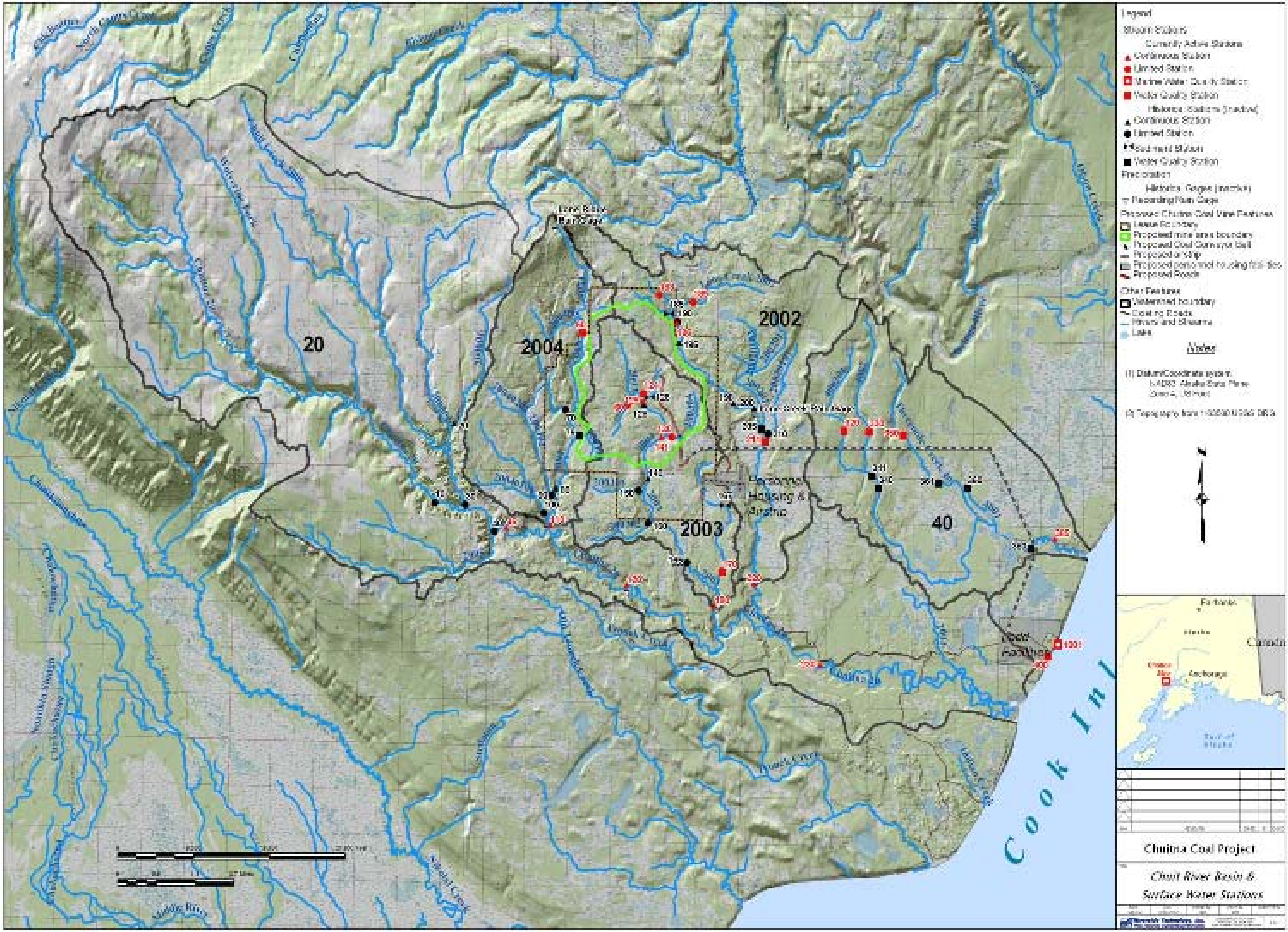
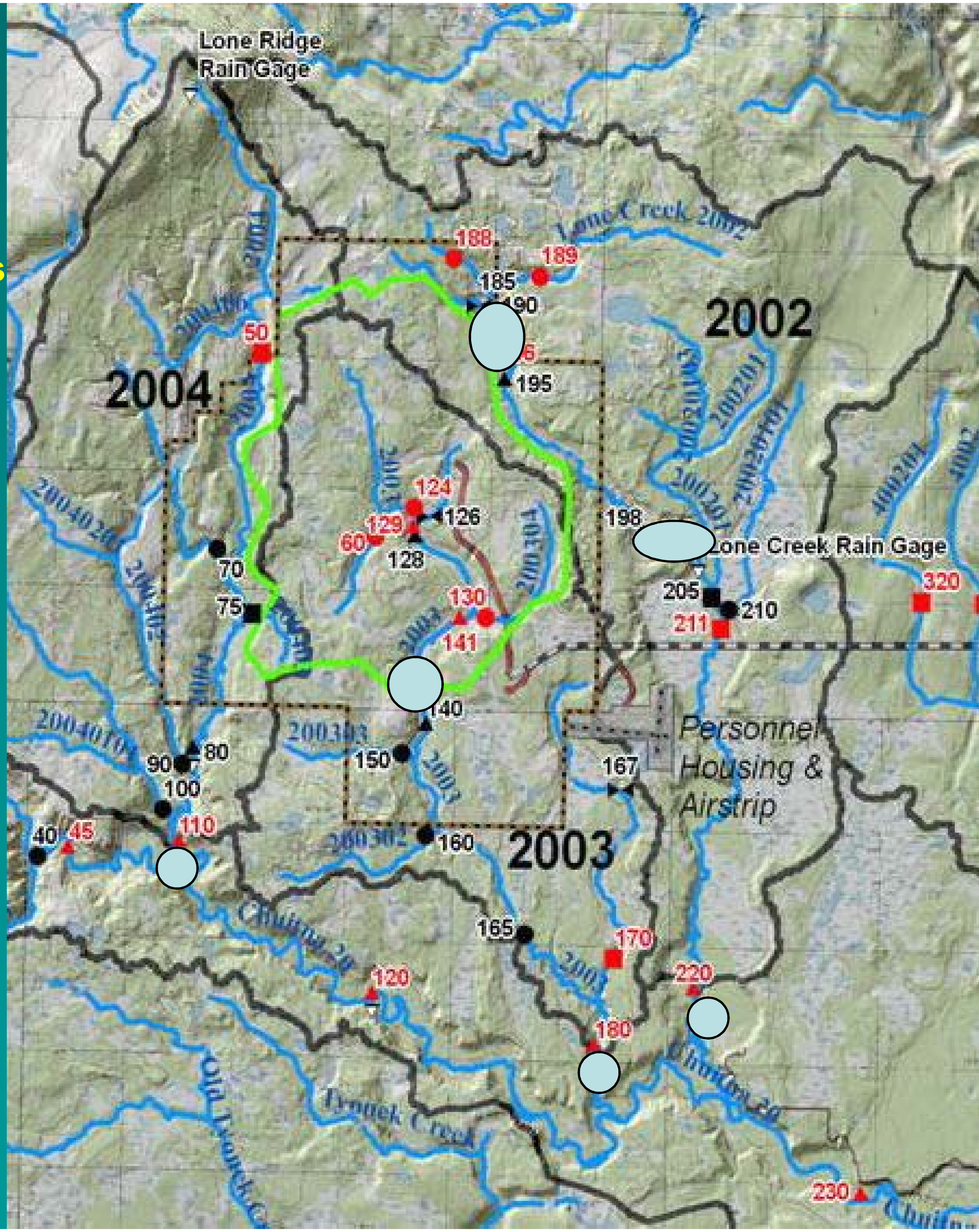
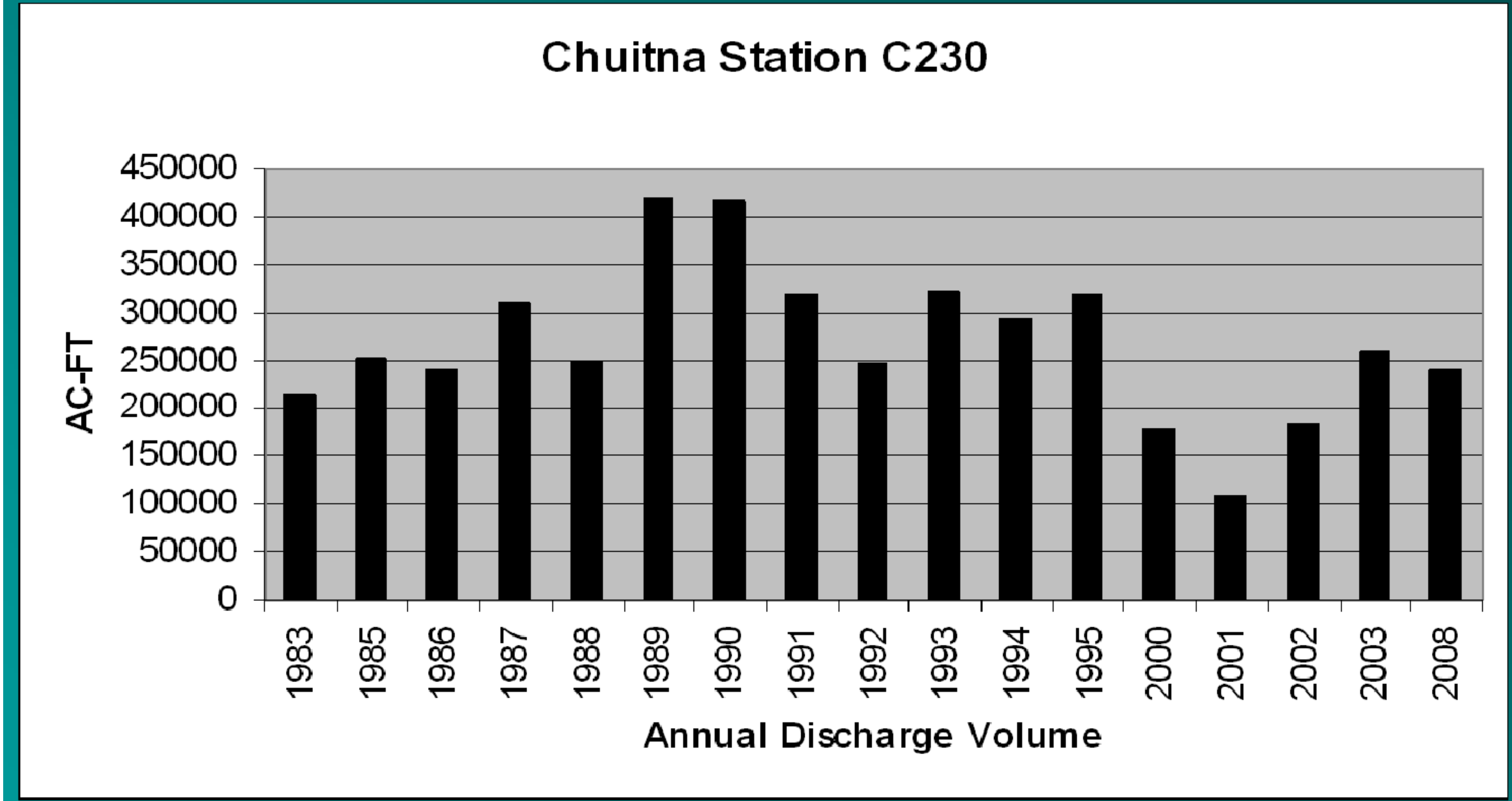

Legend
Stream Stations
Currently Active Stations
Continuous Station
Limited Station
Marine Water Quality Station
Water Quality Station
Historical Stations (inactive)
Continuous Station
Limited Station
Sediment Station
Water Quality Station
Precipitation
Historical Gages (inactive)
Recording Rain Gage
Proposed Chuitna Coal Mine Features
Lease Boundary
Proposed mine area boundary
Proposed Coal Conveyor Belt
Proposed airstrip
Proposed personnel housing facilities
Proposed Roads
Other Features
Watershed boundary
Existing Roads
Rivers and Streams
Lake
Notes
(1) Datum/Coordinate system:
NAD83 Alaska State Plane
Zone 4, US Feet
(2) Topography from 1:63360 USGS DRG
20
2004
2002
2003
40
Personnel Housing & Airstrip
Cook Inl
Anchorage
Canada
Chuitna Coal Project
Chuit River Basin &
Surface Water Stations

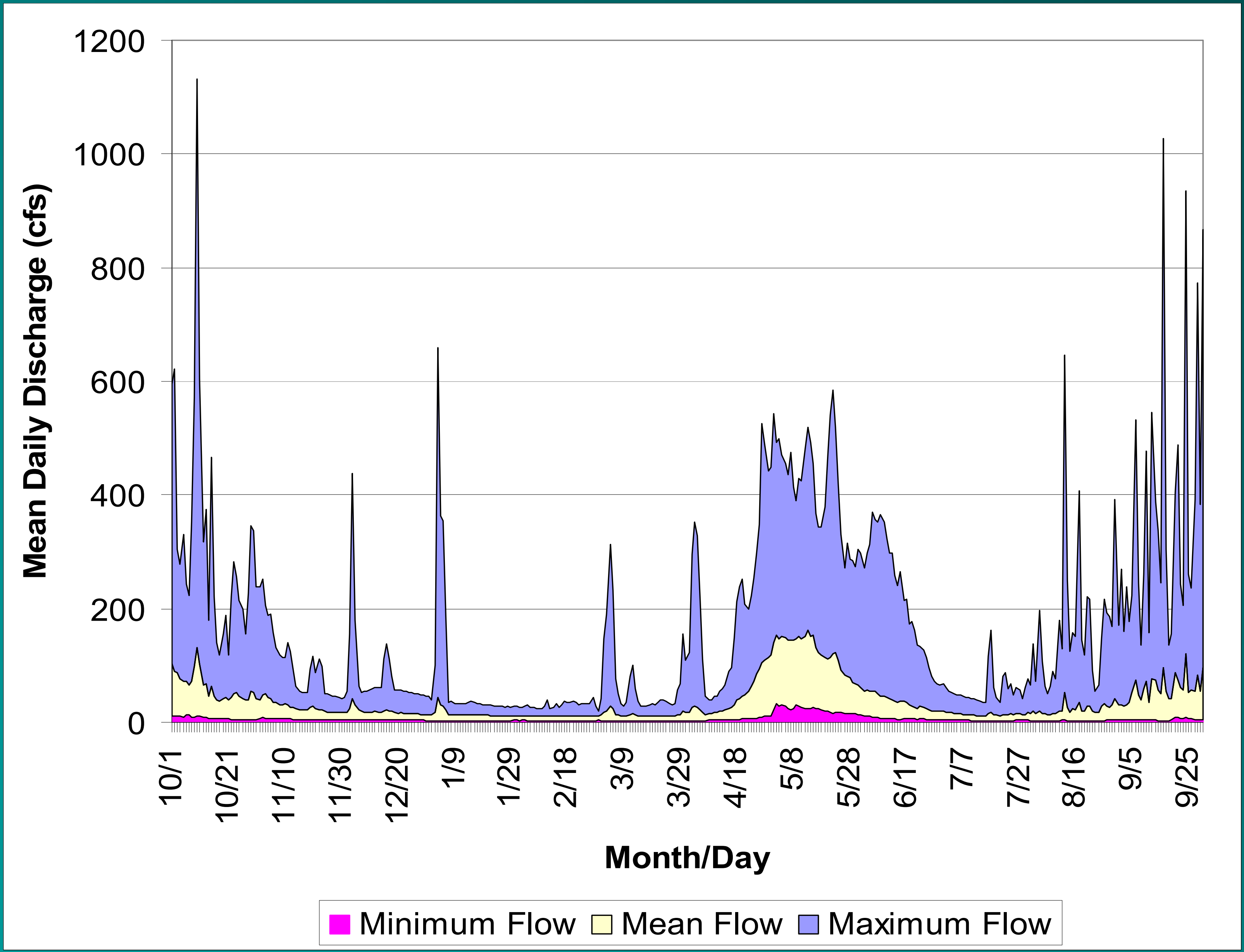
Key Continuous Monitor Stations



Annual Flow in the Chuitna



Daily Flow Variation at Station 180 – 2003 Creek



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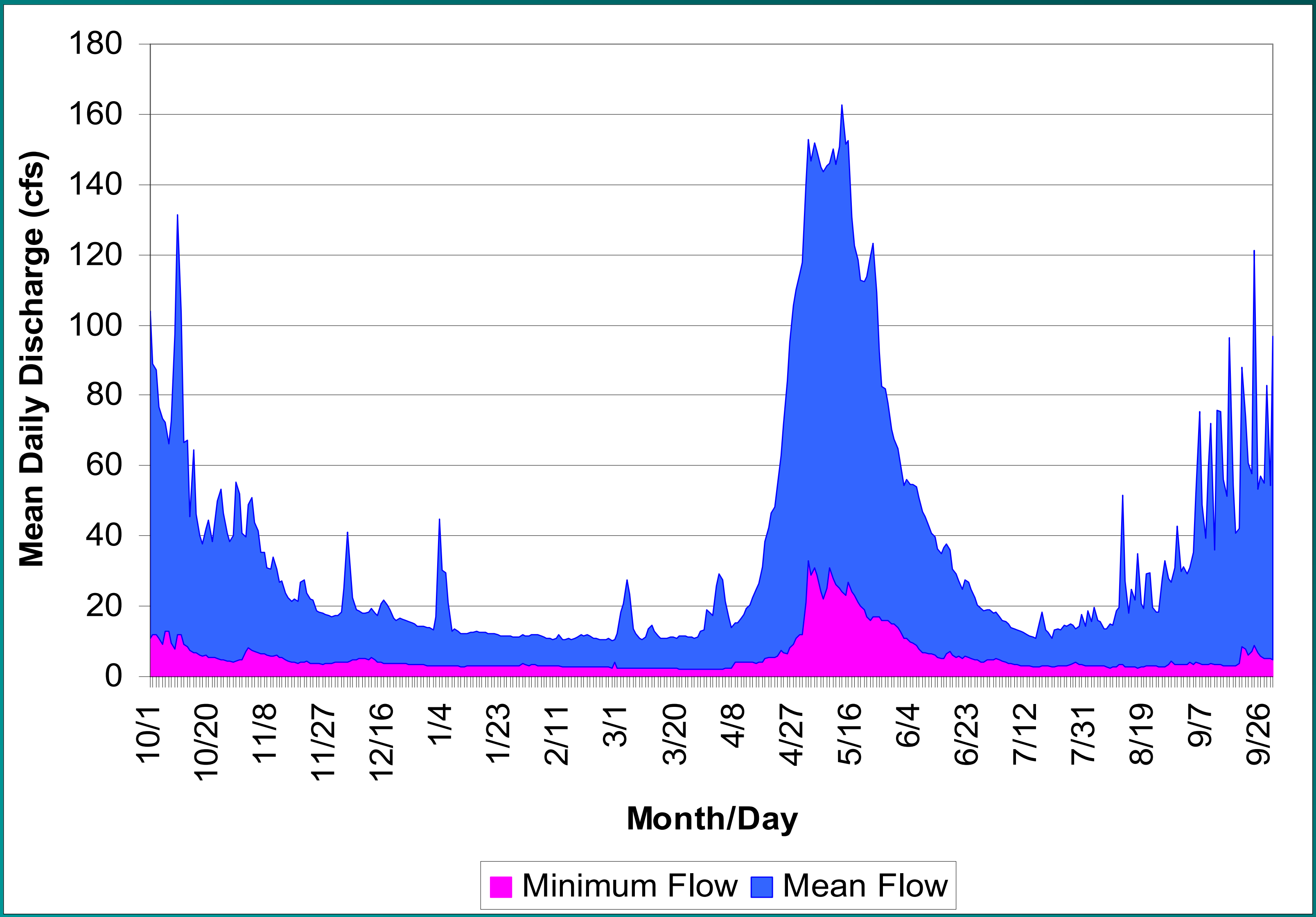
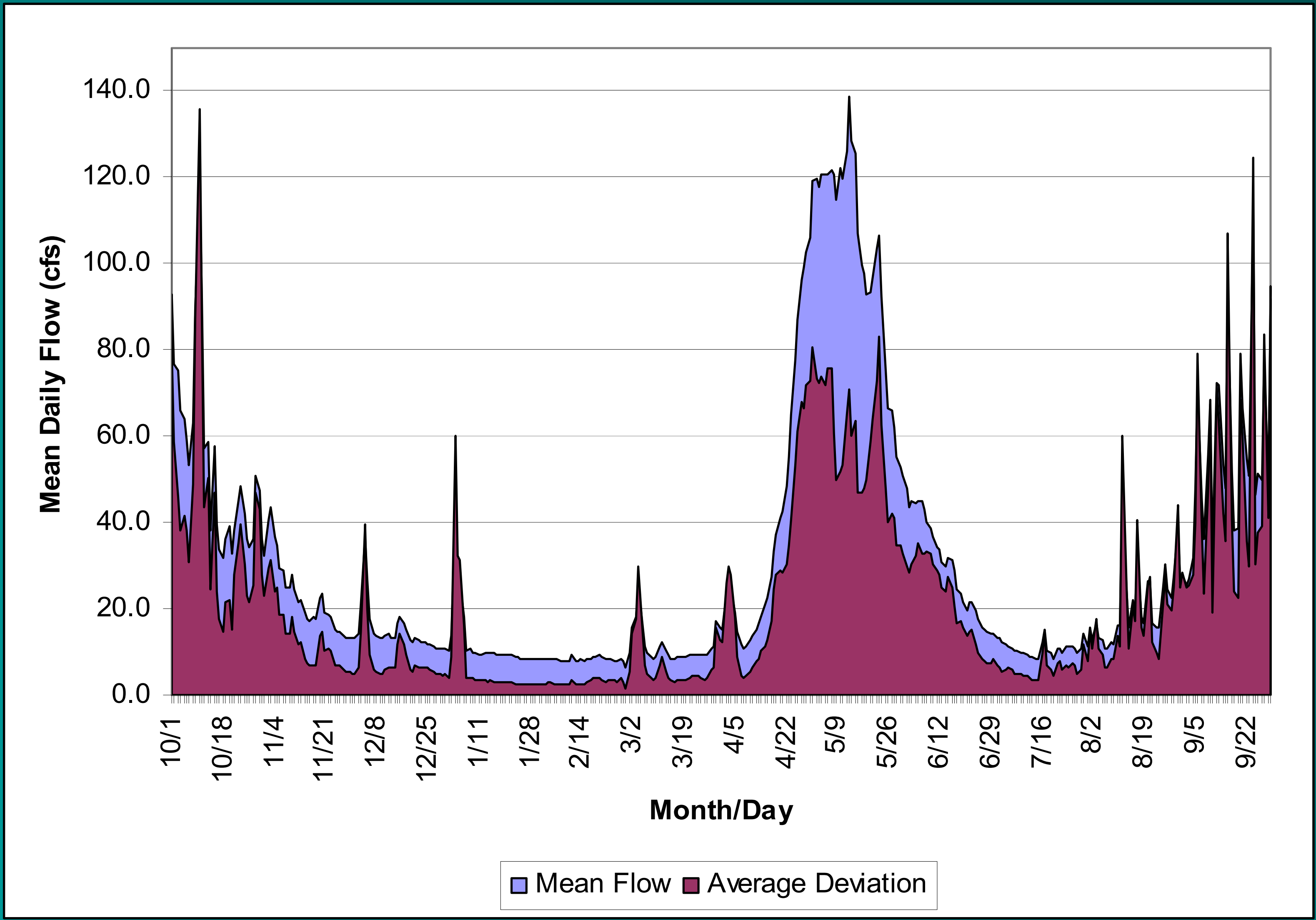
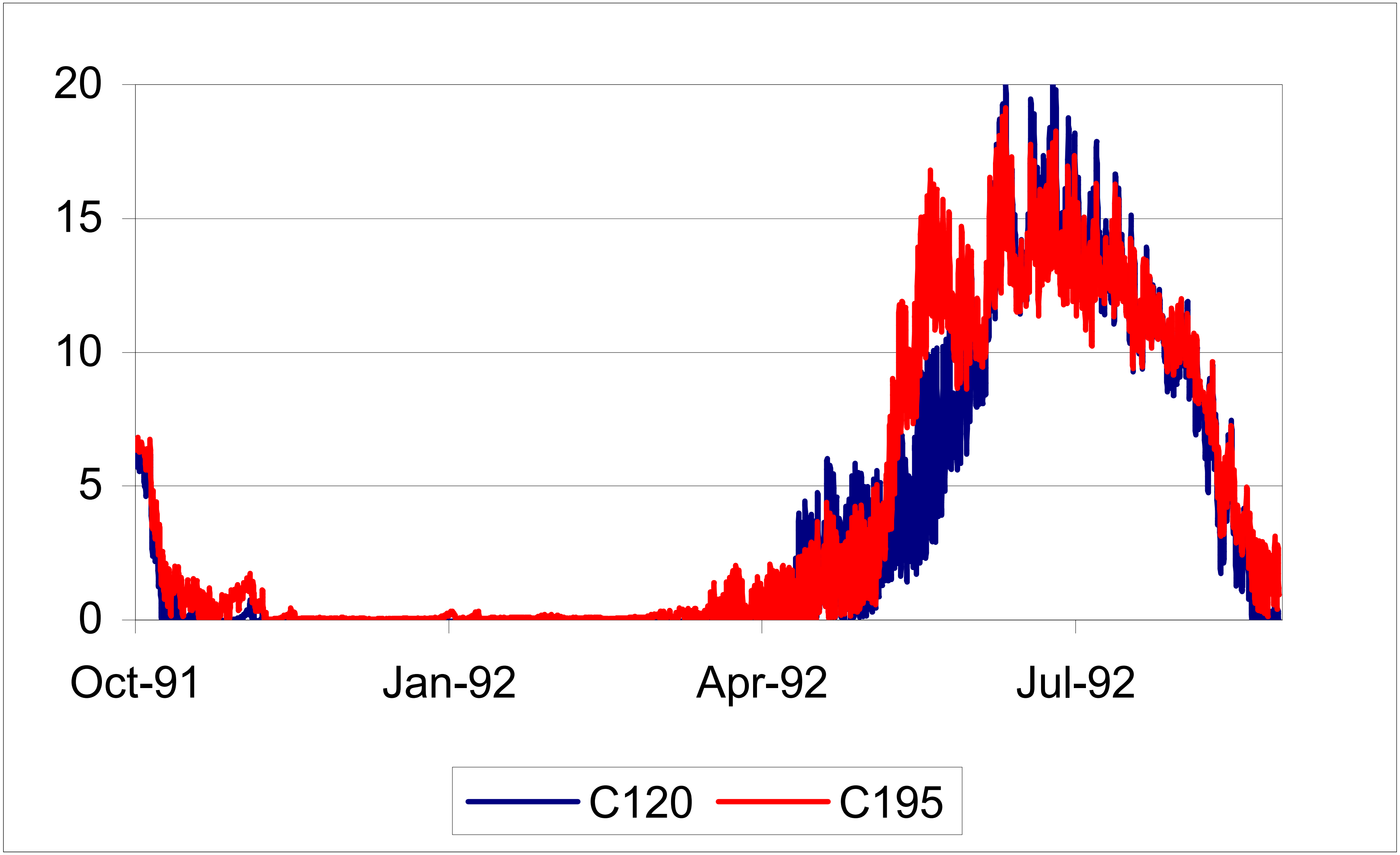


Daily Flow Variation at Station 180 – 2003 Creek

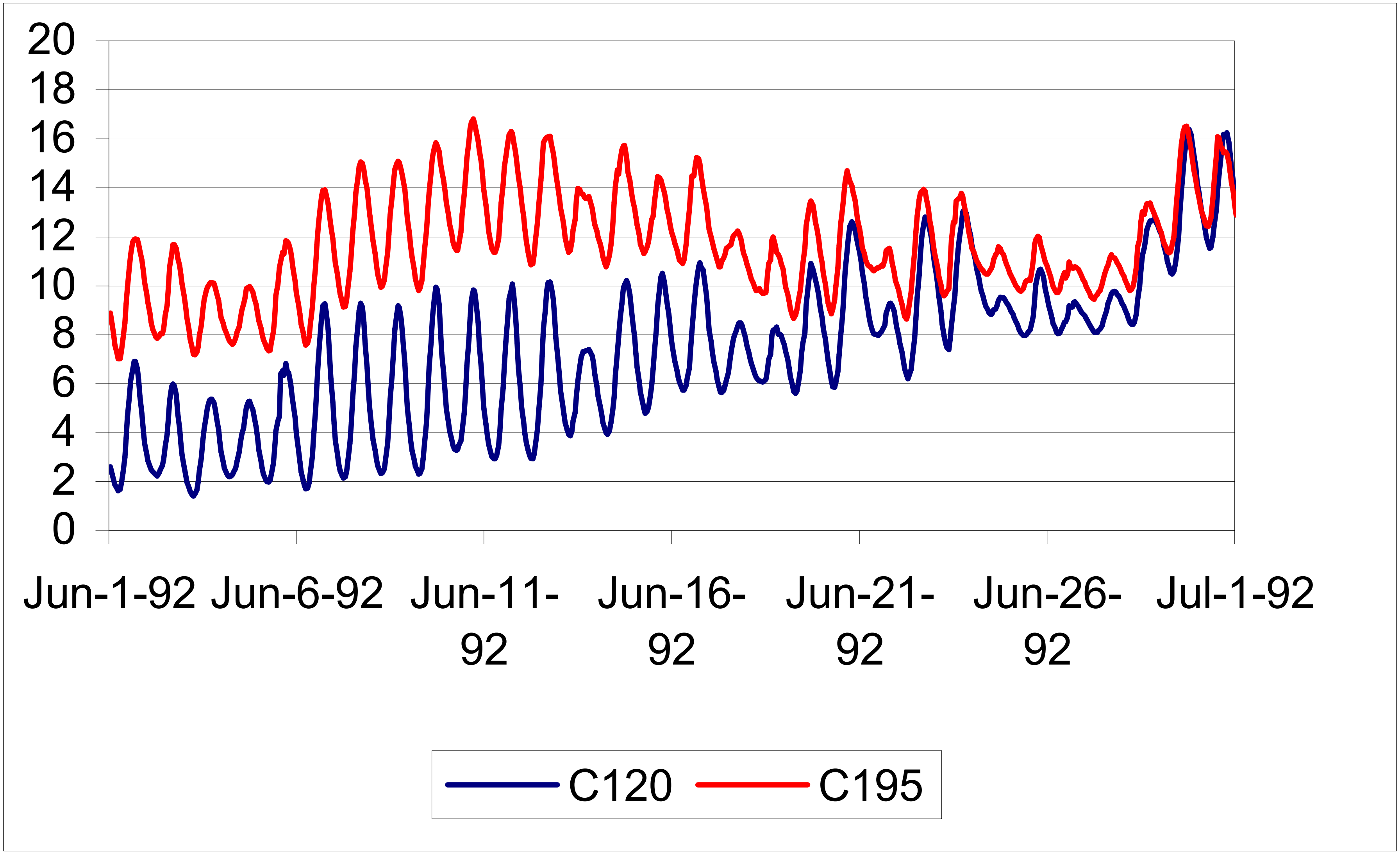


SURFACE WATER TEMPERATURE

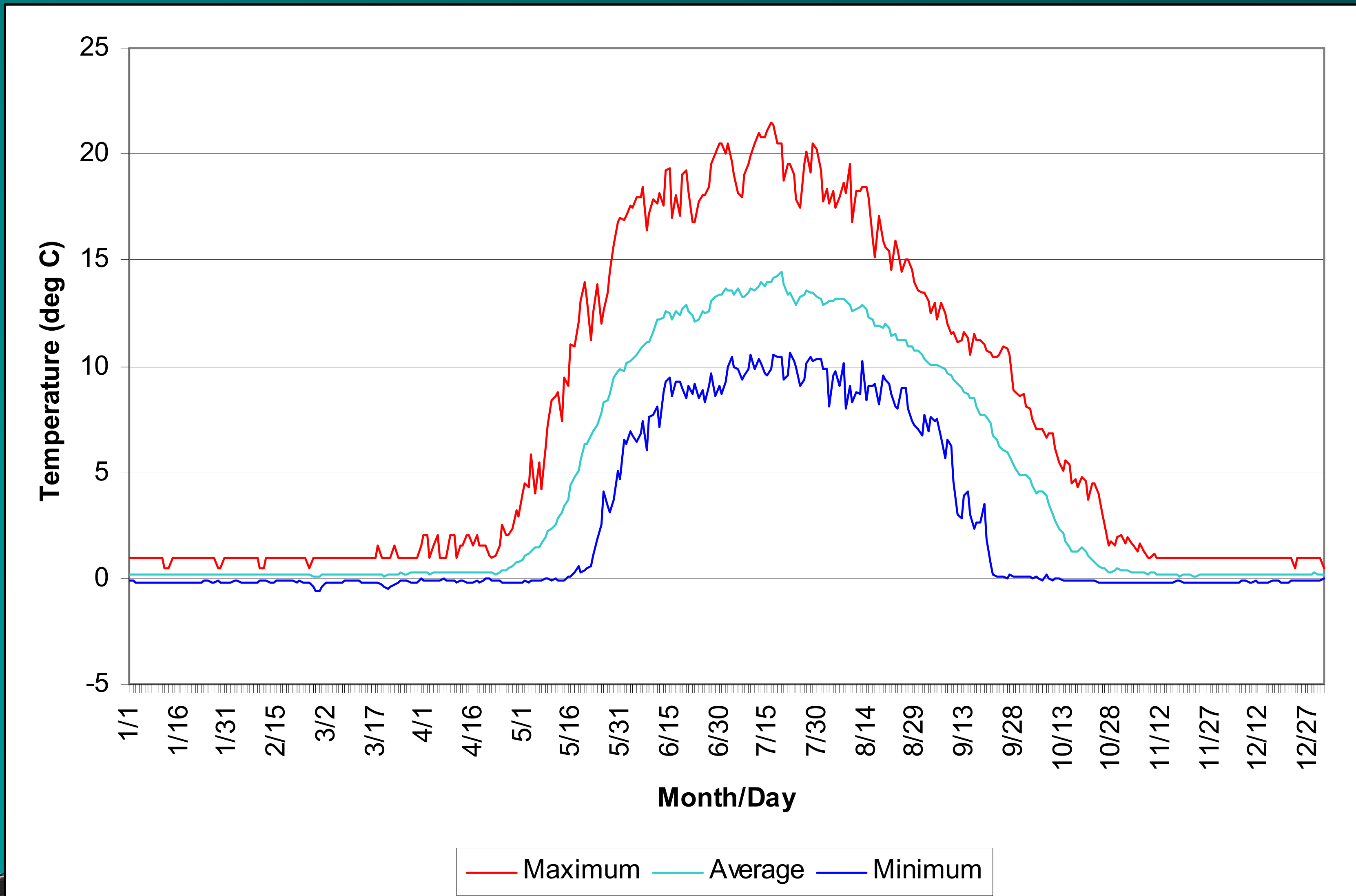
Annual Variation in Stream Temperature



Diurnal Variation in Daily Temperature



Daily Temperature at Station 180 on 2003 Creek



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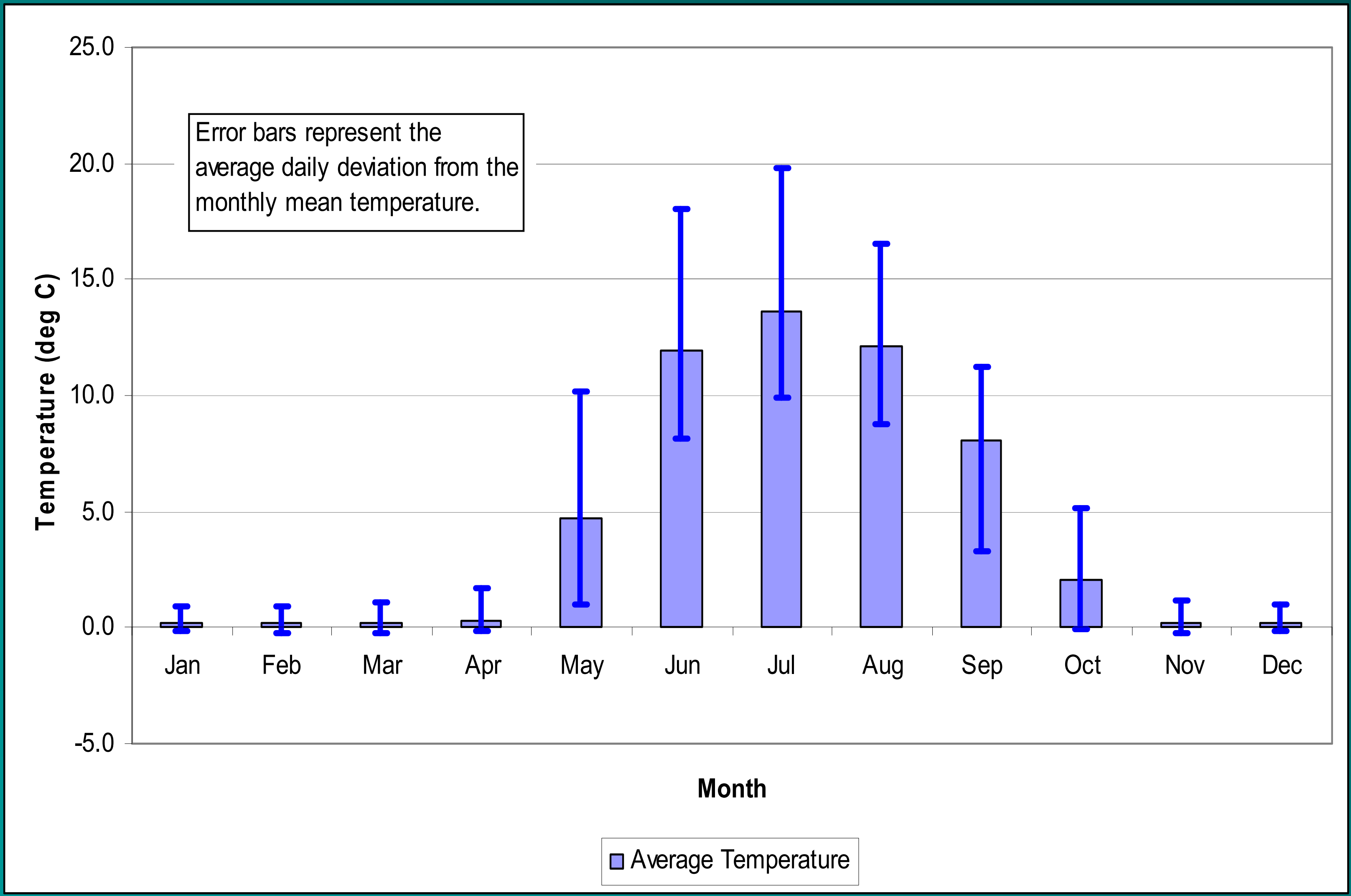
Daily Temperature Variation vs Mean at Station 180 on 2003 Creek



SURFACE WATER QUALITY

General Surface Water Quality

- Approximately 25 years of sampling data
- Water Quality in Chuitna and Tributaries reflects the geology of the area
- Bicarbonate Water Type
  - ➔ Low Hardness
  - ➔ Low Dissolved Solids (salts)
  - ➔ Neutral pH

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Surface Water Quality Characteristics

- Water Quality in All Tributaries and Chuitna is Similar
- Relatively High Levels of Dissolved Iron and Manganese
- Total Aluminum and Total Zinc become elevated with Suspended Sediments
  - ➔ Dissolved Metals Remain Low

Water Quality Data for Station 141 on 2003 Creek

Date	TSS	Hardness	Al - T	Cu - T	Cu - D	Fe - T	Fe - D	Mn - T	Mn - D	Zn - T	Zn - D
	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Aug-06	10	20	180	1	< 1	1,420	860	90	100	6	6
Feb-07	< 5	40	50	< 1	< 1	3,170	1,520	270	210	< 5	< 5
May-07	23	20	530	< 1	< 1	3,590	1,670	170	100	8	< 5
Jul-07	< 5	30	50	< 1	< 1	3,350	1,740	230	210	< 5	< 5
Oct-07	< 5	10	100	< 1	< 1	1,280	870	70	< 10	< 5	< 5
Feb-08	< 5	30	60	< 1	< 1	2,910	1,450	220	220	< 5	< 5
May-08	11	< 10	130	< 1	< 1	480	250	80	70	< 5	< 5
Aug-08	< 5	20	60	< 1	< 1	3,090	970	350	340	< 5	< 5
Sep-08	8	< 10	140	1	< 1	930	610	40	< 10	< 5	< 5

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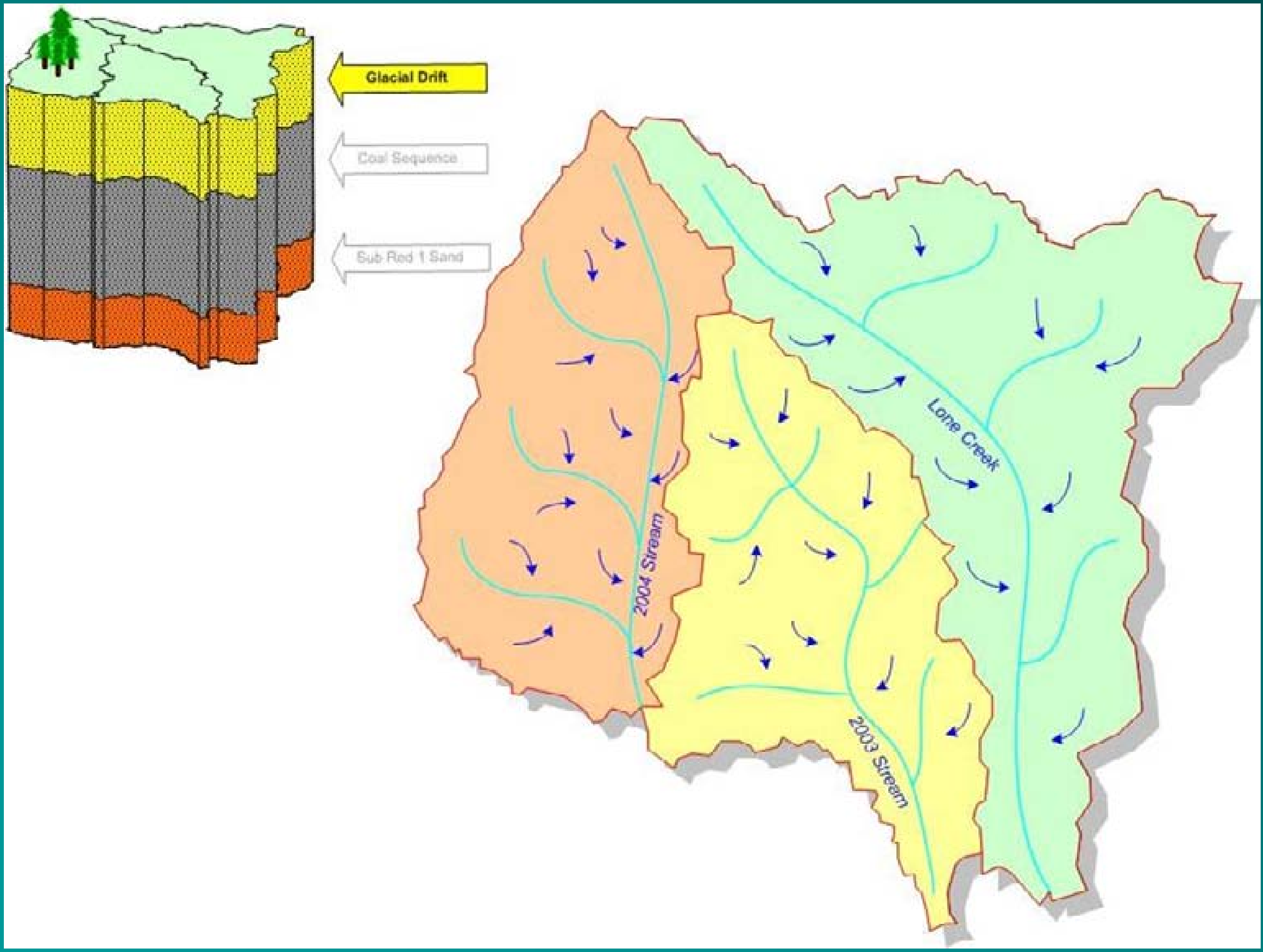
Groundwater System

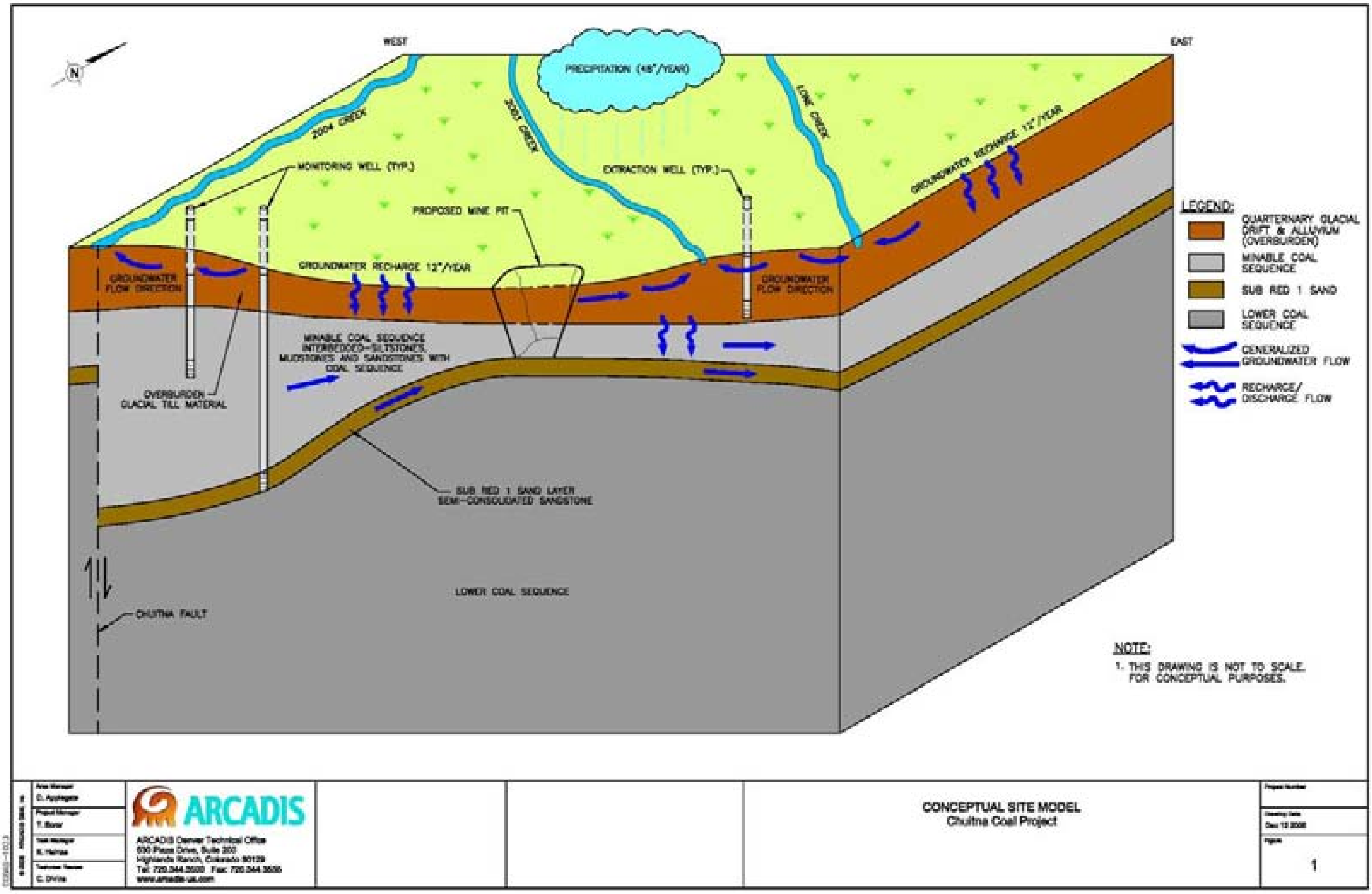
Ground Water

- Approximately 1/3 Annual Precipitation Infiltrates to Groundwater
  - ➔ Provides Base Flow
  - ➔ Remains Predominantly in the Uppermost Groundwater System – Glacial Drift and Alluvium

Groundwater Flow Direction from Glacial Drift



Groundwater Conceptual Site Model



Groundwater Quality

Groundwater Quality Characteristics (Continued)

- Similar to Surface Water Quality when TSS of the sample is low.
- Several sample results with very high TSS (1,000 mg/L)+
- High TSS = High total metals
  - ➔ Low metals when TSS is low
- Likely result of well construction/sampling issues
  - ➔ Well Construction and Development
  - ➔ Iron Precipitation on well casing

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Groundwater Quality

	TSS mg/L	Al (total) µg/L	Cu (total) µg/L	Fe (total) µg/L	Mn (total) µg/L	Zn (total) µg/L
Alluvium	< 5	< 20	< 1	1,100	200	9
	5-20 [b]	110	1	1,600	200	49
Drift	< 5	< 20	< 1	1,310	110	7
	20-May	500	2	2,030	200	9
	20-50	890	7	4,290	190	11
	> 50	11,320	41	59,800	2,430	203
Coal	< 5	< 20	< 1	600	100	< 5
	20-May	140	2	6,200	640	31
	20-50	160	3	8,800	1,430	230
	> 50	340	2	21,100	900	160
SubRed1	< 5 [c]	< 20	1	130	30	6

[a] TSS ranges compared to geometric mean of detected metals values, except as noted.
[b] Based on one sample with detected TSS greater than 5 mg/L.
[c] All samples for SubRed1 showed non-detect values for TSS (<5 mg/L).

Groundwater Pumping:

- Pumping primarily from Glacial Drift and Sub-Red 1 Sand
- Pump rates required for mining based on groundwater model (Arcadis)
- Goal is to offset baseflow reductions in adjoining streams with augmented flow from wells as best possible (reductions are minimal)

Project Water Balance

Goal: Determine Need for and Size of Impoundments to store and treat mine water

*Analysis based on wet years will control (maximize) impoundment sizing

Components:

- -Rainfall & Snowmelt
- -Evaporation
- -Surface Runoff
- -Infiltration ==> Baseflow & Groundwater Recharge
- -GW Pumping

Overall Approach

- **Determine Natural Condition Water Balance**
- **Estimate Changes Due to Disturbance**
- **Integrate natural and disturbed conditions with GW pumping and mine plan**
- **Predict monthly water management needs through Year 8 of mining**

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Sources of Water from Mining Area

- Precipitation and Runoff
  - ➔ Rainfall (Stormwater)
  - ➔ Snowmelt
- Groundwater Pumping
  - ➔ Dewatering of Glacial Drift
  - ➔ Reduce Hydrostatic Head in Red 1 Sand Formation
- There is no processing of the coal needed for this project. It will be excavated, crushed and shipped to the port.

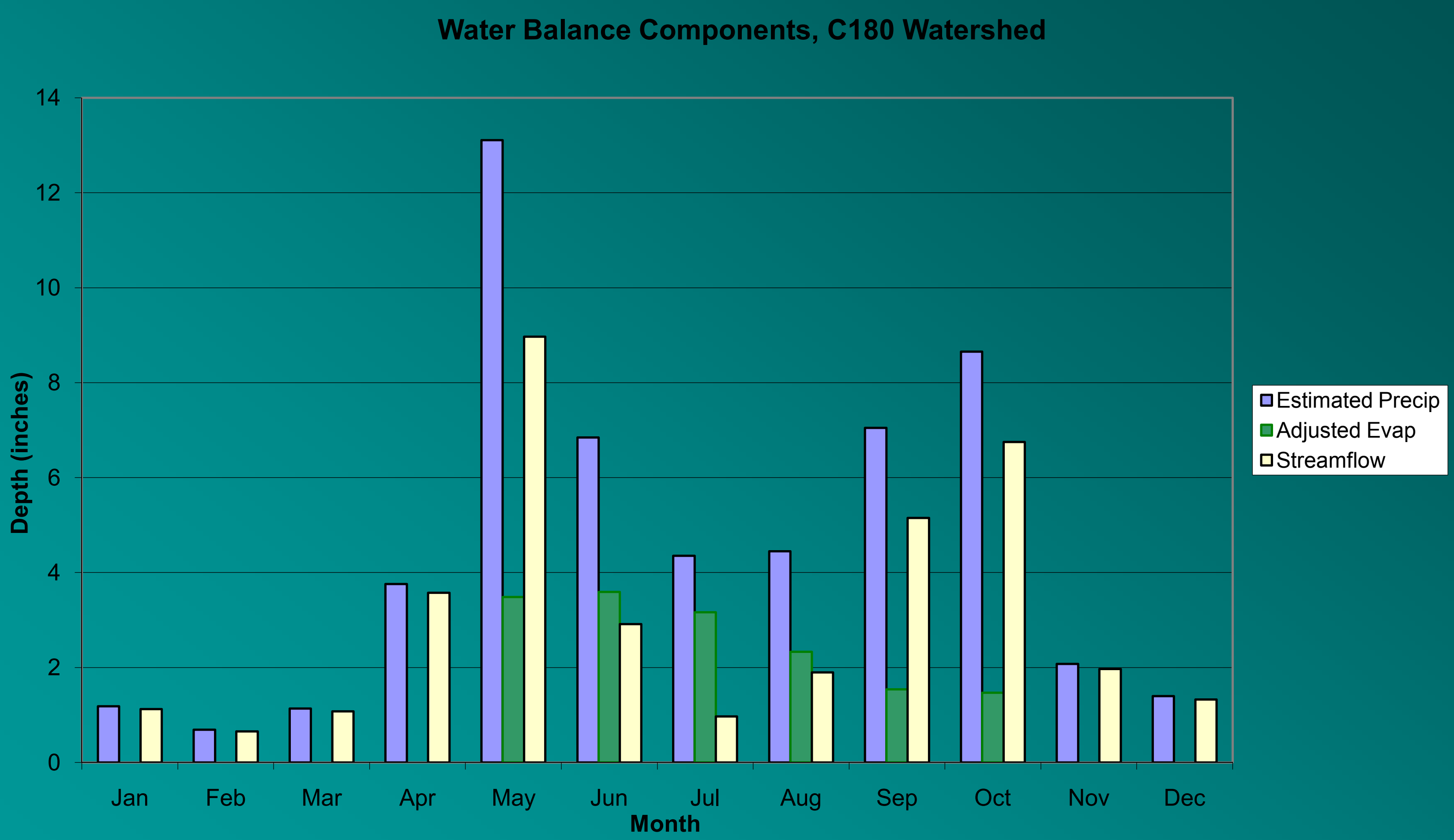
Water Balance: Natural Condition

Based on:

- **Streamflow from C180 record. Uses long flow record (24 calendar years at C180, 19-22 occurrences of each month)**
- **Evaporation from 1982 through 2008 average, Matanuska Station**
- **Infiltration to Deep GW Recharge assumed to be 5% of total precipitation**

This approach avoids uncertain rainfall & snow measurements

Water Balance: Natural Condition Components



Water Balance: Disturbed Areas

Used Natural Conditions Water Balance Run-off Coefficients as a starting point

Recomputed for disturbed land by eliminating 80% of evaporation losses

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Water Balance: Runoff Coefficient Table

Runoff Coefficient Derivation

Month	Flow at C180		Adjusted Evap. (in)	Losses to Groundwater (in)	Estimated Precip. (in)	Runoff Coefficient		Runoff Depth	
	(cfs)	(inches)				Natural	Disturbed	Natural	Disturbed
Jan	14.0	1.13	0	0.06	1.18	0.95	0.95	1.13	1.13
Feb	9.0	0.65	0	0.03	0.69	0.95	0.95	0.65	0.65
Mar	13.4	1.08	0	0.06	1.13	0.95	0.95	1.08	1.08
Apr	45.8	3.57	0	0.19	3.76	0.95	0.95	3.57	3.57
May	111.2	8.97	3.49	0.66	13.11	0.68	0.90	8.97	11.75
Jun	37.4	2.92	3.59	0.34	6.85	0.43	0.85	2.92	5.79
Jul	12.0	0.97	3.16	0.22	4.35	0.22	0.80	0.97	3.50
Aug	23.5	1.90	2.33	0.22	4.45	0.43	0.85	1.90	3.76
Sep	66.0	5.15	1.54	0.35	7.04	0.73	0.91	5.15	6.38
Oct	83.7	6.75	1.47	0.43	8.65	0.78	0.92	6.75	7.93
Nov	25.3	1.97	0	0.10	2.07	0.95	0.95	1.97	1.97
Dec	16.5	1.33	0	0.07	1.40	0.95	0.95	1.33	1.33
Total	457.7	36.38	15.58	2.73	54.69	0.67	0.89	36.38	48.84

Water Balance: Integration with Mine Plan

- Compute monthly water yield from disturbed and undisturbed areas reporting to each structure based on effective precipitation and runoff coefficients
- Add groundwater pumping volumes
- Storage Requirments Based On:
  - Total Water Handled
  - Season of the Year
  - Instream Flow Capacities
  - NPDES Permit Requirements and Limits

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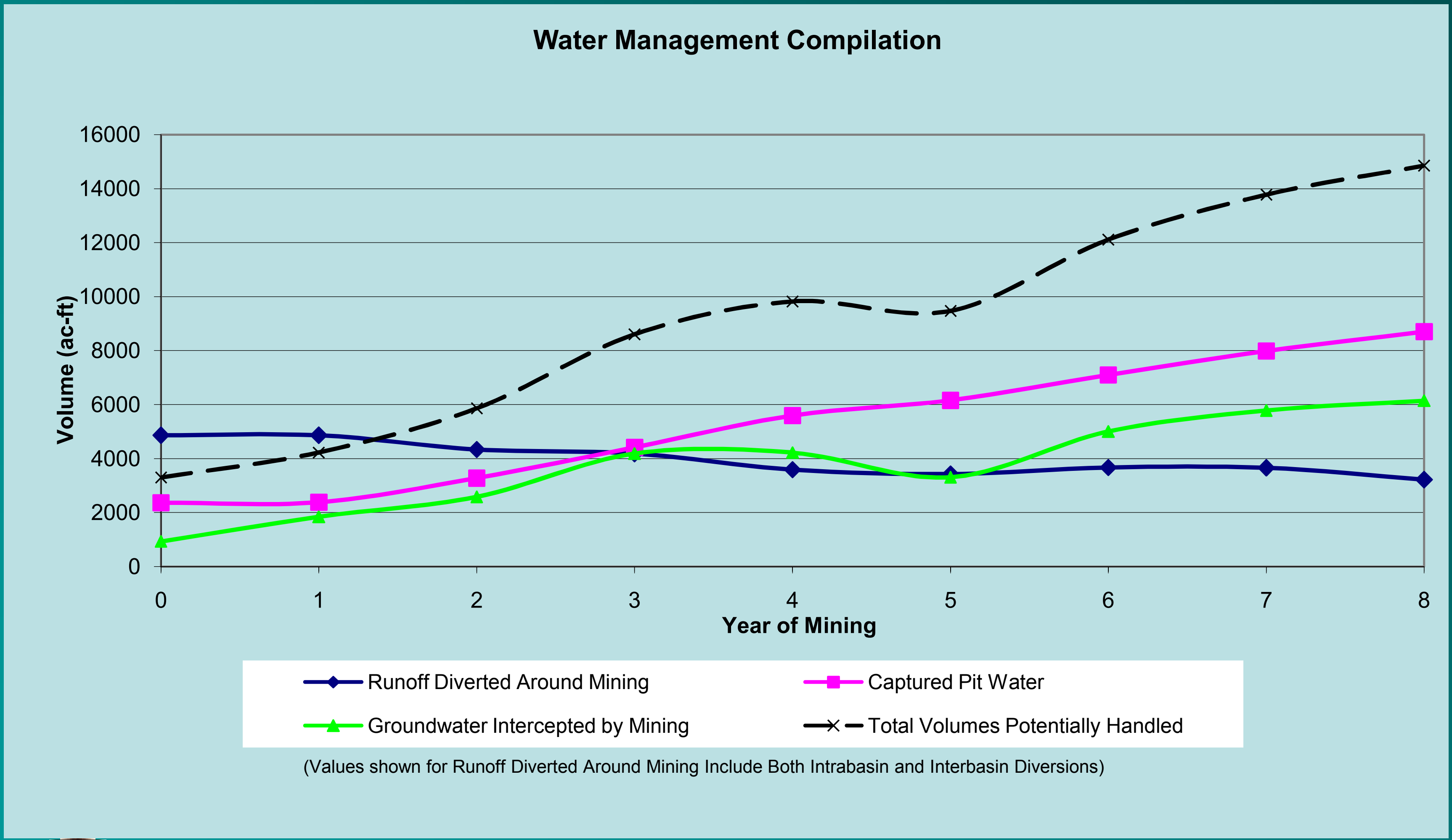
Water Balance Compilation



Mining Operation

Typical Coal Mining Sequence

How Water Is Managed – **Major** Control Methods

- **Clean Water Diversion**
  - ➔ **Keeps Water from Undisturbed areas away from mining**
- **Groundwater Wells**
  - ➔ **Pumped to dewater before mining**
- **Settling/Storm Water Ponds**
  - ➔ **Prevents erosion and sediments from leaving mining area**
- **Infiltration Basins**
  - ➔ **Used to Return Groundwater to support Stream Baseflow and Groundwater Recharge**
- **On site Storage**
  - ➔ **Surface Storage Pond**

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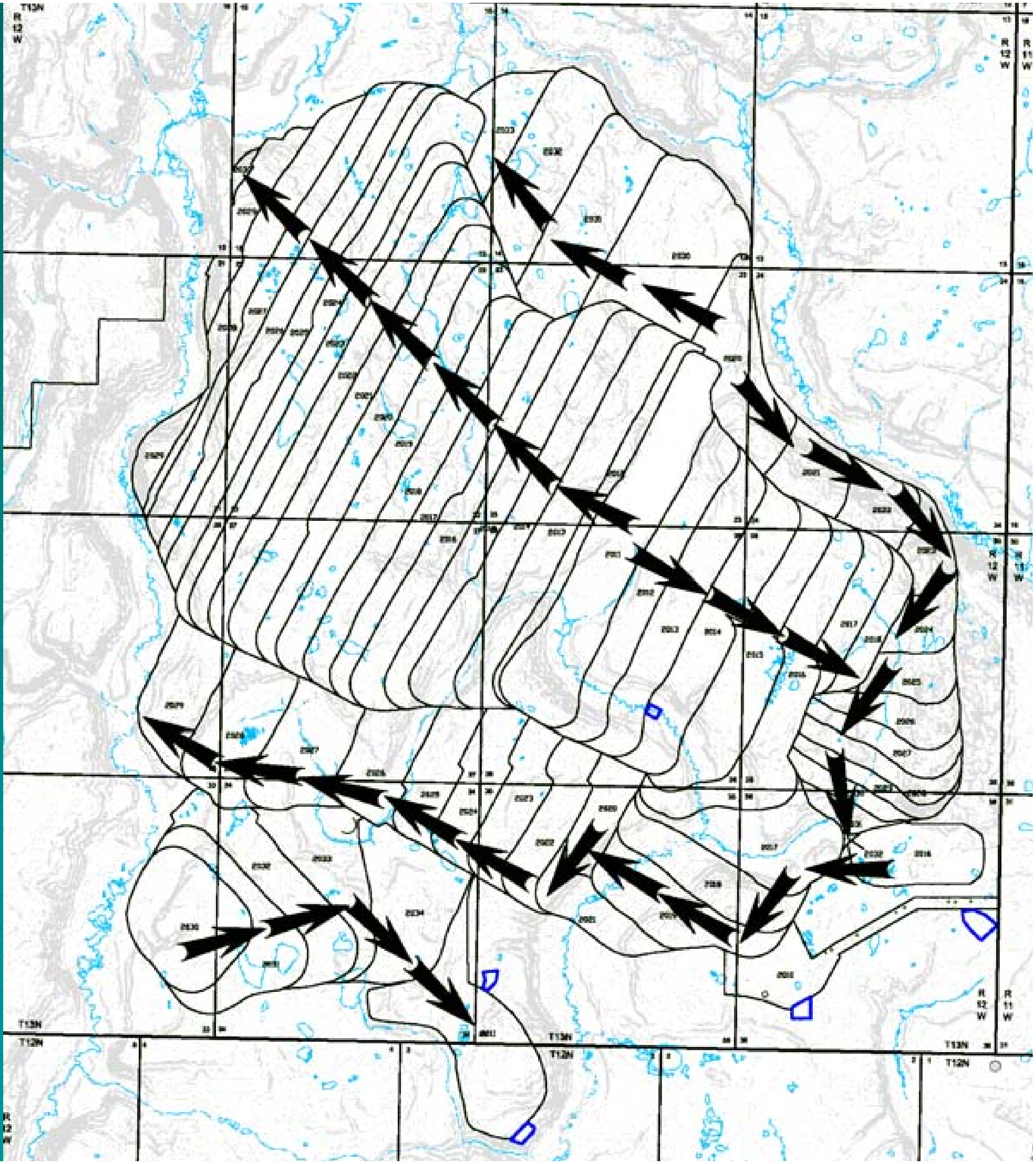
Mine Plan



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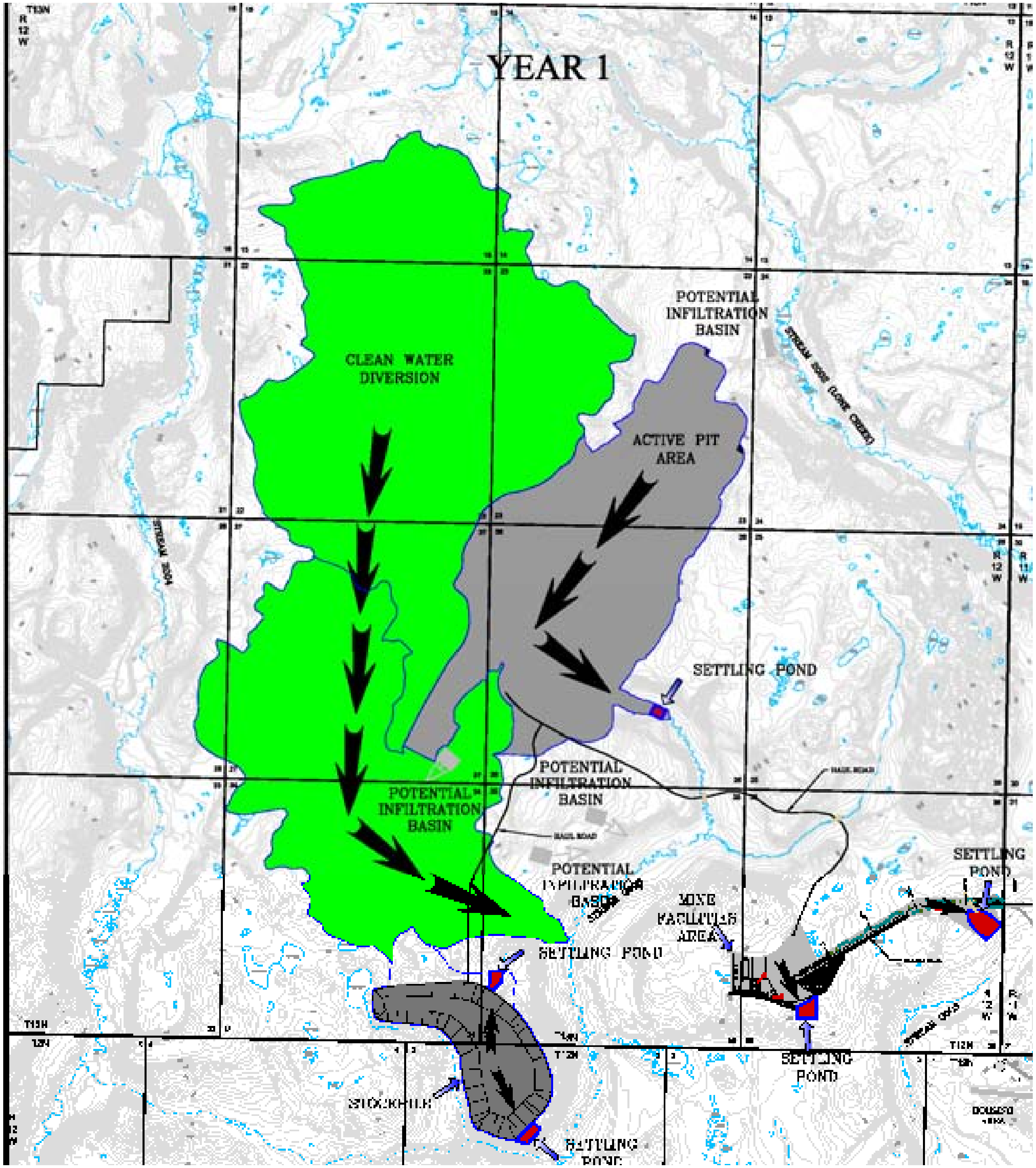
General Water Control Plan Year 1 of Mining



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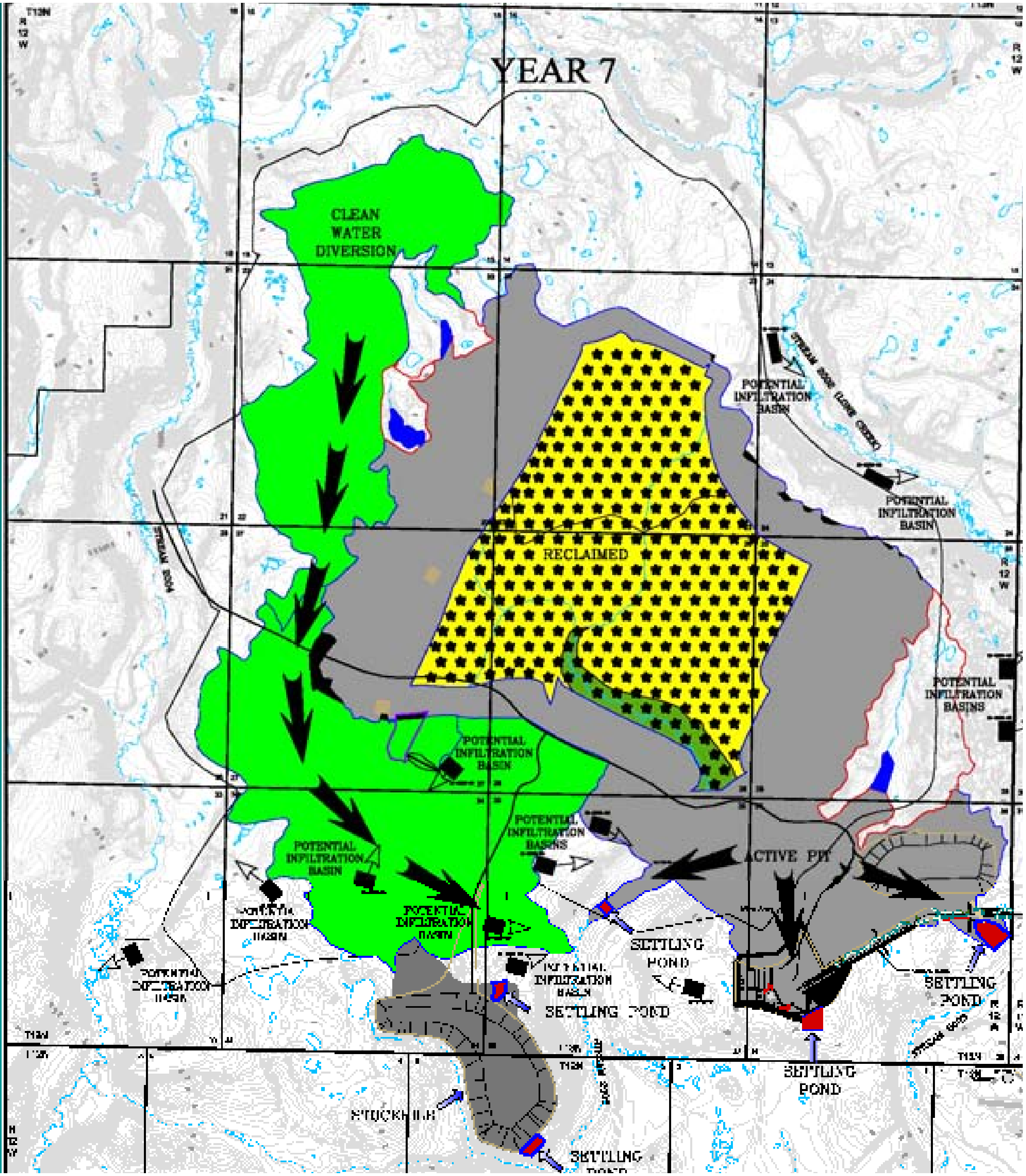
General Water Control Plan Year 7 of Mining



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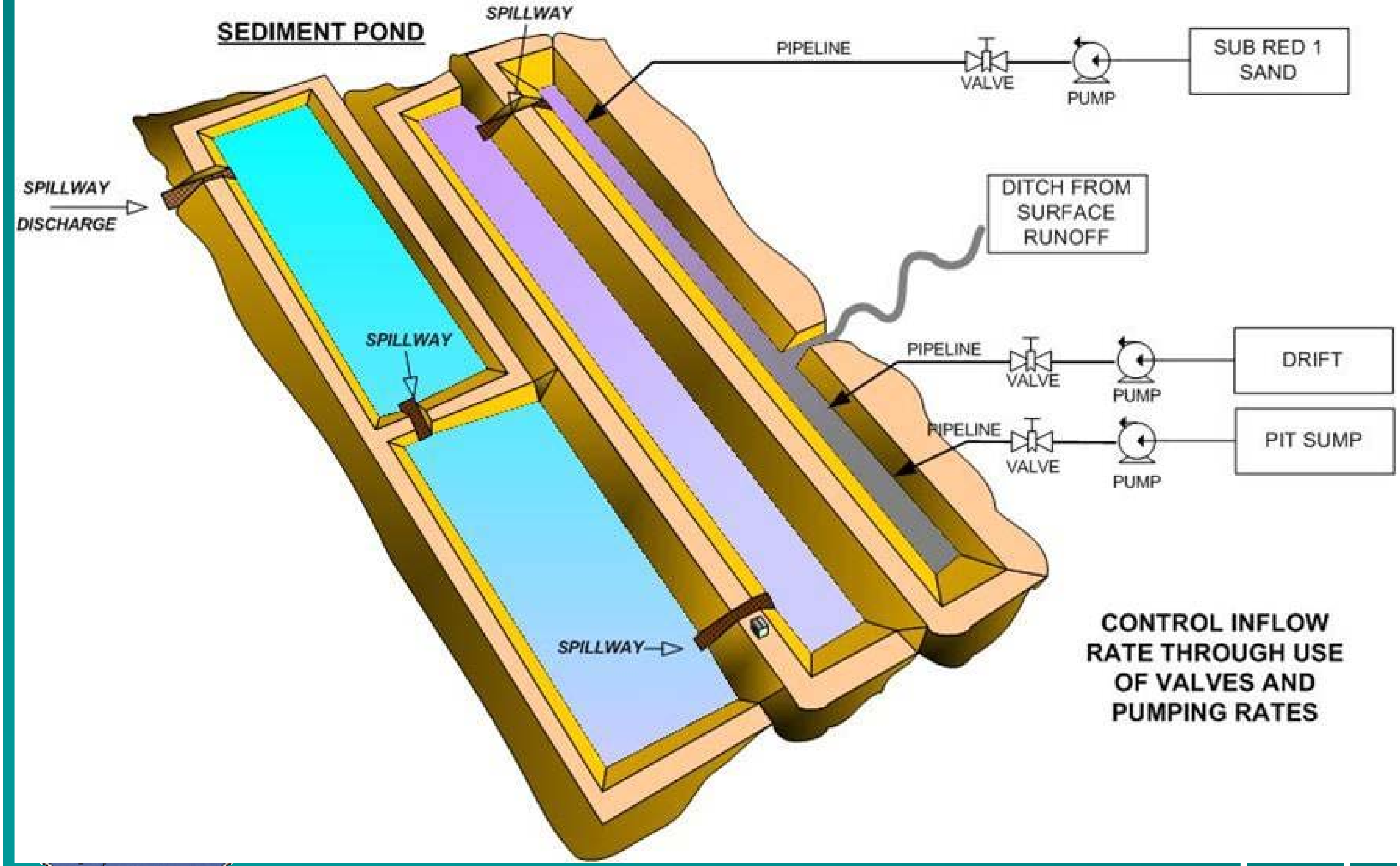
Settling Pond Conceptual Design



CONTROL INFLOW RATE THROUGH USE OF VALVES AND PUMPING RATES

How Water Is Managed – **Local** Control Methods

- Silt Fences
- Hay Bales
- Check Dams
- Grading Controls
- Vegetation
- Sediment Traps or Depressions

All These Methods Will Be Used to Control Flow Velocity and Erosion Throughout the Mine Site

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Agency Input

- **Water Control and Permitting Designed to Maintain Surface Water Flows and Quality**
- **What Key Items Does the Water Plan Need To Address?**
  - ➔ **Flow**
  - ➔ **Temperature?**
  - ➔ **Others?**

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Next Steps

- **Final Development and Review of Water Balance**
- **Initial Design and Locations for Site Water Control**
- **Submit Final Draft Conceptual Water Management Plan to Agencies for Review**
- **Begin Developing Detailed Plan**
- **Review Workshop with Agencies on Draft Detailed Plan**
- **Revise and Submit Final Detail Water Management Plan**

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