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WALKER MINE REPORT

OCTOBER 5, 1957
L. E. TRUMBULL

SUMMARY

WALKER MINE, PLUMAS COUNTY, HAS BEEN INOPERATIVE SINCE 1942, BUT CONTINUES TO IMPAIR WATERS OF LITTLE GRIZZLY CREEK AND INDIAN CREEK THROUGH DISCHARGES OF TOXIC MATERIALS AND SILT. RESTORATION OF LITTLE GRIZZLY CREEK, AS A RECREATIONAL AREA, AND PROTECTION OF IRRIGATION AND RECREATIONAL WATER USES IN INDIAN VALLEY MAY BE APPROACHED BY A) ESTABLISHMENT OF JURISDICTIONS; B) SETTING OF REQUIREMENTS; AND C) COOPERATIVE ACTION AMONG THE SEVERAL INTERESTED PARTIES.

WALKER MINE, PLUMAS COUNTY
WATER POLLUTION STUDY

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1. DESCRIPTION OF AREA:

WALKER MINE LIES IN PLUMAS COUNTY ABOVE TAYLORSVILLE. IT IS SITUATED NEAR THE TOP OF A MOUNTAIN AT AN ELEVATION OF 6200 FEET. MINE PORTAL AND STRUCTURES LIE IN A SLOPING BOWL WHICH IS THE SOURCE OF "WALKER" CREEK. NUMEROUS SPRINGS ORIGINATE AROUND THE PERIPHERY OF THIS BOWL, WITH ALL WATERS BEING OF EXCELLENT QUALITY.

THIS REGION IS GENERALLY FORESTED WITH PINE AND FIR, WITH ROCK OUTCROPS SHOWING ON MOUNTAIN TOPS. MUCH OF THE TIMBER IS SECOND GROWTH, AS THE MINE OPERATIONS CONSUMED MUCH OF THE AVAILABLE TIMBER. ALSO A SAW MILL WAS OPERATING ON MINE PROPERTY UP TO 1952, SAWING TIMBER TAKEN FROM MINE PROPERTIES.

COUNTY RECORDS SHOW THAT 764 ACRES OF PATENTED LAND ARE LISTED IN THE WALKER MINE HOLDINGS, WITH SEVERAL TIMES THIS ACREAGE HELD IN ADJOINING MINING CLAIMS. THE REGION IS FAIRLY ISOLATED AND FINDS ITS MAJOR USE AS A RECREATIONAL AREA, PARTICULARLY FOR DEER HUNTING. LITTLE GRIZZLY CREEK, DRAINING THE AREA, IS GENERALLY REGARDED AS BARREN, AND FEW FISHERMEN NOW PLY THE STREAM.

2. WATERS OF THE AREA: Streams affected by Mine Drainage

WALKER MINE AREA IS THE SOURCE OF NUMEROUS SPRINGS WHICH FORM A TRIBUTARY TO LITTLE GRIZZLE CREEK. FOR WANT OF A BETTER NAME, THIS TRIBUTARY IS HEREIN CALLED "WALKER CREEK". WALKER CREEK TRAVERSES THE TAILINGS DEPOSIT AND JOINS LITTLE GRIZZLY CREEK JUST ABOVE BROWNS CABIN, ABOUT 1.5 MILES BELOW THE MINE PORTAL. LITTLE GRIZZLY CREEK TUMBLES THROUGH SOME 10 MILES OF NARROW CANYON TO JOIN INDIAN CREEK ABOUT 5 MILES ABOVE TAYLORSVILLE. WATER IS DIVERTED FROM INDIAN CREEK, JUST ABOVE TAYLORSVILLE INTO THE IRRIGATION CANALS OF THE AMERICAN AND INDIAN VALLEY SOIL CONSERVATION DISTRICT.

MR. HUMPHREY OF GREENVILLE, IS A MEMBER OF THE BOARD OF DIRECTORS OF THIS DISTRICT AND PROVIDED INFORMATION ON THE DISTRICTS OPERATION. HE INDICATED THAT, AT THE PRESENT TIME, SILTATION IN DISTRICT CANALS IS NOT SEVERE. HE ALSO NOTED THAT, DURING THE HIGH WATER PERIOD, INDIAN CREEK IS QUITE TURBID ABOVE LITTLE GRIZZLY CREEK, AND THE DISTRICT DOES NOT FEEL THAT WALKER MINE TAILINGS ARE PRESENTLY A MAJOR FACTOR IN CANAL SILTATION. HE DID NOT FEEL THE DISTRICT WOULD CONTRIBUTE TOWARDS A COOPERATIVE SOLUTION OF WALKER MINE AREA PROBLEMS.

FISH AND GAME AND SPORTSMANS ORGANIZATIONS ARE INTERESTED IN RESTORING FISH POPULATION TO LITTLE GRIZZLY CREEK, SAID TO HAVE BEEN EXCELLENT TROUT WATERS AT ONE TIME. THE STREAM CURRENTLY SUPPORTS TROUT ABOVE THE WALKER MINE BUT IS BARREN MOST OF THE YEAR IN THE LOWER REACHES. TROUT DO MOVE UP INTO THIS CREEK DURING THE LATE FALL MONTHS WHEN TOXIC MINE WASTES ARE AT MINIMUM FLOW.

A NUMBER OF FISH KILLS HAVE BEEN REPORTED IN INDIAN CREEK BELOW THE CONFLUENCE OF LITTLE GRIZZLY CREEK. MEAGER DATA AVAILABLE INDICATE

FISH DEATHS WERE PROBABLY DUE TO SUSPENDED MATERIALS, POSSIBLE ABRASIVE SOLIDS FROM THE WALKER MINE TAILINGS DUMP. CATFISH AND CARP APPARENTLY SUFFER GREATEST MORTALITY, WITH TROUT POPULATION IN INDIAN CREEK NOT SHOWING ANY PARTICULAR DISTRESS.

IN JULY, 1947, DEPARTMENT OF FISH AND GAME PLANTED 5000 TROUT IN LITTLE GRIZZLY CREEK, SOME 5 MILES DOWNSTREAM FROM WALKER MINE. ALL FISH DIED WITHIN 24 HOURS. AGAIN IN 1949, TROUT IN A CAGE WERE PLACED IN LITTLE GRIZZLY CREEK AT BROWNS CABIN; THESE TROUT WERE ALL DEAD WITHIN THE SPACE OF 1 HOUR.

INSPECTION OF LITTLE GRIZZLY CREEK INDICATES THE COMBINATION OF SAND DEPOSITS AND TOXIC MINE DRAINAGE HAS CAUSED A STERILE STREAM CONDITION. PLANT AND AQUATIC LIFE APPEAR TO BE ALMOST TOTALLY ABSENT, ALTHOUGH SHRUBBERY AND TREES LINING THE STREAMS APPEAR HEALTHY.

WALKER MINE WORKINGS SURFACE ON THE OTHER SIDE OF THE RIDGE FROM LITTLE GRIZZLY CREEK, WHERE DRAINAGE IS INTO WARD CREEK. WARD CREEK EMPTIES INTO INDIAN CREEK ABOUT 2 MILES ABOVE THE CONFLUENCE OF LITTLE GRIZZLY CREEK. IT IS REPORTED THAT MINE WATERS WERE PUMPED INTO WARD CREEK DURING MINE OPERATIONS, AND THAT WARD CREEK WAS BARREN OF FISH LIFE DURING THIS PERIOD. THERE IS NO INDICATION THAT MINE WASTES HAVE OVERFLOWED INTO THIS DRAINAGE IN RECENT TIMES.

3. MINE WATERS: Drainage

3A. MINE OWNERSHIP:

OWNERSHIP OF MINE PROPERTIES IS QUITE CONFUSED AT THE PRESENT TIME, ALTHOUGH IT CURRENTLY WOULD APPEAR THE ROBERT E. BARRY, 29 HEREFORD ROAD, BRONXVILLE, NEW YORK, REPRESENTS THE PROPERTY OWNERS.

TITLE TO THE PROPERTY APPEARED TO RESIDE CLEARLY WITH ANACONDA COPPER UP TO 1942, WHEN THE OPERATION OF THE MINE CEASED. IT IS REPORTED THAT ANACONDA SOLD TO AN INVESTMENT GROUP WHO AUCTIONED OFF THE PROPERTIES ABOUT 1946. ROBERT E. WILSON, APPARENTLY BID IN MOST OF THE ASSETS, USING THE FINANCIAL BACKING OF A MR. CAREY, SAID TO HAVE BEEN PRESIDENT OF THE YALE AND TOWNE COMPANY.

AT THIS POINT, THE TRANSACTIONS BECOME QUITE COMPLICATED AND CONFUSED. IT IS REPORTED WILSON FAILED TO MEET ALL PURCHASE COMMITTMENTS, BUT PROCEEDED TO ESTABLISH SUBSIDIARY ORGANIZATIONS, INCLUDING PLUMAS LAND CORPORATION, PLUMAS MINING CORPORATION, AND PLUMAS LUMBER CORPORATION.

IT IS REPORTED THAT THE MORE VALUABLE LANDS, BUILDINGS, EQUIPMENT AND HOUSING WERE TRANSFERRED TO THESE CORPORATIONS, WHOSE CONTROLLING OWNERSHIP WAS REPORTEDLY ESTABLISHED BY WILSON, WITH DUBIOUS AUTHORITY, AS WILSON AND MRS. WILSON.

ABOUT 1948, CAREY MOVED TO TAKE OVER OPERATION FROM WILSON, BUT DIED IN AN AUTO ACCIDENT SHORTLY THEREAFTER. ROBER R. BARRY, AND WILFORD CAREY, CAME ONTO THE SCENE AT THIS POINT AS ADMINISTRATORS FOR THE ESTATES OF W. GIBSON CAREY, JR., PLUMAS LAND CORPORATION, ETAL.

IN 1948, WILSON ENTERED SUIT IN SUPERIOR COURT TO DETERMINE RIGHTS AND INTERESTS IN WALKER MINE PROPERTIES. LATER IN 1948, WILSON BY AFFIDAVIT RELEASED HIS INTERESTS IN TIMBER RIGHTS ON THE PATENTED LANDS.

IN MAY, 1957, THE SUPERIOR COURT DISMISSED WILSON'S SUIT (OF 1948) FOR FAILURE TO PROSECUTE WITH REASONABLE DILIGENCE, AND RULED A JUDGEMENT OF DISMISSAL BE FILED AGAINST R. P. WILSON.

ON MAY 31, 1957, R. P. WILSON, APPEALED THIS DECISION TO THE DISTRICT COURT OF APPEALS, THUS OWNERSHIP AND INTERESTS OF SEVERAL PARTIES REMAINS IN LITIGATION.

BASED UPON THE MAY 1957, DECISION OF THE COURT, AND UPON PERUSAL OF WILSON'S CHARGES AGAINST BARRY, IT APPEARS THAT BARRY MUST BE LOGICALLY CONSIDERED THE LEGAL OWNER OF WALKER MINE PROPERTY. IT IS TO BE NOTED, HOWEVER, THAT SALE OF TIMBER AND A PROPOSED TUNNEL TO TAP WALKER MINE DEPOSITS (TO BE DRIVEN FROM GENESSEE) ARE CURRENTLY HELD UP BECAUSE TITLE GUARANTEE COMPANIES WILL HAVE NOTHING TO DO WITH WALKER MINE PROPERTIES.

COUNTY RECORDS INDICATE THAT BARRY HAS BEEN PAYING TAXES ON THE 764 ACRES OF PATENTED GROUND WHICH INCLUDES THE MILL SITE AND MAJOR DEPOSIT AREAS.

IN A LETTER DATED SEPTEMBER 15, 1957, MR. R. R. BARRY HAS ACKNOWLEDGED THAT HE REPRESENTS THE WALKER MINE OWNERS.

3B. <u>MINE DESCRIPTION AND SOURCE OF WATERS</u>:

WALKER MINE WAS ORIGINALLY LOCATED AS AN ORE OUTCROP ON TOP OF THE RIDGE. RATHER EXTENSIVE MINING WAS CARRIED ON AT THIS POINT, WITH ORE BEING TRAMMED TO THE MILL AT WALKER MINE. THIS MINING AREA IS LOCATED ABOVE THE SO-CALLED "CENTRAL ORE-BODY" AND MAY BE IDENTIFIED BY THE "GLORY-HOLE". IT WOULD APPEAR THAT SNOW MELT IN THIS AREA WILL CONTRIBUTE CONSIDERABLE WATER TO THE WALKER MINE UNDERGROUND SYSTEM.

AT A LATER DATE, A TUNNEL WAS DRIVEN FROM THE MILL SITE TO TAP THE ORE BODIES. THIS TUNNEL IS REPORTED TO HAVE ENCOUNTERED 200 FEET OF CLAY AND DECOMPOSED GRANITE, WHICH SECTION WAS TIMBERED, PRIOR TO ENTERING SOLID ROCK. THIS TUNNEL THEN TRAVELLED SOME 2000 FEET TO TIE INTO THE WORKING LATERAL, SOME 8000 FEET LONG, WHICH CROSSED THROUGH THE 5 MAJOR ORE BODIES, THE SOUTH, CENTRAL, NORTH, 712, AND PIUTE.

THREE OTHER LATERALS ARE REPORTED, ONE 300 AND ONE 700 FEET BELOW THE MAIN TUNNEL, AND ANOTHER 600 FEET ABOVE THE MAIN TUNNEL. IN ALL, SOME 15 TO 20 MILES OF TUNNEL ARE SAID TO EXIST. IN 1928, A RAISE WAS DRIVEN FROM THE PIUTE ORE BODY TO THE SURFACE, AND VENTILATION EQUIPMENT PROVIDED AT THIS POINT.

THE 5 ORE BODIES WERE EXTENSIVELY STOPED, WITH RATHER TREMENDOUS CAVITIES LEFT IN THE BOWELS OF THE EARTH. ESTIMATED CAVITY VOLUMES ARE:

SOUTH ORE BODY:	2.0	MILLION CU. FEET.
CENTRAL:.	17.0	MILLION CU. FEET.
NORTH:	192	MILLION CU. FEET.
712:	20.	MILLION CU. FEET.
PIUTE:	300	MILLION CU. FEET
TOTAL	531	MILLION CUBIC FEET.

IN MORE UNDERSTANDABLE FIGURES, THIS REPRESENTS A ROOM 1 SQUARE MILE IN AREA AND ABOUT 20 FEET HIGH. MUCH OF THIS SPACE MAY BE FILLED WITH WASTE ROCK, BUT IT IS EVIDENT FROM THESE FIGURES THAT A TREMENDOUS EXPOSURE OF ORES TO OXIDATIVE CONDITIONS DOES EXIST.

FORMER MINE EMPLOYEES REPORT THAT UNDERGROUND AREA HAD MANY DRIPS AND SEEPS FROM OVERHEAD. GROUND SURFACE VARIED FROM 400 TO 900 FEET ABOVE THE MAIN TUNNEL, THUS WATER DRIPS WERE RATHER CLOSELY ASSOCIATED WITH SNOW MELT AND SURFACE RUN-OFF. APPARENTLY WORKINGS WERE FAIRLY DRY IN LATE FALL AND EARLY WINTER.

PUMPS WERE REQUIRED TO KEEP LOWER LEVELS EXPOSED, AND CONTINUOUS PUMPING OF LARGE VOLUMES OF WATER IS REPORTED. THIS PUMPING WAS OF SUCH EXTREME IMPORTANCE THAT THE UTILITY COMPANY SUPPLYING THE MINE WAS FACED WITH A SEVERE COST PENALTY FOR EVEN SHORT INTERRUPTIONS OF POWER.

TWO VENTILATION FANS WERE PROVIDED, ONE AT THE MILL END OF THE TUNNEL AND THE OTHER AT THE PIUTE OR FAR END OF THE TUNNEL. VENTILATOR SHAFTS WERE SIMILAR IN NATURE; EACH STARTING SEVERAL HUNDRED FEET ABOVE THE TUNNEL AND ANGLING DOWN TO MEET THE MAIN TUNNEL SOME 300 FEET BACK FROM THE PORTAL. PIUTE WAS LOCATED SOME 400 FEET ABOVE THE MAIN TUNNEL WHILE THE MILL SITE WAS POSSIBLY 100 FEET ABOVE THE TUNNEL.

ABOVE DATA MAY BE USED TO GAIN A PICTURE OF WATER CONDITIONS IN THE MINE. IN THE FALL AND WINTER, SURFACE SUPPLY OF WATER DWINDLES AND WATER LEVEL IN MINE WORKINGS DROPS BELOW THE MILLSITE VENTILATOR OPENING. SEALING OF PORTAL WITH CLAY AND GRANITE ALLOWS A CONTINUED SEEPAGE FROM THE POOL IN THE MINE. MAIN TUNNEL AND ALL LOWER WORKINGS MAY BE CONSIDERED COMPLETELY FLOODED. LEAKAGE FROM MINE PORTAL IS DILUTED WITH SHALLOW SUB-SURFACE SPRING WATER AND CONCENTRATIONS OF CHEMICALS ARE NOT REPRESENTATIVE OF MAIN BODY OF WATER IN THE MINE.

IN THE SPRING, FISSURES AND SURFACE OPENINGS, SUCH AS ON THE CENTRAL AND PIUTE ORE BODIES, CONTRIBUTE SNOW MELT WATERS WHICH BRING UP THE LEVEL OF MINE WATER UNTIL OVERFLOW OCCURS AT THE MILL SITE VENTILATOR SHAFT. FIRST SPRING FLOW WILL BE WATER WHICH HAS BEEN IN CONTACT WITH ORE FOR SOME TIME, AND CHEMICALS SHOULD BE AT THE HIGHEST CONCENTRATION. ALSO INITIAL LEACHING OF SUB-SURFACE OXIDIZED ORES WILL CONTRIBUTE A MAXIMUM OF ACID SOLUBLE MINERALS. CONTINUED DILUTION WITH PERCOLATION WATERS WILL RESULT IN SOMEWHAT DIMINISHED CHEMICAL CONCENTRATIONS. AS SUMMER PROCEEDS, AND SNOW DISAPPEARS, SUPPLY OF WATER IS CUT OFF AND THE MINE POOL WILL EVENTUALLY DRAIN DOWN TO VENTILATOR SHAFT LEVEL, AND OUTFLOW WILL ESSENTIALLY CEASE.

30.

QUALITY OF MINE WATERS:

WATERS IN THE WALKER MINE AREA WERE SAMPLED ON JUNE 17 AND 25, 1957, WITH THE FOLLOWING RESULTS:

DATE	SAMPLE LOCATION	FLOW CFS	pH	COND. MMHO	APPEAR.	Cu	Zn	SO_4	Al	CLASSIFICATION
6-25	UPPER SPRINGS	1.0	7.6	107	CLEAR	.01	.02	0.0	0.00	EXCELLENT
6-25	MINE TUNNEL	0.1	4.6	259	CLEAR	12	3.2	105	0.94	TOXIC
6-25	VENTILATOR SHAFT	0.5	3.7	328	CLEAR	22	5.5	125	3.1	TOXIC
6-25	WALKER CREEK- ABOVE MINE WASTE	0.5	7.8	96	CLEAR	.01	.02	0.0	0.00	EXCELLENT
6-25	WALKER CREEK- BELOW MINE WASTE	2.0	7.5	135	SLIGHT TURBID BLUE CAST	0.27	.12	37	0.00	TOXIC
6-25	L. GRIZZLY CRK. @ BROWNS CABIN	4.5	7.8	102	SLIGHT TURBID	0.32	.08	9.6	0.00	TOXIC
6-17	INDIAN CREEK 1 MI. BELOW L. G. CRK.	30	7.1	113	CLEAR	0.05	.03	6.7	0.08	EXCELLENT

IT WILL BE NOTED THAT VENTILATOR SHAFT DISCHARGES THE MAJOR PORTION OF MINE WASTES, WITH THE HIGHEST CONCENTRATION OF COPPER, NAMELY 22 PPM. UNITED STATES PUBLIC HEALTH SERVICE LIMIT ON COPPER, DRINKING WATER STANDARDS, IS NOW 3 PPM, BUT COPPER AT 0.1 PPM MAY SERIOUSLY DAMAGE MICROORGANISMS IN WATERS. WATERS IN THE AREA MAY GENERALLY BE CLASSIFIED AS SOFT, WHICH IS UNFORTUNATE AS HARD WATERS TEND TO NEUTRALIZE THE TOXIC EFFECTS OF COPPER. COPPER CARBONATE (MALACHITE OR AZURITE) IS QUITE INSOLUBLE.

IT IS INTERESTING TO NOTE THE FORMATION OF THESE MINERALS BELOW THE WASTE ROCK PILE AT THE MINE, WHERE SPRING WATERS AND MINE WATERS COMBINE. THE COATING OF THESE BLUE MINERALS ON THE STREAM BOTTOM PROVIDES A STRIKING EFFECT.

SAMPLES OF AREA WATERS WERE AGAIN COLLECTED ON OCTOBER 5, 1957. AT THIS TIME THE VENTILATOR SHAFT FLOW HAD DRIED UP AND ONLY 5 TO 10 GPM WASTES WERE OBSERVED AT TUNNEL PORTAL. DATA FROM THESE SAMPLES ~~WILL BE AVAILABLE AT A LATER DATE.~~ show little or no change from June conditions

TO PROVIDE A COMPLETE PICTURE OF MINE WATER QUALITY, PERIODIC SAMPLING, AT LEAST ON A MONTHLY BASIS, SHOULD BE MADE THROUGH ONE CALENDAR YEAR. SAMPLER SHOULD ESTIMATE FLOW FROM THE TUNNEL, VENTILATOR SHAFT, AND GRIZZLY CREEK AT THE TIME OF SAMPLING. THESE SAMPLES MAY BE OBTAINED BY LOCAL WARDENS AND TRANSMITTED TO THIS OFFICE FOR FURTHER HANDLING.

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3D: C POSSIBLE pollution CONTROL MEASURES for mine drainage

CONTROL MEASURES MUST BE AIMED AT MAINTAINING CONCENTRATIONS OF TOXIC MATERIALS BELOW THRESHOLD LEVEL OF DAMAGE TO AQUATIC LIFE. IN THE CASE OF COPPER MINES, THIS NORMALLY RESOLVES INTO CONTROL OF COPPER, ZINC, IRON AND ACID VALUES. CONTROL MEASURES MAY BE GROUPED INTO THREE GENERAL CATEGORIES:

A) PREVENT OUTFLOW OF MINE WATER;
B) MINIMIZE SOLUTION OF TOXIC MATERIALS;
C) TREAT MINE OUTFLOW.

ITEM A 1 MAY BE REALIZED BY SEALING OFF EXITS AND PREVENTING ACCESS OF WATERS TO MINERAL DEPOSITS. NEITHER OF THESE SEEMS FEASIBLE IN THE WALKER MINE CASE, THE MAIN ROCK TUNNEL BEING INACCESSIBLE AT THE PRESENT TIME, AND WATERS ENTERING THE MINE THROUGH NUMEROUS FISSURES AND OPENINGS.

ITEM B 2 IS USUALLY ACCOMPLISHED BY LIMITING AIR CONTACT AND PROVIDING A GAS-TIGHT WATER DRAIN SYSTEM. DUE TO THE TREMENDOUS UNDERGROUND WORKINGS, AND THE POSSIBILITY OF MYRIAD OPENINGS FOR ENTRANCE OF AERATED SURFACE WATERS, LIMITING OF AIR CONTACT DOES NOT APPEAR WORKABLE.

C TREATMENT OF MINE WASTES THUS APPEARS TO BE THE ONLY FEASIBLE APPROACH. ECONOMIC RECOVERY OF COPPER IS NOT CURRENTLY POSSIBLE, AT MARKET PRICES FOR COPPER. IT MAY BE STATED THAT THE AGE-OLD RECOVERY OF COPPER BY IRON CONTACT LEAVES AN EFFLUENT LADEN WITH IRON AND ZINC, AND IS NOT ALWAYS A SATISFACTORY SOLUTION TO THE WATER POLLUTION PROBLEM.

ISOLATION OF MINE WATERS AND DISSIPATION OF TOXIC MATERIALS BY PERCOLATION, EVAPORATION, AND AIR OXIDATION APPEAR TO MERIT FURTHER STUDY IN THIS CASE. TASK WOULD APPEAR TO BE ACCOMPLISHED WITH MINIMUM OUTLAY THROUGH UTILIZATION OF AN OLD DIVERSION CHANNEL. THIS UNDERTAKING WOULD PRODUCE NO DIRECT BENEFITS TO MINE OWNERS, BUT WOULD RESTORE CONSIDERABLE RECREATION VALUES TO PLUMAS COUNTY.

CONSIDERING THE RESPONSIBILITY OF MINE OWNERS UNDER CALIFORNIA LAW, AND THE BENEFIT TO PLUMAS COUNTY RESULTING FROM RESTORATION OF LITTLE GRIZZLY CREEK TO A RECREATIONAL AREA, IT IS LOGICAL THAT THESE TWO COULD COOPERATIVELY ACT TO REMOVE TOXIC WASTES FROM LITTLE GRIZZLY. MINE OWNERS COULD PROVIDE FLUME OR PIPE TO CONVEY ACID WATERS SOME 1000 FEET TO THE CANAL, AND COUNTY COULD ASSUME YEARLY MAINTENANCE OF FACILITIES, USING THE FINE FUND ACCUMULATED FOR JUST SUCH PURPOSES.

SUPERVISOR HUMPHREY HAS INDICATED THE PLUMAS COUNTY BOARD WOULD LOOK FAVORABLY ON SUCH A PROGRAM. THE FINE FUND, WHICH MAY BE USED FOR SUCH PURPOSES, CURRENTLY SHOWS A TOTAL OF $9000.00.

Walker Mine

4. A TAILINGS AREA:

~~4A.~~ A DESCRIPTION of area

TAILINGS FROM THE MILL WERE IMPOUNDED IN A NATURAL BASIN ABOUT 0.5 MILE BELOW THE MINE PORTAL. AREA IS A BROAD FAN COVERING SOME 100 ACRES, WITH TAILINGS DEPTH ESTIMATED AT 0 TO 20 FEET.

LITTLE GRIZZLY CREEK IS HELD AGAINST THE SOUTHWESTERN BOUNDARY OF THIS BASIN BY A LEVEE SOME 1/2 MILE IN LENGTH. LEVEE ALSO CONTAINS THE TAILINGS, EXCEPT FOR ONE MAJOR BREAK IN THE CENTRAL PORTION. WALKER CREEK SPREADS OUT ON THE WESTERN PORTION OF THE TAILINGS AND THEN COLLECTS TO SPILL OVER A RETAINING DAM LOCATED AGAINST THE NORTHERN HILLSIDE AND AT THE FAR WESTERN REACH OF THE TAILINGS AREA.

TAILINGS POND DAM CONSISTS OF A 10 FOOT HIGH CONCRETE WALL SOME 20 FEET ACROSS SURMOUNTED BY 3 FEET OF WOOD TIMBERS. ENTIRE STRUCTURE IS TILTED OUTWARD AND APPEARS IN DANGER OF COLLAPSING.

EFFORTS MADE IN 1952 TO REPAIR THE BREAK IN THE CENTRAL LEVEE WALL FAILED TO HOLD, AND RUN-OFF WATERS HAVE ERODED SEVERAL RAVINES IN THE TAILINGS AT THIS POINT. TROUT AND BEAVER EXIST BELOW THIS POINT, HOWEVER, INDICATING THAT SILT AND WASH WATER THEREFROM ARE NOT TOXIC TO AQUATIC LIFE. THUS PRIMARY POLLUTANT WOULD APPEAR TO BE TOXIC CHEMICALS CONTRIBUTED BY MINE WATERS.

MAJOR ADVERSE EFFECTS OF SILTATION WOULD APPEAR TO BE THE SMOTHERING OF TROUT EGGS AND BOTTOM LIFE, AND THE DESTRUCTION OF ADEQUATE COVER FOR FISH. BEAVER HAVE NOW DESERTED THE AREA, APPARENTLY UNABLE TO COPE WITH THE YEARLY SILTATION OF THEIR PONDS.

TO COMPLETE THE CHEMICAL BACKGROUND OF AREA WATERS, A HIGH SPOT WAS LOCATED ON THE TAILINGS BED, AND A SAMPLE COLLECTED SOME 12 INCHES UNDER THE SURFACE. SAMPLE WILL BE LEACHED AND THE FILTRATE ASSAYED FOR HEAVY METALS PLUS XANTHATES AND CYANIDE.

POTASSIUM XANTHATE IS A FLOTATION CHEMICAL, AND ALONG WITH CYANIDE AND LIME, WAS USED DURING THE OPERATION OF THE WALKER MINE MILL. XANTHATE IS TOXIC TO PLANKTON AT 0.01 PPM, BUT IS SUBJECT TO DECOMPOSITION UPON AGING. IT IS NOT EXPECTED TO FIND ANY OF THIS REAGENT IN THE TAILINGS. U.S.G.S. WILL ATTEMPT A COLORIMETRIC QUALITATIVE DETERMINATION FOR THIS MATERIAL.

ATTEMPTS TO ESTABLISH PLANT GROWTH, ON THIS MATERIAL, BY THE UNIVERSITY OF CALIFORNIA, FAILED, EVEN WITH FERTILIZATION. AN ANALYSIS OF SOLUBLE CHEMICALS MAY BE OF ASSISTANCE TO THE U.S. FOREST SERVICE IN ESTABLISHING A STABILIZING GROUND COVER ON THE TAILINGS AREA.

4B B OWNERSHIP: of Tailings

MR. R. L. ALLEN, POST OFFICE BOX 347, PORTOLA, CURRENTLY CLAIMS TO OWN MINING CLAIMS COVERING THE ENTIRE TAILINGS AREA. HE STATES THAT AFTER SEVERAL YEARS EXPERIMENTATION, HE NOW HAS A PROCESS CAPABLE OF RECOVERING GOLD AND SILVER VALUES FROM THIS MATERIAL, AND PLANS TO SET UP OPERATIONS IN 1958. MR. ALLEN WAS INFORMED THAT, UNDER CALIFORNIA LAW, THE OWNER OF A PROPERTY WAS RESPONSIBLE FOR DISCHARGES THEREFROM. A COPY OF THE LAW AND DISCHARGE REPORT FORMS WERE LEFT WITH MR. ALLEN.

SURVEY OF RECORDS IN PLUMAS COURTHOUSE FAILED TO SHOW ALLEN AS OWNER ON CLAIMS, BUT IT IS INDICATED HE HAS LEASED CLAIMS FROM ROBERT R. BARRY. IN A DISCUSSION WITH R. P. WILSON, WILSON INDICATED THAT HE CONSIDERS THE TAILINGS AS HIS PROPERTY, AND THAT BARRY DOES NOT HAVE THE AUTHORITY TO LEASE A CLAIM THEREON.

CONSULTATION OF COUNTY RECORDS AGAIN REVEALED THAT BOTH BARRY AND WILSON HAVE CONSISTENTLY FILED SEPARATE ASSESSMENT WORK NOTICES ON WALKER MINE CLAIMS. SOME 300 OR MORE CLAIMS ARE LISTED, AND IT WAS PRESUMED THAT THE TAILINGS AREA IS INCLUDED AMONG THESE CLAIMS.

MR. GEORGE A. FISHER, IN CHARGE OF LAND USES, RANGE AND WILDLIFE SERVICE, PLUMAS NATIONAL FOREST, WAS CONSULTED. HE RECOGNIZES A LIMITED RESPONSIBILITY OF THE FOREST SERVICE IN CONTROLLING DISCHARGES FROM THE TAILINGS AREA. WASTES WERE APPARENTLY ORIGINALLY DEPOSITED HERE THROUGH A "USE PERMIT" ISSUED BY THE NATIONAL FOREST SERVICE. LAND SHOWS ON COUNTY ASSESSORS MAP AS BELONGING TO THE FOREST SERVICE.

IN THE ABSENCE OF ACTIVE UTILIZATION OF DEPOSITS, IT WOULD APPEAR THAT AREA JURISDICTION AND RESPONSIBILITY FOR CONTROL OF SILT DISCHARGE RESIDE WITH THE PLUMAS NATIONAL FOREST ADMINISTRATION.

4C C Possible SILT CONTROL MEASURES:

IT WOULD APPEAR THAT SILT OUTFLOW MIGHT BE CONTROLLED BY CONSTRUCTION OF AN ADEQUATE DAM AT THE LOWER END OF THE POND, AND BY THOROUGH REPAIR OF LEVEE BREAKS WITH PROVISION FOR DISPOSAL OF STORM WATERS TO WALKER CREEK, OR PERHAPS SOUTHEASTERLY TO LITTLE GRIZZLY CREEK ABOVE THE TAILINGS AREA. INITIAL COST OF SUCH PROGRAM ESTIMATES AT $30,000.00 WITH YEARLY MAINTENANCE COSTS AT PERHAPS 500 TO $1,000. THIS METHOD WOULD INTERFERE WITH ANY ATTEMPT TO PROCESS TAILINGS.

ANOTHER POSSIBILITY, AS OUTLINED BY MR. FISHER, WOULD BE TO EMPLOY A BULL-DOZER AND CARRY-ALL TO EXCAVATE TAILINGS DOWN TO THE ORIGINAL SOIL, AND TO THEN REMOVE THE EXISTING DAM COMPLETELY. STABILIZATION OF STREAM BANKS WOULD REQUIRE ROCK RIP-RAP, PLANT COVER, OR CONCRETING TO PREVENT SLOUGHING OFF OF TAILINGS INTO WALKER CREEK. TAILINGS THEMSELVES WOULD SUPPLY MIX FOR CEMENTING, A SIMILAR TAILINGS MATERIAL NOW BEING USED FOR GROUTING OF WATER TRANSPORT TUNNELS.

SOLUTION OF THIS PROBLEM WOULD APPEAR TO REQUIRE A COOPERATIVE APPROACH BETWEEN THE FOREST SERVICE AND PLUMAS COUNTY.

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5. PROGRAM FOR WALKER-MINE ~~CLEAN-UP~~ Solution

RESTORATION OF LITTLE GRIZZLY CREEK AS A RECREATIONAL AREA, AND PROTECTION OF IRRIGATION AND RECREATIONAL WATER USES IN INDIAN VALLEY, REQUIRES ACTION ON TWO SEPARATE PROBLEMS.

A) CONTROL OF TOXIC MINE WASTES:

TOXIC MINE WASTE APPEARS TO BE THE PRIMARY AND MAJOR POLLUTANT AT THIS TIME. ABATEMENT SHOULD PROCEED ON SEVERAL FRONTS:

a) ESTABLISH SAMPLING PROGRAM TO MORE FULLY ASCERTAIN EXTENT OF COPPER POLLUTION PROBLEM.

b) PROCEED WITH REQUIREMENTS AND NEGOTIATIONS WITH CURRENT OWNERS OF MINE (ROBERT R. BARRY) TO DIVERT MINE WATERS TO IRRIGATION CANAL.

c) MEET WITH PLUMAS COUNTY BOARD OF SUPERVISORS, AND THE NATIONAL FOREST SERVICE WHO OWN THE CANAL, TO ESTABLISH A CANAL AND DIVERSION MAINTENANCE SCHEDULE.

B) CONTROL OF SILT DISCHARGE:

PRIMARY PROBLEM HERE APPEARS TO BE THE ESTABLISHMENT OF AUTHORITIES AND LIABILITIES INVOLVED IN THE TAILINGS AREA. ATTORNEY-GENERAL'S OPINION WOULD SEEM TO BE REQUIRED TO ESTABLISH PRIMARY RESPONSIBILITY FOR AREA EITHER WITH FOREST SERVICE OR WITH CLAIM HOLDER; AND IF FOREST SERVICE HAS JURISDICTION, WHAT ARE ITS DUTIES AND OBLIGATIONS TOWARDS CLAIM HOLDERS?

REQUIREMENTS SHOULD BE ESTABLISHED UPON TAILINGS AREA, AND THE RESPONSIBLE PARTY, AS DESIGNATED BY ATTORNEY-GENERAL, BE SERVED THEREWITH. AS SEVERAL PARTIES BENEFIT FROM SILT CONTROL, AND CONTROL MAY PROVE RATHER COSTLY, JOINT DISCUSSIONS SHOULD BE HELD TOWARDS DEVELOPING COOPERATIVE CONTROL ACTION.

WALKER MINE REPORT

OCTOBER 5, 1957
L. E. TRUMBULL

SUMMARY

WALKER MINE, PLUMAS COUNTY, HAS BEEN INOPERATIVE SINCE 1942, BUT CONTINUES TO IMPAIR WATERS OF LITTLE GRIZZLY CREEK AND INDIAN CREEK THROUGH DISCHARGES OF TOXIC MATERIALS AND SILT. RESTORATION OF LITTLE GRIZZLY CREEK, AS A RECREATIONAL AREA, AND PROTECTION OF IRRIGATION AND RECREATIONAL WATER USES IN INDIAN VALLEY MAY BE APPROACHED BY A) ESTABLISHMENT OF JURISDICTIONS; B) SETTING OF REQUIREMENTS; AND C) COOPERATIVE ACTION AMONG THE SEVERAL INTERESTED PARTIES.

WALKER MINE, PLUMAS COUNTY
WATER POLLUTION STUDY

Insert 3

OCTOBER 5, 1957
L. E. TRUMBULL

1. DESCRIPTION OF AREA:

WALKER MINE LIES IN PLUMAS COUNTY ABOVE TAYLORSVILLE. IT IS SITUATED NEAR THE TOP OF A MOUNTAIN AT AN ELEVATION OF 6200 FEET. MINE PORTAL AND STRUCTURES LIE IN A SLOPING BOWL WHICH IS THE SOURCE OF "WALKER" CREEK. NUMEROUS SPRINGS ORIGINATE AROUND THE PERIPHERY OF THIS BOWL, WITH ALL WATERS BEING OF EXCELLENT QUALITY.

THIS REGION IS GENERALLY FORESTED WITH PINE AND FIR, WITH ROCK OUTCROPS SHOWING ON MOUNTAIN TOPS. MUCH OF THE TIMBER IS SECOND GROWTH, AS THE MINE OPERATIONS CONSUMED MUCH OF THE AVAILABLE TIMBER. ALSO A SAW MILL WAS OPERATING ON MINE PROPERTY UP TO 1952, SAWING TIMBER TAKEN FROM MINE PROPERTIES.

COUNTY RECORDS SHOW THAT 764 ACRES OF PATENTED LAND ARE LISTED IN THE WALKER MINE HOLDINGS, WITH SEVERAL TIMES THIS ACREAGE HELD IN ADJOINING MINING CLAIMS. THE REGION IS FAIRLY ISOLATED AND FINDS ITS MAJOR USE AS A RECREATIONAL AREA, PARTICULARLY FOR DEER HUNTING. LITTLE GRIZZLY CREEK, DRAINING THE AREA, IS GENERALLY REGARDED AS BARREN, AND FEW FISHERMEN NOW PLY THE STREAM.

2. WATERS OF THE AREA: Streams affected by Mine Drainage

WALKER MINE AREA IS THE SOURCE OF NUMEROUS SPRINGS WHICH FORM A TRIBUTARY TO LITTLE GRIZZLE CREEK. FOR WANT OF A BETTER NAME, THIS TRIBUTARY IS HEREIN CALLED "WALKER CREEK". WALKER CREEK TRAVERSES THE TAILINGS DEPOSIT AND JOINS LITTLE GRIZZLY CREEK JUST ABOVE BROWNS CABIN, ABOUT 1.5 MILES BELOW THE MINE PORTAL. LITTLE GRIZZLY CREEK TUMBLES THROUGH SOME 10 MILES OF NARROW CANYON TO JOIN INDIAN CREEK ABOUT 5 MILES ABOVE TAYLORSVILLE. WATER IS DIVERTED FROM INDIAN CREEK, JUST ABOVE TAYLORSVILLE INTO THE IRRIGATION CANALS OF THE AMERICAN AND INDIAN VALLEY SOIL CONSERVATION DISTRICT.

MR. HUMPHREY OF GREENVILLE, IS A MEMBER OF THE BOARD OF DIRECTORS OF THIS DISTRICT AND PROVIDED INFORMATION ON THE DISTRICTS OPERATION. HE INDICATED THAT, AT THE PRESENT TIME, SILTATION IN DISTRICT CANALS IS NOT SEVERE. HE ALSO NOTED THAT, DURING THE HIGH WATER PERIOD, INDIAN CREEK IS QUITE TURBID ABOVE LITTLE GRIZZLY CREEK, AND THE DISTRICT DOES NOT FEEL THAT WALKER MINE TAILINGS ARE PRESENTLY A MAJOR FACTOR IN CANAL SILTATION. HE DID NOT FEEL THE DISTRICT WOULD CONTRIBUTE TOWARDS A COOPERATIVE SOLUTION OF WALKER MINE AREA PROBLEMS.

FISH AND GAME AND SPORTSMANS ORGANIZATIONS ARE INTERESTED IN RESTORING FISH POPULATION TO LITTLE GRIZZLY CREEK, SAID TO HAVE BEEN EXCELLENT TROUT WATERS AT ONE TIME. THE STREAM CURRENTLY SUPPORTS TROUT ABOVE THE WALKER MINE BUT IS BARREN MOST OF THE YEAR IN THE LOWER REACHES. TROUT DO MOVE UP INTO THIS CREEK DURING THE LATE FALL MONTHS WHEN TOXIC MINE WASTES ARE AT MINIMUM FLOW.

A NUMBER OF FISH KILLS HAVE BEEN REPORTED IN INDIAN CREEK BELOW THE CONFLUENCE OF LITTLE GRIZZLY CREEK. MEAGER DATA AVAILABLE INDICATE

FISH DEATHS WERE PROBABLY DUE TO SUSPENDED MATERIALS, POSSIBLE ABRASIVE SOLIDS FROM THE WALKER MINE TAILINGS DUMP. CATFISH AND CARP APPARENTLY SUFFER GREATEST MORTALITY, WITH TROUT POPULATION IN INDIAN CREEK NOT SHOWING ANY PARTICULAR DISTRESS.

IN JULY, 1947, DEPARTMENT OF FISH AND GAME PLANTED 5000 TROUT IN LITTLE GRIZZLY CREEK, SOME 5 MILES DOWNSTREAM FROM WALKER MINE. ALL FISH DIED WITHIN 24 HOURS. AGAIN IN 1949, TROUT IN A CAGE WERE PLACED IN LITTLE GRIZZLY CREEK AT BROWNS CABIN; THESE TROUT WERE ALL DEAD WITHIN THE SPACE OF 1 HOUR.

INSPECTION OF LITTLE GRIZZLY CREEK INDICATES THE COMBINATION OF SAND DEPOSITS AND TOXIC MINE DRAINAGE HAS CAUSED A STERILE STREAM CONDITION. PLANT AND AQUATIC LIFE APPEAR TO BE ALMOST TOTALLY ABSENT, ALTHOUGH SHRUBBERY AND TREES LINING THE STREAMS APPEAR HEALTHY.

WALKER MINE WORKINGS SURFACE ON THE OTHER SIDE OF THE RIDGE FROM LITTLE GRIZZLY CREEK, WHERE DRAINAGE IS INTO WARD CREEK. WARD CREEK EMPTIES INTO INDIAN CREEK ABOUT 2 MILES ABOVE THE CONFLUENCE OF LITTLE GRIZZLY CREEK. IT IS REPORTED THAT MINE WATERS WERE PUMPED INTO WARD CREEK DURING MINE OPERATIONS, AND THAT WARD CREEK WAS BARREN OF FISH LIFE DURING THIS PERIOD. THERE IS NO INDICATION THAT MINE WASTES HAVE OVERFLOWED INTO THIS DRAINAGE IN RECENT TIMES.

3. MINE WATERS: Drainage

3A. MINE OWNERSHIP:

OWNERSHIP OF MINE PROPERTIES IS QUITE CONFUSED AT THE PRESENT TIME, ALTHOUGH IT CURRENTLY WOULD APPEAR THE ROBERT E. BARRY, 29 HEREFORD ROAD, BRONXVILLE, NEW YORK, REPRESENTS THE PROPERTY OWNERS.

TITLE TO THE PROPERTY APPEARED TO RESIDE CLEARLY WITH ANACONDA COPPER UP TO 1942, WHEN THE OPERATION OF THE MINE CEASED. IT IS REPORTED THAT ANACONDA SOLD TO AN INVESTMENT GROUP WHO AUCTIONED OFF THE PROPERTIES ABOUT 1946. ROBERT E. WILSON, APPARENTLY BID IN MOST OF THE ASSETS, USING THE FINANCIAL BACKING OF A MR. CAREY, SAID TO HAVE BEEN PRESIDENT OF THE YALE AND TOWNE COMPANY.

AT THIS POINT, THE TRANSACTIONS BECOME QUITE COMPLICATED AND CONFUSED. IT IS REPORTED WILSON FAILED TO MEET ALL PURCHASE COMMITTMENTS, BUT PROCEEDED TO ESTABLISH SUBSIDIARY ORGANIZATIONS, INCLUDING PLUMAS LAND CORPORATION, PLUMAS MINING CORPORATION, AND PLUMAS LUMBER CORPORATION.

IT IS REPORTED THAT THE MORE VALUABLE LANDS, BUILDINGS, EQUIPMENT AND HOUSING WERE TRANSFERRED TO THESE CORPORATIONS, WHOSE CONTROLLING OWNERSHIP WAS REPORTEDLY ESTABLISHED BY WILSON, WITH DUBIOUS AUTHORITY, AS WILSON AND MRS. WILSON.

ABOUT 1948, CAREY MOVED TO TAKE OVER OPERATION FROM WILSON, BUT DIED IN AN AUTO ACCIDENT SHORTLY THEREAFTER. ROBER R. BARRY, AND WILFORD CAREY, CAME ONTO THE SCENE AT THIS POINT AS ADMINISTRATORS FOR THE ESTATES OF W. GIBSON CAREY, JR., PLUMAS LAND CORPORATION, ETAL.

IN 1948, WILSON ENTERED SUIT IN SUPERIOR COURT TO DETERMINE RIGHTS AND INTERESTS IN WALKER MINE PROPERTIES. LATER IN 1948, WILSON BY AFFIDAVIT RELEASED HIS INTERESTS IN TIMBER RIGHTS ON THE PATENTED LANDS.

IN MAY, 1957, THE SUPERIOR COURT DISMISSED WILSON'S SUIT (OF 1948) FOR FAILURE TO PROSECUTE WITH REASONABLE DILIGENCE, AND RULED A JUDGEMENT OF DISMISSAL BE FILED AGAINST R. P. WILSON.

ON MAY 31, 1957, R. P. WILSON, APPEALED THIS DECISION TO THE DISTRICT COURT OF APPEALS, THUS OWNERSHIP AND INTERESTS OF SEVERAL PARTIES REMAINS IN LITIGATION.

BASED UPON THE MAY 1957, DECISION OF THE COURT, AND UPON PERUSAL OF WILSON'S CHARGES AGAINST BARRY, IT APPEARS THAT BARRY MUST BE LOGICALLY CONSIDERED THE LEGAL OWNER OF WALKER MINE PROPERTY. IT IS TO BE NOTED, HOWEVER, THAT SALE OF TIMBER AND A PROPOSED TUNNEL TO TAP WALKER MINE DEPOSITS (TO BE DRIVEN FROM GENESSEE) ARE CURRENTLY HELD UP BECAUSE TITLE GUARANTEE COMPANIES WILL HAVE NOTHING TO DO WITH WALKER MINE PROPERTIES.

COUNTY RECORDS INDICATE THAT BARRY HAS BEEN PAYING TAXES ON THE 764 ACRES OF PATENTED GROUND WHICH INCLUDES THE MILL SITE AND MAJOR DEPOSIT AREAS.

IN A LETTER DATED SEPTEMBER 15, 1957, MR. R. R. BARRY HAS ACKNOWLEDGED THAT HE REPRESENTS THE WALKER MINE OWNERS.

3B. <u>MINE DESCRIPTION AND SOURCE OF WATERS</u>:

WALKER MINE WAS ORIGINALLY LOCATED AS AN ORE OUTCROP ON TOP OF THE RIDGE. RATHER EXTENSIVE MINING WAS CARRIED ON AT THIS POINT, WITH ORE BEING TRAMMED TO THE MILL AT WALKER MINE. THIS MINING AREA IS LOCATED ABOVE THE SO-CALLED "CENTRAL ORE-BODY" AND MAY BE IDENTIFIED BY THE "GLORY-HOLE". IT WOULD APPEAR THAT SNOW MELT IN THIS AREA WILL CONTRIBUTE CONSIDERABLE WATER TO THE WALKER MINE UNDERGROUND SYSTEM.

AT A LATER DATE, A TUNNEL WAS DRIVEN FROM THE MILL SITE TO TAP THE ORE BODIES. THIS TUNNEL IS REPORTED TO HAVE ENCOUNTERED 200 FEET OF CLAY AND DECOMPOSED GRANITE, WHICH SECTION WAS TIMBERED, PRIOR TO ENTERING SOLID ROCK. THIS TUNNEL THEN TRAVELLED SOME 2000 FEET TO TIE INTO THE WORKING LATERAL, SOME 8000 FEET LONG, WHICH CROSSED THROUGH THE 5 MAJOR ORE BODIES, THE SOUTH, CENTRAL, NORTH, 712, AND PIUTE.

THREE OTHER LATERALS ARE REPORTED, ONE 300 AND ONE 700 FEET BELOW THE MAIN TUNNEL, AND ANOTHER 600 FEET ABOVE THE MAIN TUNNEL. IN ALL, SOME 15 TO 20 MILES OF TUNNEL ARE SAID TO EXIST. IN 1928, A RAISE WAS DRIVEN FROM THE PIUTE ORE BODY TO THE SURFACE, AND VENTILATION EQUIPMENT PROVIDED AT THIS POINT.

THE 5 ORE BODIES WERE EXTENSIVELY STOPED, WITH RATHER TREMENDOUS CAVITIES LEFT IN THE BOWELS OF THE EARTH. ESTIMATED CAVITY VOLUMES ARE:

SOUTH ORE BODY:	2.0	MILLION CU. FEET.
CENTRAL:.	17.0	MILLION CU. FEET.
NORTH:	192	MILLION CU. FEET.
712:	20.	MILLION CU. FEET.
PIUTE:	300	MILLION CU. FEET
TOTAL	531	MILLION CUBIC FEET.

IN MORE UNDERSTANDABLE FIGURES, THIS REPRESENTS A ROOM 1 SQUARE MILE IN AREA AND ABOUT 20 FEET HIGH. MUCH OF THIS SPACE MAY BE FILLED WITH WASTE ROCK, BUT IT IS EVIDENT FROM THESE FIGURES THAT A TREMENDOUS EXPOSURE OF ORES TO OXIDATIVE CONDITIONS DOES EXIST.

FORMER MINE EMPLOYEES REPORT THAT UNDERGROUND AREA HAD MANY DRIPS AND SEEPS FROM OVERHEAD. GROUND SURFACE VARIED FROM 400 TO 900 FEET ABOVE THE MAIN TUNNEL, THUS WATER DRIPS WERE RATHER CLOSELY ASSOCIATED WITH SNOW MELT AND SURFACE RUN-OFF. APPARENTLY WORKINGS WERE FAIRLY DRY IN LATE FALL AND EARLY WINTER.

PUMPS WERE REQUIRED TO KEEP LOWER LEVELS EXPOSED, AND CONTINUOUS PUMPING OF LARGE VOLUMES OF WATER IS REPORTED. THIS PUMPING WAS OF SUCH EXTREME IMPORTANCE THAT THE UTILITY COMPANY SUPPLYING THE MINE WAS FACED WITH A SEVERE COST PENALTY FOR EVEN SHORT INTERRUPTIONS OF POWER.

TWO VENTILATION FANS WERE PROVIDED, ONE AT THE MILL END OF THE TUNNEL AND THE OTHER AT THE PIUTE OR FAR END OF THE TUNNEL. VENTILATOR SHAFTS WERE SIMILAR IN NATURE; EACH STARTING SEVERAL HUNDRED FEET ABOVE THE TUNNEL AND ANGLING DOWN TO MEET THE MAIN TUNNEL SOME 300 FEET BACK FROM THE PORTAL. PIUTE WAS LOCATED SOME 400 FEET ABOVE THE MAIN TUNNEL WHILE THE MILL SITE WAS POSSIBLY 100 FEET ABOVE THE TUNNEL.

ABOVE DATA MAY BE USED TO GAIN A PICTURE OF WATER CONDITIONS IN THE MINE. IN THE FALL AND WINTER, SURFACE SUPPLY OF WATER DWINDLES AND WATER LEVEL IN MINE WORKINGS DROPS BELOW THE MILLSITE VENTILATOR OPENING. SEALING OF PORTAL WITH CLAY AND GRANITE ALLOWS A CONTINUED SEEPAGE FROM THE POOL IN THE MINE. MAIN TUNNEL AND ALL LOWER WORKINGS MAY BE CONSIDERED COMPLETELY FLOODED. LEAKAGE FROM MINE PORTAL IS DILUTED WITH SHALLOW SUB-SURFACE SPRING WATER AND CONCENTRATIONS OF CHEMICALS ARE NOT REPRESENTATIVE OF MAIN BODY OF WATER IN THE MINE.

IN THE SPRING, FISSURES AND SURFACE OPENINGS, SUCH AS ON THE CENTRAL AND PIUTE ORE BODIES, CONTRIBUTE SNOW MELT WATERS WHICH BRING UP THE LEVEL OF MINE WATER UNTIL OVERFLOW OCCURS AT THE MILL SITE VENTILATOR SHAFT. FIRST SPRING FLOW WILL BE WATER WHICH HAS BEEN IN CONTACT WITH ORE FOR SOME TIME, AND CHEMICALS SHOULD BE AT THE HIGHEST CONCENTRATION. ALSO INITIAL LEACHING OF SUB-SURFACE OXIDIZED ORES WILL CONTRIBUTE A MAXIMUM OF ACID SOLUBLE MINERALS. CONTINUED DILUTION WITH PERCOLATION WATERS WILL RESULT IN SOMEWHAT DIMINISHED CHEMICAL CONCENTRATIONS. AS SUMMER PROCEEDS, AND SNOW DISAPPEARS, SUPPLY OF WATER IS CUT OFF AND THE MINE POOL WILL EVENTUALLY DRAIN DOWN TO VENTILATOR SHAFT LEVEL, AND OUTFLOW WILL ESSENTIALLY CEASE.

30.

QUALITY OF MINE WATERS:

WATERS IN THE WALKER MINE AREA WERE SAMPLED ON JUNE 17 AND 25, 1957, WITH THE FOLLOWING RESULTS:

DATE	SAMPLE LOCATION	FLOW CFS	pH	COND. MMHO	APPEAR.	Cu	Zn	SO_4	Al	CLASSIFICATION
6-25	UPPER SPRINGS	1.0	7.6	107	CLEAR	.01	.02	0.0	0.00	EXCELLENT
6-25	MINE TUNNEL	0.1	4.6	259	CLEAR	12	3.2	105	0.94	TOXIC
6-25	VENTILATOR SHAFT	0.5	3.7	328	CLEAR	22	5.5	125	3.1	TOXIC
6-25	WALKER CREEK- ABOVE MINE WASTE	0.5	7.8	96	CLEAR	.01	.02	0.0	0.00	EXCELLENT
6-25	WALKER CREEK- BELOW MINE WASTE	2.0	7.5	135	SLIGHT TURBID BLUE CAST	0.27	.12	37	0.00	TOXIC
6-25	L. GRIZZLY CRK. @ BROWNS CABIN	4.5	7.8	102	SLIGHT TURBID	0.32	.08	9.6	0.00	TOXIC
6-17	INDIAN CREEK 1 MI. BELOW L. G. CRK.	30	7.1	113	CLEAR	0.05	.03	6.7	0.08	EXCELLENT

IT WILL BE NOTED THAT VENTILATOR SHAFT DISCHARGES THE MAJOR PORTION OF MINE WASTES, WITH THE HIGHEST CONCENTRATION OF COPPER, NAMELY 22 PPM. UNITED STATES PUBLIC HEALTH SERVICE LIMIT ON COPPER, DRINKING WATER STANDARDS, IS NOW 3 PPM, BUT COPPER AT 0.1 PPM MAY SERIOUSLY DAMAGE MICROORGANISMS IN WATERS. WATERS IN THE AREA MAY GENERALLY BE CLASSIFIED AS SOFT, WHICH IS UNFORTUNATE AS HARD WATERS TEND TO NEUTRALIZE THE TOXIC EFFECTS OF COPPER. COPPER CARBONATE (MALACHITE OR AZURITE) IS QUITE INSOLUBLE.

IT IS INTERESTING TO NOTE THE FORMATION OF THESE MINERALS BELOW THE WASTE ROCK PILE AT THE MINE, WHERE SPRING WATERS AND MINE WATERS COMBINE. THE COATING OF THESE BLUE MINERALS ON THE STREAM BOTTOM PROVIDES A STRIKING EFFECT.

SAMPLES OF AREA WATERS WERE AGAIN COLLECTED ON OCTOBER 5, 1957. AT THIS TIME THE VENTILATOR SHAFT FLOW HAD DRIED UP AND ONLY 5 TO 10 GPM WASTES WERE OBSERVED AT TUNNEL PORTAL. DATA FROM THESE SAMPLES ~~WILL BE AVAILABLE AT A LATER DATE.~~ show little or no change from June conditions

TO PROVIDE A COMPLETE PICTURE OF MINE WATER QUALITY, PERIODIC SAMPLING, AT LEAST ON A MONTHLY BASIS, SHOULD BE MADE THROUGH ONE CALENDAR YEAR. SAMPLER SHOULD ESTIMATE FLOW FROM THE TUNNEL, VENTILATOR SHAFT, AND GRIZZLY CREEK AT THE TIME OF SAMPLING. THESE SAMPLES MAY BE OBTAINED BY LOCAL WARDENS AND TRANSMITTED TO THIS OFFICE FOR FURTHER HANDLING.

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3D: C POSSIBLE pollution CONTROL MEASURES for mine drainage

CONTROL MEASURES MUST BE AIMED AT MAINTAINING CONCENTRATIONS OF TOXIC MATERIALS BELOW THRESHOLD LEVEL OF DAMAGE TO AQUATIC LIFE. IN THE CASE OF COPPER MINES, THIS NORMALLY RESOLVES INTO CONTROL OF COPPER, ZINC, IRON AND ACID VALUES. CONTROL MEASURES MAY BE GROUPED INTO THREE GENERAL CATEGORIES:

A) PREVENT OUTFLOW OF MINE WATER;
B) MINIMIZE SOLUTION OF TOXIC MATERIALS;
C) TREAT MINE OUTFLOW.

ITEM A 1 MAY BE REALIZED BY SEALING OFF EXITS AND PREVENTING ACCESS OF WATERS TO MINERAL DEPOSITS. NEITHER OF THESE SEEMS FEASIBLE IN THE WALKER MINE CASE, THE MAIN ROCK TUNNEL BEING INACCESSIBLE AT THE PRESENT TIME, AND WATERS ENTERING THE MINE THROUGH NUMEROUS FISSURES AND OPENINGS.

ITEM B 2 IS USUALLY ACCOMPLISHED BY LIMITING AIR CONTACT AND PROVIDING A GAS-TIGHT WATER DRAIN SYSTEM. DUE TO THE TREMENDOUS UNDERGROUND WORKINGS, AND THE POSSIBILITY OF MYRIAD OPENINGS FOR ENTRANCE OF AERATED SURFACE WATERS, LIMITING OF AIR CONTACT DOES NOT APPEAR WORKABLE.

C TREATMENT OF MINE WASTES THUS APPEARS TO BE THE ONLY FEASIBLE APPROACH. ECONOMIC RECOVERY OF COPPER IS NOT CURRENTLY POSSIBLE, AT MARKET PRICES FOR COPPER. IT MAY BE STATED THAT THE AGE-OLD RECOVERY OF COPPER BY IRON CONTACT LEAVES AN EFFLUENT LADEN WITH IRON AND ZINC, AND IS NOT ALWAYS A SATISFACTORY SOLUTION TO THE WATER POLLUTION PROBLEM.

ISOLATION OF MINE WATERS AND DISSIPATION OF TOXIC MATERIALS BY PERCOLATION, EVAPORATION, AND AIR OXIDATION APPEAR TO MERIT FURTHER STUDY IN THIS CASE. TASK WOULD APPEAR TO BE ACCOMPLISHED WITH MINIMUM OUTLAY THROUGH UTILIZATION OF AN OLD DIVERSION CHANNEL. THIS UNDERTAKING WOULD PRODUCE NO DIRECT BENEFITS TO MINE OWNERS, BUT WOULD RESTORE CONSIDERABLE RECREATION VALUES TO PLUMAS COUNTY.

CONSIDERING THE RESPONSIBILITY OF MINE OWNERS UNDER CALIFORNIA LAW, AND THE BENEFIT TO PLUMAS COUNTY RESULTING FROM RESTORATION OF LITTLE GRIZZLY CREEK TO A RECREATIONAL AREA, IT IS LOGICAL THAT THESE TWO COULD COOPERATIVELY ACT TO REMOVE TOXIC WASTES FROM LITTLE GRIZZLY. MINE OWNERS COULD PROVIDE FLUME OR PIPE TO CONVEY ACID WATERS SOME 1000 FEET TO THE CANAL, AND COUNTY COULD ASSUME YEARLY MAINTENANCE OF FACILITIES, USING THE FINE FUND ACCUMULATED FOR JUST SUCH PURPOSES.

SUPERVISOR HUMPHREY HAS INDICATED THE PLUMAS COUNTY BOARD WOULD LOOK FAVORABLY ON SUCH A PROGRAM. THE FINE FUND, WHICH MAY BE USED FOR SUCH PURPOSES, CURRENTLY SHOWS A TOTAL OF $9000.00.

Walker Mine

4. A TAILINGS AREA:

~~4A.~~ A DESCRIPTION of area

TAILINGS FROM THE MILL WERE IMPOUNDED IN A NATURAL BASIN ABOUT 0.5 MILE BELOW THE MINE PORTAL. AREA IS A BROAD FAN COVERING SOME 100 ACRES, WITH TAILINGS DEPTH ESTIMATED AT 0 TO 20 FEET.

LITTLE GRIZZLY CREEK IS HELD AGAINST THE SOUTHWESTERN BOUNDARY OF THIS BASIN BY A LEVEE SOME 1/2 MILE IN LENGTH. LEVEE ALSO CONTAINS THE TAILINGS, EXCEPT FOR ONE MAJOR BREAK IN THE CENTRAL PORTION. WALKER CREEK SPREADS OUT ON THE WESTERN PORTION OF THE TAILINGS AND THEN COLLECTS TO SPILL OVER A RETAINING DAM LOCATED AGAINST THE NORTHERN HILLSIDE AND AT THE FAR WESTERN REACH OF THE TAILINGS AREA.

TAILINGS POND DAM CONSISTS OF A 10 FOOT HIGH CONCRETE WALL SOME 20 FEET ACROSS SURMOUNTED BY 3 FEET OF WOOD TIMBERS. ENTIRE STRUCTURE IS TILTED OUTWARD AND APPEARS IN DANGER OF COLLAPSING.

EFFORTS MADE IN 1952 TO REPAIR THE BREAK IN THE CENTRAL LEVEE WALL FAILED TO HOLD, AND RUN-OFF WATERS HAVE ERODED SEVERAL RAVINES IN THE TAILINGS AT THIS POINT. TROUT AND BEAVER EXIST BELOW THIS POINT, HOWEVER, INDICATING THAT SILT AND WASH WATER THEREFROM ARE NOT TOXIC TO AQUATIC LIFE. THUS PRIMARY POLLUTANT WOULD APPEAR TO BE TOXIC CHEMICALS CONTRIBUTED BY MINE WATERS.

MAJOR ADVERSE EFFECTS OF SILTATION WOULD APPEAR TO BE THE SMOTHERING OF TROUT EGGS AND BOTTOM LIFE, AND THE DESTRUCTION OF ADEQUATE COVER FOR FISH. BEAVER HAVE NOW DESERTED THE AREA, APPARENTLY UNABLE TO COPE WITH THE YEARLY SILTATION OF THEIR PONDS.

TO COMPLETE THE CHEMICAL BACKGROUND OF AREA WATERS, A HIGH SPOT WAS LOCATED ON THE TAILINGS BED, AND A SAMPLE COLLECTED SOME 12 INCHES UNDER THE SURFACE. SAMPLE WILL BE LEACHED AND THE FILTRATE ASSAYED FOR HEAVY METALS PLUS XANTHATES AND CYANIDE.

POTASSIUM XANTHATE IS A FLOTATION CHEMICAL, AND ALONG WITH CYANIDE AND LIME, WAS USED DURING THE OPERATION OF THE WALKER MINE MILL. XANTHATE IS TOXIC TO PLANKTON AT 0.01 PPM, BUT IS SUBJECT TO DECOMPOSITION UPON AGING. IT IS NOT EXPECTED TO FIND ANY OF THIS REAGENT IN THE TAILINGS. U.S.G.S. WILL ATTEMPT A COLORIMETRIC QUALITATIVE DETERMINATION FOR THIS MATERIAL.

ATTEMPTS TO ESTABLISH PLANT GROWTH, ON THIS MATERIAL, BY THE UNIVERSITY OF CALIFORNIA, FAILED, EVEN WITH FERTILIZATION. AN ANALYSIS OF SOLUBLE CHEMICALS MAY BE OF ASSISTANCE TO THE U.S. FOREST SERVICE IN ESTABLISHING A STABILIZING GROUND COVER ON THE TAILINGS AREA.

4B B OWNERSHIP: of Tailings

MR. R. L. ALLEN, POST OFFICE BOX 347, PORTOLA, CURRENTLY CLAIMS TO OWN MINING CLAIMS COVERING THE ENTIRE TAILINGS AREA. HE STATES THAT AFTER SEVERAL YEARS EXPERIMENTATION, HE NOW HAS A PROCESS CAPABLE OF RECOVERING GOLD AND SILVER VALUES FROM THIS MATERIAL, AND PLANS TO SET UP OPERATIONS IN 1958. MR. ALLEN WAS INFORMED THAT, UNDER CALIFORNIA LAW, THE OWNER OF A PROPERTY WAS RESPONSIBLE FOR DISCHARGES THEREFROM. A COPY OF THE LAW AND DISCHARGE REPORT FORMS WERE LEFT WITH MR. ALLEN.

SURVEY OF RECORDS IN PLUMAS COURTHOUSE FAILED TO SHOW ALLEN AS OWNER ON CLAIMS, BUT IT IS INDICATED HE HAS LEASED CLAIMS FROM ROBERT R. BARRY. IN A DISCUSSION WITH R. P. WILSON, WILSON INDICATED THAT HE CONSIDERS THE TAILINGS AS HIS PROPERTY, AND THAT BARRY DOES NOT HAVE THE AUTHORITY TO LEASE A CLAIM THEREON.

CONSULTATION OF COUNTY RECORDS AGAIN REVEALED THAT BOTH BARRY AND WILSON HAVE CONSISTENTLY FILED SEPARATE ASSESSMENT WORK NOTICES ON WALKER MINE CLAIMS. SOME 300 OR MORE CLAIMS ARE LISTED, AND IT WAS PRESUMED THAT THE TAILINGS AREA IS INCLUDED AMONG THESE CLAIMS.

MR. GEORGE A. FISHER, IN CHARGE OF LAND USES, RANGE AND WILDLIFE SERVICE, PLUMAS NATIONAL FOREST, WAS CONSULTED. HE RECOGNIZES A LIMITED RESPONSIBILITY OF THE FOREST SERVICE IN CONTROLLING DISCHARGES FROM THE TAILINGS AREA. WASTES WERE APPARENTLY ORIGINALLY DEPOSITED HERE THROUGH A "USE PERMIT" ISSUED BY THE NATIONAL FOREST SERVICE. LAND SHOWS ON COUNTY ASSESSORS MAP AS BELONGING TO THE FOREST SERVICE.

IN THE ABSENCE OF ACTIVE UTILIZATION OF DEPOSITS, IT WOULD APPEAR THAT AREA JURISDICTION AND RESPONSIBILITY FOR CONTROL OF SILT DISCHARGE RESIDE WITH THE PLUMAS NATIONAL FOREST ADMINISTRATION.

4C C Possible SILT CONTROL MEASURES:

IT WOULD APPEAR THAT SILT OUTFLOW MIGHT BE CONTROLLED BY CONSTRUCTION OF AN ADEQUATE DAM AT THE LOWER END OF THE POND, AND BY THOROUGH REPAIR OF LEVEE BREAKS WITH PROVISION FOR DISPOSAL OF STORM WATERS TO WALKER CREEK, OR PERHAPS SOUTHEASTERLY TO LITTLE GRIZZLY CREEK ABOVE THE TAILINGS AREA. INITIAL COST OF SUCH PROGRAM ESTIMATES AT $30,000.00 WITH YEARLY MAINTENANCE COSTS AT PERHAPS 500 TO $1,000. THIS METHOD WOULD INTERFERE WITH ANY ATTEMPT TO PROCESS TAILINGS.

ANOTHER POSSIBILITY, AS OUTLINED BY MR. FISHER, WOULD BE TO EMPLOY A BULL-DOZER AND CARRY-ALL TO EXCAVATE TAILINGS DOWN TO THE ORIGINAL SOIL, AND TO THEN REMOVE THE EXISTING DAM COMPLETELY. STABILIZATION OF STREAM BANKS WOULD REQUIRE ROCK RIP-RAP, PLANT COVER, OR CONCRETING TO PREVENT SLOUGHING OFF OF TAILINGS INTO WALKER CREEK. TAILINGS THEMSELVES WOULD SUPPLY MIX FOR CEMENTING, A SIMILAR TAILINGS MATERIAL NOW BEING USED FOR GROUTING OF WATER TRANSPORT TUNNELS.

SOLUTION OF THIS PROBLEM WOULD APPEAR TO REQUIRE A COOPERATIVE APPROACH BETWEEN THE FOREST SERVICE AND PLUMAS COUNTY.

Insert #5

5. PROGRAM FOR WALKER-MINE ~~CLEAN-UP~~ Solution

RESTORATION OF LITTLE GRIZZLY CREEK AS A RECREATIONAL AREA, AND PROTECTION OF IRRIGATION AND RECREATIONAL WATER USES IN INDIAN VALLEY, REQUIRES ACTION ON TWO SEPARATE PROBLEMS.

A) CONTROL OF TOXIC MINE WASTES:

TOXIC MINE WASTE APPEARS TO BE THE PRIMARY AND MAJOR POLLUTANT AT THIS TIME. ABATEMENT SHOULD PROCEED ON SEVERAL FRONTS:

a) ESTABLISH SAMPLING PROGRAM TO MORE FULLY ASCERTAIN EXTENT OF COPPER POLLUTION PROBLEM.

b) PROCEED WITH REQUIREMENTS AND NEGOTIATIONS WITH CURRENT OWNERS OF MINE (ROBERT R. BARRY) TO DIVERT MINE WATERS TO IRRIGATION CANAL.

c) MEET WITH PLUMAS COUNTY BOARD OF SUPERVISORS, AND THE NATIONAL FOREST SERVICE WHO OWN THE CANAL, TO ESTABLISH A CANAL AND DIVERSION MAINTENANCE SCHEDULE.

B) CONTROL OF SILT DISCHARGE:

PRIMARY PROBLEM HERE APPEARS TO BE THE ESTABLISHMENT OF AUTHORITIES AND LIABILITIES INVOLVED IN THE TAILINGS AREA. ATTORNEY-GENERAL'S OPINION WOULD SEEM TO BE REQUIRED TO ESTABLISH PRIMARY RESPONSIBILITY FOR AREA EITHER WITH FOREST SERVICE OR WITH CLAIM HOLDER; AND IF FOREST SERVICE HAS JURISDICTION, WHAT ARE ITS DUTIES AND OBLIGATIONS TOWARDS CLAIM HOLDERS?

REQUIREMENTS SHOULD BE ESTABLISHED UPON TAILINGS AREA, AND THE RESPONSIBLE PARTY, AS DESIGNATED BY ATTORNEY-GENERAL, BE SERVED THEREWITH. AS SEVERAL PARTIES BENEFIT FROM SILT CONTROL, AND CONTROL MAY PROVE RATHER COSTLY, JOINT DISCUSSIONS SHOULD BE HELD TOWARDS DEVELOPING COOPERATIVE CONTROL ACTION.

STATE OF CALIFORNIA

Inter-Departmental Communication

To: Central Valleys Regional Water Pollution Control Board No. 5
608 - 13th Street
Sacramento, California

Att'n: Col. Joseph S. Gorlinski, Executive Officer

From: Department of Fish and Game
Region II, 1001 Jedsmith Drive
Sacramento 19, California

File No.

Date: December 3, 1957

Subject: COMMENTS AND RECOMMENDATIONS CONCERNING WALKER MINE AND WALKER MINE TAILINGS, PLUMAS COUNTY

This is in reply to your request of October 14, 1957, for our comments concerning discharges from Walker Mine to Little Grizzly Creek, thence Indian Creek, Plumas County.

There is a verified history of fish kills in both Little Grizzly Creek and Indian Creek attributed to this waste discharge. Some 10 miles of the former and 5 of the latter have been affected. Drainage from the mine tunnels and through the mine tailings apparently carry toxic quantities of copper, zinc, and other heavy metals into Little Grizzly Creek, which is now essentially barren of aquatic life.

It is imperative that strict requirements be set to protect the beneficial uses of water in Little Grizzly and Indian Creeks; that is, fishing, camping, swimming, and picnicking. Restoration of the recreational potential of these streams is especially important in view of the increased tourist pressure in this area.

We would like to recommend that the following tentative requirements govern the nature of the discharges from Walker Mine. These requirements are esentially like those recommended for the Penn Mine discharge. The minimum concentrations may not be entirely reliable. They were chosen following a search of the literature and are not based on a specific evaluation of the Walker Mine discharge diluted with Little Grizzly Creek waters.

1. The discharge shall not cause concentrations of the following substances in Little Grizzly Creek in excess of the following limits:

Copper	0.05 ppm	Lead	0.10 ppm
Zinc	0.50 ppm	Arsenic	0.05 ppm
Aluminum	0.05 ppm	Sulfate	10.0 ppm
Iron	0.10 ppm		

2. The discharge shall not cause the pH of Little Grizzly Creek water to fall below 6.5.

3. The discharge shall not produce concentrations of toxic materials in Little Grizzly Creek which are deleterious to human, animal, plant or aquatic life.

4. The discharge shall not cause silt, gravel, or sludge deposits in Little Grizzly Creek.

5. The discharge shall not cause objectionable coloration of little Grizzly Creek waters.

6. Neither the discharge nor the disposals shall result in nuisance due to odors or unsightliness.

Sincerely yours,

Robert D. Montgomery

Robert D. Montgomery
Regional Manager
Region II

cc: Dept. of Fish and Game,
Water Projects Coordinator
Dept. of Water Resources,
Division of Resources Planning
Dept. of Public Health,
Bureau of Sanitary Engineering

CENTRAL VALLEY REGION
REGIONAL WATER QUALITY CONTROL BOARD
DEC 1957
RECEIVED

RESOLUTION

WALKER MINE SITUATION

Resolution No. 58-327 Adopted: 24 July 1958

WHEREAS, the Central Valley Regional Water Pollution Control Board has by resolution established waste discharge requirements to cover the discharge of drainage waters from the Walker Mine and the Walker Mine Tailings Dump for disposal into Little Grizzly Creek in Plumas County; and

WHEREAS, these waste discharges continue to cause conditions in Little Grizzly Creek below the discharge points which are inimical to fish and aquatic life and the use of the affected portion of the stream for recreational purposes; therefore, be it

RESOLVED, that the Executive Officer of the Central Valley Regional Water Pollution Control Board is hereby authorized to notify all persons responsible for the correction of these conditions to submit their programs for remedial action to the Central Valley Regional Water Pollution Control Board on or before 1 October 1958; and

RESOLVED, further, that in the event the responsible parties do not submit remedial programs by 1 October 1958, that the Executive Officer is hereby authorized to initiate the steps necessary to bring corrective action under Sections 13060, 13061, 13061.5, 13062, 13063 and 13064 of the California Water Code.

/s/ Clifford E. Plummer
Chairman

ATTEST:

/s/ Joseph S. Gorlinski
Executive Officer

OFFICE MEMORANDUM

TO: Colonel Joseph S. Gorlinski
FROM: L. E. Trumbull
SUBJECT: Inspection of Walker Mine, Plumas County

On June 10 and 11, 1960, I visited the Walker Mine to determine the nature of mine drainage waters. Accompanying me on this trip was Virgil Stone, U.S.G.S. chemist.

Water conditions were observed at the following stations:

LITTLE GRIZZLY CREEK

Sample	Location	Time PDST	Temp. °F	Est. Flow cfs	Remarks
60T-101	1 mile above mouth	12:50P	58	10	Water clear.
60T-102	@ Clyde Smith Mine	1:40P	57	8	Water clear. Aquatic organisms observed.
60T-106	@ Browns Cabin	3:10P	--	7	Water clear. Stream bottom relatively clean & free of aquatic growths.
60T-105	just above Dollie Creek confluence	2:45P	61	5	Water clear; trout observed, many aquatic organisms observed.
60T-115	above tailings pile	9:00P	--	5	Water clear; many trout in evidence; abundant aquatic organisms.

DOLLIE CREEK

60T-104	@ Tailings Dam	2:30P	88	2	Water clear; some fine silt moving on stream bottom.

Dollie Creek (Continued)

Sample	Location	Time PDST	Temp. °F	Est. Flow cfs.	Remarks
60T-114	@ Lower Road Bridge (at upper end of tailings)	6:15P	62	2	Water clear; green copper salt deposits visible.
60T-108	above confluence of mine wastes.	4:25P	63	0.75	Water clear - bottom covered with usual aquatic life.

MINE AREA STREAMS

60T-107	Combined mine area drainage. (just before confluence with Dollie Creek)	4:20P	58	1	Water clear, green copper deposits - usual aquatic life absent.
60T-109	Ventilator Shaft	5:00P	46	0.5	Water clear; iron oxide deposits on rocks; elemental copper replacement product showing on iron articles in the stream.
60T-110	Mine Portal	5:05P	46	0.2	Water clear; water flowing to edge of waste rock dump - then percolating into rocks.
60T-111	East Spring	5:20P	43	1	Water clear.
60T-112	'Blue' Spring (at foot of rock dump)	5:30P	--	0.1	Blue sludge on stream bottom.

Observations in Little Grizzly Creek:

The flow in Little Grizzly Creek, particularly in the upper reach, is very low for this season of the year. Flow in the lower reach is relatively higher due to good run-off from the feeder streams which are carrying the last of the snow melt.

Patches of snow are still visible in the shaded higher elevations.

Visible aquatic life in Little Grizzly Creek below the confluence of Dollie Creek was limited to a small swimming beetle. Stream bottom was relatively free of the usual bottom growths.

Character of stream bed changed radically above the confluence of Dollie Creek. Stream bottom showed typical brownish coloration of healthy mountain streams. Caddis fly larvae (white grubs encased in sand and leaf shells) were very abundant. These larvae are a prime source of trout food. Trout were observed, with some very large specimens evident in the beaver ponds.

Observations in Dollie Creek:

Dollie Creek flow was estimated at 2 cfs at the tailings dam. Water was quite warm, being heated in its shallow course across the tailings area. Typical greenish deposits of copper salts were visible beginning at the upper end of the tailings. Aquatic life, except for a mossy growth, was absent.

Dollie Creek above the confluence of mine area waters was clear and stream banks were lined with mossy growths and ferns. Aquatic life was normal, with plants visible and animal organisms visible on the underside of rocks.

Mill-Site Area Waters:

Both the ventilator shaft and the mine portal were found to be discharging water at an appreciable rate. These discharges were not in existence on prior visits made this year (April 28 and May 19). This bears out the theory that mine waters do not overflow until sufficient volumes of snow melt water have been accumulated.

The east spring was carrying its usual flow of clear cold water.

Mine portal water ran out on the rock dump to disappear into the rock at the edge of the dump.

Ventilator shaft waters split into two streams, one flowed onto the rock pile to percolate into the pile; the other flows easterly to join the East Spring waters. These two streams (Ventilator shaft flow and East Spring water) meet in a relatively quiescent area. The line of contact of these two waters is very markedly defined by a linear deposit of blue-green sludge. This is probably due to the neutralization and carbonation of the mine waste waters upon contacting the East Spring water.

All waters tend to percolate through the east end of the rock pile. Four major points of emergence of these waters exist. All channels are currently vividly marked by blue-green deposits. The two easterly channels, carrying primarily spring water, did not exhibit the blue-green coloration upon earlier visits this year. Apparently the Ve tilator shaft water is the reason for the colors now making their appearance.

The "blue" spring at the foot of the rock pile, and directly under the point of disappearance of mine portal outflow, had doubled in volume over that observed on prior visits this year. This observation tends to tie this outflow to percolating waters from the mine portal. If this outflow is connected to mine portal drainage, it maybe expected that the copper content thereof should vary in accordance with copper content of mine portal waters.

Observations on inflow waters to mine workings:

A visit was made to the Central Ore Body or Upper Camp area. Three large 'glory' holes exist here, although two of these holes appear to be 'sinks' created by caving of the ground into stopes of the mine.

Erosion and flow channels leading into these pits were observed, however no surface flow was found. About 1000 feet above these pits, a surface flow of about 100 gpm (1/4 cfs) was found. This flow disappeared into the ground at the head of the small basin draining into the glory holes. It might be suspected that this water ultimately finds it way into the mine workings.

There is ample evidence in this drainage area above the glory holes that mine operators found it prudent to carefully divert all these waters around the glory hole area. Neglect of the diversion structures for the past 20 years has made them worthless, and all drainage waters in the basin must now terminate in the glory holes.

Further over the hill, near the so-called Piute shaft, we found a series of four 'sinks', where the ground had caved in to fill the underground cavities left in the mining operations. One of these sinks exposes an underground cavern with a tunnel leading away into the mountain.

A surface flow of perhaps 125 gpm (1/4 cfs) was observed cascading into one of these sinks. This flow disappeared immediately in the rocky bottom of the sink. Flow into this sink was permitted by the failure of an old diversion system to carry water around the sink.

These sinks in the Piute shaft area appear to present a bit of a hazard to stock, wildlife, and travelers in the area. Rather precipitous bluffs exist in several places. An old wire fence, which once protected the area, is now completely gone.

Preliminary copper analysis of water samples indicates high copper concentrations in the Mine Portal waters (19 ppm) and in the Ventilator overflow (36 ppm), and that this copper is causing concentrations in Little Grizzly Creek of 0.13 ppm.

My inspection indicates that Little Grizzly Creek waters are currently polluted by mine drainage water, and that specifically the copper contributed by Walker Mine drainage water causes copper concentrations in Little Grizzly Creek which are deleterious to aquatic life. This discharge is thus in violation of the Boards Resolution No. 58-180, wherein it is resolved:

> "3. Drainage shall not cause concentrations of materials in receiving waters which are deleterious to human, plant, animal, or aquatic life."

Complete analyses of area waters, together with bio-assay data on selected samples, will be available shortly.

March 17, 1971

TO: Central Valley Regional Water Quality Control Board

FROM: Robert A. Matthews, Sacramento District, Division of Mines and Geology

SUBJECT: Walker Copper Mine--Recommendations and Estimated Costs for Study of the Effect of Mine Water Drainage in the Little Grizzly Creek Watershed

Introduction

The Walker mine is in east central Plumas County about twenty miles east of Quincy. It is near the head of north-flowing Little Grizzly Creek. It has been one of California's most productive copper mines with a total output in excess of 167,000,000 pounds. Copper-bearing waters that flow from the old mine workings and the extensive accumulation of mill tailings are alleged to have caused a serious pollution problem for more than thirty years in Little Grizzly Creek. As yet no solutions for reducing or eliminating this problem have been determined.

The mine is owned by Calicopia Corporation, c/o Robert Barry, Thunderbird Country Club, Palm Springs, California and is presently leased by Norandex, a United States subsidiary of Noranda Mines, Limited, of Toronto, Canada. In 1969 and 1970, Norandex conducted an exploration program in the mine area which included diamond drilling.

History

Although the mine was discovered around 1904, principal periods of activity were from 1916 to 1932 and 1935 to 1941. Soon after mining operations ceased in November 1941, all of the equipment was removed, and the surface plant was dismantled. The following table gives production figures that were obtained from William Sanborn, Mining Engineer, U. S. Forest Service. These figures were given to Mr. Sanborn by the late Henry A. Geisendorfer, manager of the mine during the 1930s.

Table 1: Walker Mine Production 1916-1941

Amount of ore mined.	5,319,249 short tons
Amount of concentrates	3,640,546 short tons
Amount of copper recovered . . .	167,786,000 lbs. (83,893 short tons)
Amount of gold recovered	179,088 ounces
Amount of silver recovered	3,640,812 ounces

Mr. Geisendorfer estimated that there are 5,000,000 to 6,000,000 tons of mill tailings that contain an average of 4 pounds of copper, 0.20 ounces of silver, and 0.005 ounces of gold per ton. Some brief studies were made of the mine during World War II. It was believed at that time that approximately 4,000,000 tons of copper-bearing rock occur in the mine area. The percentage of copper present in this rock is unknown.

Geology

The Walker mine is in the south end of what is known as the Plumas County copper belt. The rocks that underlie this region are a series of northwest-trending belts of metamorphic rocks of Paleozoic and Mesozoic age which in places have been intruded by granitic rocks (see maps 1 and 2). Some of the ridges are capped by nearly flat flows of volcanic rock of Tertiary age. The rocks in the immediate vicinity of the copper deposits are dark, fine-grained garnet* and andalusite-bearing micaceous schist and cordierite and tourmaline-bearing hornfels that occur in a contact metamorphic zone adjacent to the granitic rocks.

Chalcopyrite is the principal copper ore mineral but other ore minerals present in smaller amounts are chalcocite, tetrahedrite, galena, sphalerite, stibnite, and jamesonite. Other metallic minerals are magnetite, which is quite abundant, and pyrite and pyrrhotite. The chemical composition of these minerals indicates the ions that may occur in water draining the rocks of the watershed in its natural state. Minor free gold also is present.

The principal ore zone strikes N 20° to 33° W and dips 32° to 70° NE. Five different bodies of ore within this zone ranging from 600 to 1400 feet in length were mined. They were from 10 to more than 100 feet in thickness but averaged 30 to 40 feet. Ore mined and milled in 1931 averaged 1.63 percent copper.

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*The chemical composition of minerals enumerated in the text are listed in the glossary.

The main working entry or adit for the mine was the north(?)-trending main haulageway or seventh level, which was driven through granitic rocks for 3000 feet until the south ore body was intersected. It then turned to the northwest and followed the ore zone for at least 7000 feet. An air raise is connected to the surface north of the portal of the main haulageway. The main haulageway is partly caved at the portal at this writing (March 1971), but some water flows out of it. Water also flows out of the air raise.

Problem

According to the files of the Central Valley Regional Water Quality Control Board, investigation of pollutants in Little Grizzly Creek began in 1957. At that time seven water samples from various locations in the area were analyzed for their content of copper, zinc, and sulfate, and their conductivity and pH. The temperature and the estimated flow were recorded at the time the samples were taken. Because of the blue-green color of the precipitate in the stream bottoms, and because of the presence of the Walker copper mine and the mine and mill tailings upstream from the precipitate, it was assumed that copper in the waters coming from the mine and the mill tailings were responsible for the disappearance of downstream aquatic life. Attempts to require the mine owner to reduce the copper content in the effluent from the mine and the mill tailings were based on that assumption.

McKee and Wolf (Water Quality Criteria, 1963) state that 0.02 mg/l (milligrams per liter) is indicated to be the threshold concentration of copper for the beneficial use of fresh water by fish and aquatic life. Higher concentrations are considered to be toxic.

Analysis of the waters in the area has continued over a number of years, but the location and frequency of the sampling were such that the precise amounts of chemical constituents contributed by different parts of the drainage remain unknown. There are two possible sources in the area for a variety of chemical constituents which might be traced to mining activity in the area:

1. The mill tailings accumulation to the east of the confluence of Dollie Creek and Little Grizzly Creek; and
2. The mine workings, both the adit and the air raise, from which percolating water containing leachate flows.

A third source of chemicals is the rocks in the area which undergo leaching of the natural-occurring copper minerals by percolating ground water.

Leaching is used to recover copper minerals in various mines throughout the world and has been used in California in Amador, Calaveras and Shasta Counties (various publications and field reports, California Division of Mines and Geology). According to a memo from Mr. L. E. Trumbull to Mr. C. T. Carnahan, dated 29 November 67 entitled, "Comments on Appended Letter from Bertram G. Buzzini, Deputy Attorney General regarding discussion on Walker Mine with Robert R. Barry," leaching was also attempted at the Walker Mine.

> ". . . In the early days of ownership by R. R. Barry (and associates), a copper recovery unit was operated on mine outflow waters. I have been informed by several persons (who were on the scene at that time), that flow into the mine was encouraged to enhance the copper recovery system via enhanced outflow from the mine."

The analyses of samples taken by the staff of the Central Valley Regional Water Quality Control Board from 1957 to 1970 in the Walker mine area have been tabulated by our staff by location and these sampling points have been plotted on a map (see Appendix, Table A and Map A).* The number of samples taken per season, which is from May through October, and the number of samples taken per location are few enough to make correlation and interpretation difficult because of differences in the water regimen from year to year. Thus, it is difficult to determine the precise source of specific ions which occur in Little Grizzly Creek throughout one water year.

*Water analyses included in the tabulation consist of those supplied by the Central Valley Regional Water Quality Control Board.

Recommendations

In order to recommend a solution to the problem, a systematic sampling program is required to determine the exact sources of pollution in Little Grizzly Creek. The purpose of a systematic sampling program, including a grid of data collection stations and a timetable for sample collection, is to reduce the number of unknowns to a workable minimum commensurate with the amount of money to be spent.

Our recommendations follow:

1. Install six water level recorder stations at the locations marked on Map 3 to determine the amount of water which passes those points. The charts should be changed weekly from the last part of May through June, at which time an appraisal of the water chemistry data so far obtained (see recommendation 2) may indicate that a reduction in the frequency of collecting samples may be possible with little or no effect on the results of the investigation. If such were the case, the recorder charts could also be changed less frequently. An advantage of changing charts every week, however, is that damage from vandalism which renders the recording installation inoperative can be repaired with a smaller loss in chart record.

Installation and observation of these stations, and the reduction of water level data obtained from these stations, will cost between $820 and $900 per station for the non-winter season, usually May through October, if the work is done by Department of Water Resources' personnel

skilled at measuring water flow. The cost of development of a flow rating curve for each recorder station is included in this cost per station.

Estimates of cost for installation and observation of the recorder stations and reduction of data were derived by conversations conducted with J. Preston Cedarholm, Senior Engineer, and Joe Nessler, Watermaster, both of the Central District, Department of Water Resources.

The estimate does not include the capital cost of the recorder which, according to Cedarholm and Nessler, can be borrowed without charge from the Department of Water Resources.

The location of each recorder site will be chosen by considering stream width, stream measurability, and location with respect to various parts of the watershed. Siting based on these parameters will allow collection of the most useful data while maintaining the cost of each installation within the plan. Siting will be done by Department of Water Resources' personnel in conjunction with Division of Mines and Geology personnel.

2. Collect water samples from each of the six recorder site locations and from a seventh site located on Map 3. Standard minerals, standard metals, and spectrographic analyses should be run on water samples collected at predetermined intervals. The sample can be collected by

the person servicing the recorder charts and the cost of collection is included in the price quoted under recommendation 1. Each sample is defined as being 0.5 gallons of water.

The first two water samples will be collected on 1 April and 1 May by the Watermaster when he enters the area to make his monthly snow survey. Snow on the ground will prevent installation of the water level recording devices until late May or early June. The amount of water flowing at each proposed recorder site will be estimated by the Watermaster when he collects the sample until the recording devices are installed.

Prices for chemical analyses of water samples were taken from the Department of Water Resources' Chemical Laboratory Price List received in January 1971.

A description of the types of appropriate chemical analyses offered by the Laboratory follows.

Wet

Standard mineral analysis: Ca, Mg, Hardness, Na, K, Alkalinity (pH, HCO_3, CO_3 or OH) SO_4, Cl, B, NO_3, total dissolved solids, electrical conductivity, non carbonate hardness.

Standard metal analysis: As, Cd, Cu, Fe, Pb, Mn, Se, Zn

Partial analysis: Cu, Zn, Fe, pH, EC, settleable and suspended solids. Other combinations of analyses are possible but the cost of a partial analysis as used in Tables 2, 3, and 4 was computed on the basis of analysis for these seven items.

Dry

Spectrographic analysis: To determine whether or not minute quantities of 17 cations are present, including Al, Be, Bi, Cd, Cr, Co, Cu, Ga, Ge, Fe, Pb, Mn, Mo, Ni, Ti, V, Zn.

Atomic absorption analysis: To determine the amounts of cations present. This process costs the same as does the standard metal analysis.

It is necessary to run a limited number of spectrographic analyses to detect traces of metallic ions that may be present. Such analyses allow for more complete understanding of the chemistry of the watershed and the possible presence of synergistically deleterious chemical constituents.

The cost of the sampling program exclusive of collecting will be directly dependent on the number of chemical analyses that are conducted, which in turn will be directly dependent on the frequency of sampling. Because of the potentially large differences in cost, three possible sampling schedules are presented ranging in cost from $1850 to $9363 (Tables 2, 3, and 4).

In addition to considering the cost of a particular sampling schedule, the adequacy of the data for the uses for which it is intended should also be considered. Partial analyses four weeks apart in time do not provide as informative a picture as do complete and partial analyses at more frequent intervals.

If one of the more costly programs of sampling and analysis is chosen, it will probably be possible to reduce the cost of the program after some analyses have been obtained by eliminating analyses for mineral constituents which seem to remain stable in quantity. Correlation and interpretation of the data must take place concurrent with the collection and analysis of the samples if such eliminations are to take place.

Measurement of electrical conductivity can be used as a rough guide to determine whether or not a chemical analysis is necessary. When the results of a few analyses are available, including electrical conductivity, and the correlation between conductivity and chemical content is known, the assumption can be made that a significant change in the conductivity is caused by significant changes in the chemistry of the water. If this assumption is valid, then it is necessary only to measure the conductivity before collecting a water sample. If the conductivity is different from the last measurement which also included a chemical analysis, then a sample should be collected and submitted for analysis. If the conductivity as measured in the field shows no significant change, then no sample need be collected. In this manner the total cost of the program can be reduced by reducing the number of chemical analyses.

To insure that adequate quantity and quality data are collected, the program must be reviewed as data collection progresses. The reviewer should be familiar with sampling techniques, analytical methods, reliability of results, the physical setting of Little Grizzly Creek, and potential chemical contributions from the basin. For these reasons the reviewer should be a geologist or engineer with sufficient background to insure the program's effectiveness.

For purposes of estimating cost, the salary of the associate rank was used. Actual charges will probably be distributed amongst the aide through supervising levels as work consisting of collection, data analysis, report writing, and review takes place.

Once the data have been collected, it will be possible to analyze them and recommend a course of action which will minimize the contribution of pollutants to Little Grizzly Creek. It should be emphasized that this program will not provide simple answers and will not eliminate the content of natural occurring ions in the streams in the area. What will probably result is that the contribution of pollutants from an already disturbed chemical regimen can be minimized.

Legal Restrictions

Permission to enter the properties to install water level recording devices on the streams and to collect water samples must be obtained from the owners. In addition, responsibility for personnel, property, and equipment will have to be established. Central Valley Regional Water Quality Control Board records show that the mine is owned by Robert Barry, but that ownership of the mill tailings appears to be in dispute.

No funds have been included in this proposal for negotiating for and obtaining these legal agreements.

Conclusions

1. The program outlined in this proposal is intended to collect data which will answer most of the questions that can reasonably be raised about the chemistry of the water above and below the Walker mine mill tailings.

Each water level recorder and sampling location was chosen so that contributions of water and ions from different parts of the watershed can be determined. For example, sites 3, 4, 5, and 6 were chosen so that the amount of water and ions coming from the air raise, the adit, and the east spring can be differentiated.

2. The thoroughness of systematic data collection will be important should litigation result over ownership of the mine property and mill tailings, and concomitant responsibility for reduction of pollution.

3. The study itself will provide no solution for reducing the pollutants in the watershed but will allow selection of a method or methods that will most effectively minimize the flow of pollutants.

4. This study includes no estimates of the cost of obtaining right of entry on the properties in question.

5. It is possible that the cost of a) obtaining the right of entry, with or without litigation; b) collecting and interpreting the data; c) proposing a solution; d) establishing responsibility therefor; and e) effecting that solution, may result in a total cost that exceeds what can reasonably be expended to reclaim less than ten miles of trout fishery.

6. This study is designed to be implemented immediately in order to collect data from April through October 1971. Ideally, the recording facilities and the sampling program should provide data through one complete "water year," October through September, in order to obtain volumetric and chemical data on the spring thaw. These data would afford greater understanding of the relationship between quantity of flow from the mine and the rest of the basin and the chemical content of the water. The collection of such data, however, would require that recording facilities be installed during the summer, that collection begin in October and continue through the following September.

7. It seems likely that any solution which is decided on will require maintenance as long as it is to be effective.

8. The cheapest solution in terms of total cost may be for the State to pay for corrective measures such as 1) diversion of surface water away from openings into the mine, and 2) reduction of the acidity of the water emanating from the mine. These actions would reduce 1) the amount of water available for leaching of the copper as well as 2) the amount of copper which could be carried in solution by the water. The funds would have to include year to year maintenance costs.

Glossary

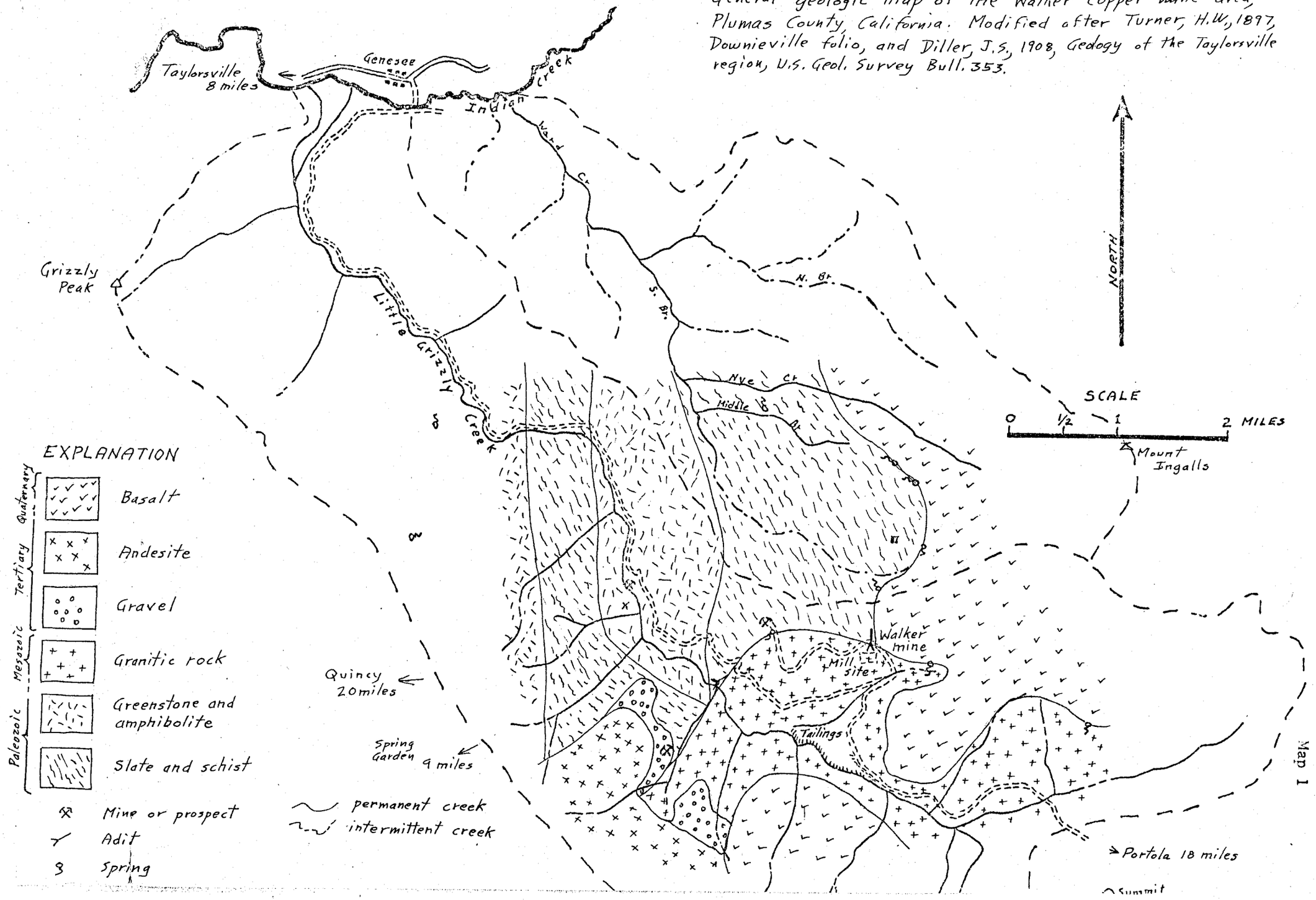
adit	A nearly horizontal passage from the surface by which a mine is entered and unwatered. If it connects to the other side of the hill, it is a tunnel.
air raise	An inclined or vertical opening connecting the mine to the surface for ventilation. Ventilation equipment may be installed at the opening for the purpose of increasing the flow of fresh air in to the mine.
concentrate	To purify by getting rid of useless rock material.
electrical conductivity or E. C.	The numerical equal of the reciprocal of resistivity equivalent to the unit of conductivity in mhos per centimeter ("ohms" backwards). The relative ability of materials to carry an electrical current.
leaching	The process of decomposition under natural agencies of an outcrop by solution. Surface waters penetrating downwards may dissolve some or all of the mineral in their path, thus carrying it away from the surface zone.
leaching process	Removing copper in solution commercially. The copper is precipitated out by replacement by scrap iron, sometimes known as "cement" copper process.
mill tailings	Useless rock material resulting from the crushing, grinding, and concentration of ore; portions of ground rock that are regarded too poor to be treated further.
milling ore	Any ore that contains sufficient valuable minerals to be treated by any milling process.
mine tailings	Waste rock, barren or submarginal rock that has been mined but is not of sufficient value to warrant treatment.
ore	A metalliferrous mineral, or an aggregate of metalliferous minerals, which from the standpoint of a miner can be won at a profit or from the standpoint of the metallurgist can be treated at a profit.
pH	The negative logarithm of the hydrogen-ion activity. It denotes the degree of acidity or of basicity of a solution. At 25° C., 7 is the neutral value. Acidity increases with decreasing values below 7, and basicity increases with increasing values above 7.

portal	Any entrance to a mine.
ppm	Parts per million, equivalent to mg/l (milligrams per liter).
shaft	A vertical or inclined entrance to a mine.
water year	1 October through 30 September. Water year 1971 begins 1 October 1970 and ends 30 September 1971.

Rocks and Minerals

andalusite	$Al_2 SiO_5$
chalcocite	Cu_2S
chalcopyrite	$CuFeS_2$
cordierite	$Mg_2 Al_4 Si_5 O_{18}$
galena	PbS
garnet	$(Ca, Mg, Fe)_3 (Al, Fe, Mn, Cr)_2 (SiO_4)_3$
hornfels	A fine grain non-schistose metamorphic rock resulting from contact metamorphism.
jamesonite	$Pb_4FeSb_6S_{14}$
magnetite	Fe_3O_4
mica	$(K,Na,Ca) (Mg, Fe, Li, Al)_{2-3} (Al, Si)_4 O_{10} (OH, F)_2$
pyrite	FeS_2
pyrrhotite	$Fe_{n-1} Sn$
schist	A medium or coarse grain metamorphic rock with sub-parallel orientation of the micaceous minerals which dominate its composition.
sphalerite	ZnS
stibnite	Sb_2S_3
tetrahedrite	$(Cu, Fe)_{12} Sb_4 S_{13}$
tourmaline	$(Na, Ca) (Al, Fe, Li, Mg)_3 B_3 Al_3 (AlSi_2 O_9)_3 (O, OH, F)_4$

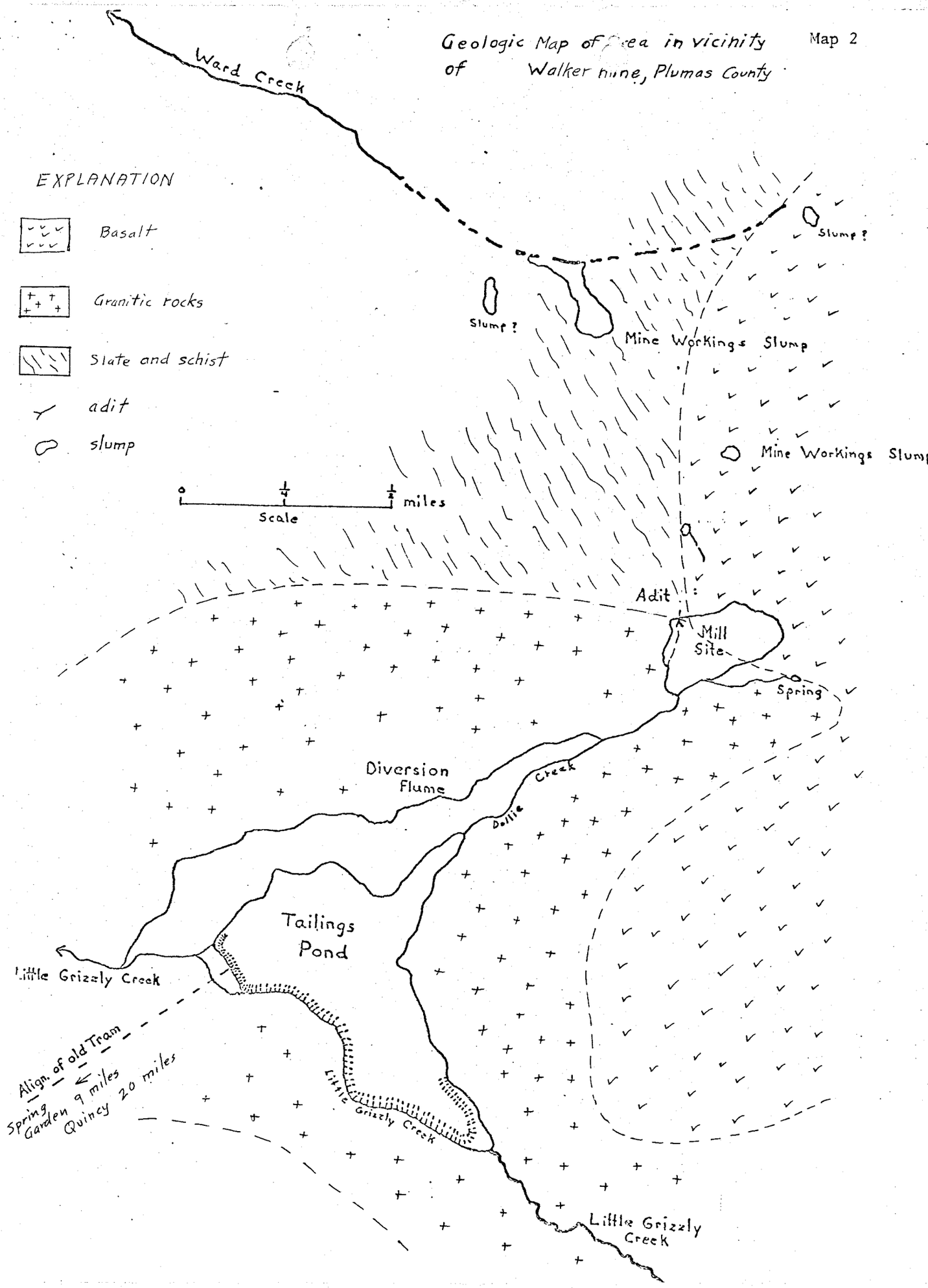
General geologic map of the Walker copper mine area, Plumas County, California. Modified after Turner, H.W., 1897, Downieville folio, and Diller, J.S., 1908, Geology of the Taylorsville region, U.S. Geol. Survey Bull. 353.



Map 1

Geologic Map of area in vicinity of Walker mine, Plumas County

Map 2



Map 3

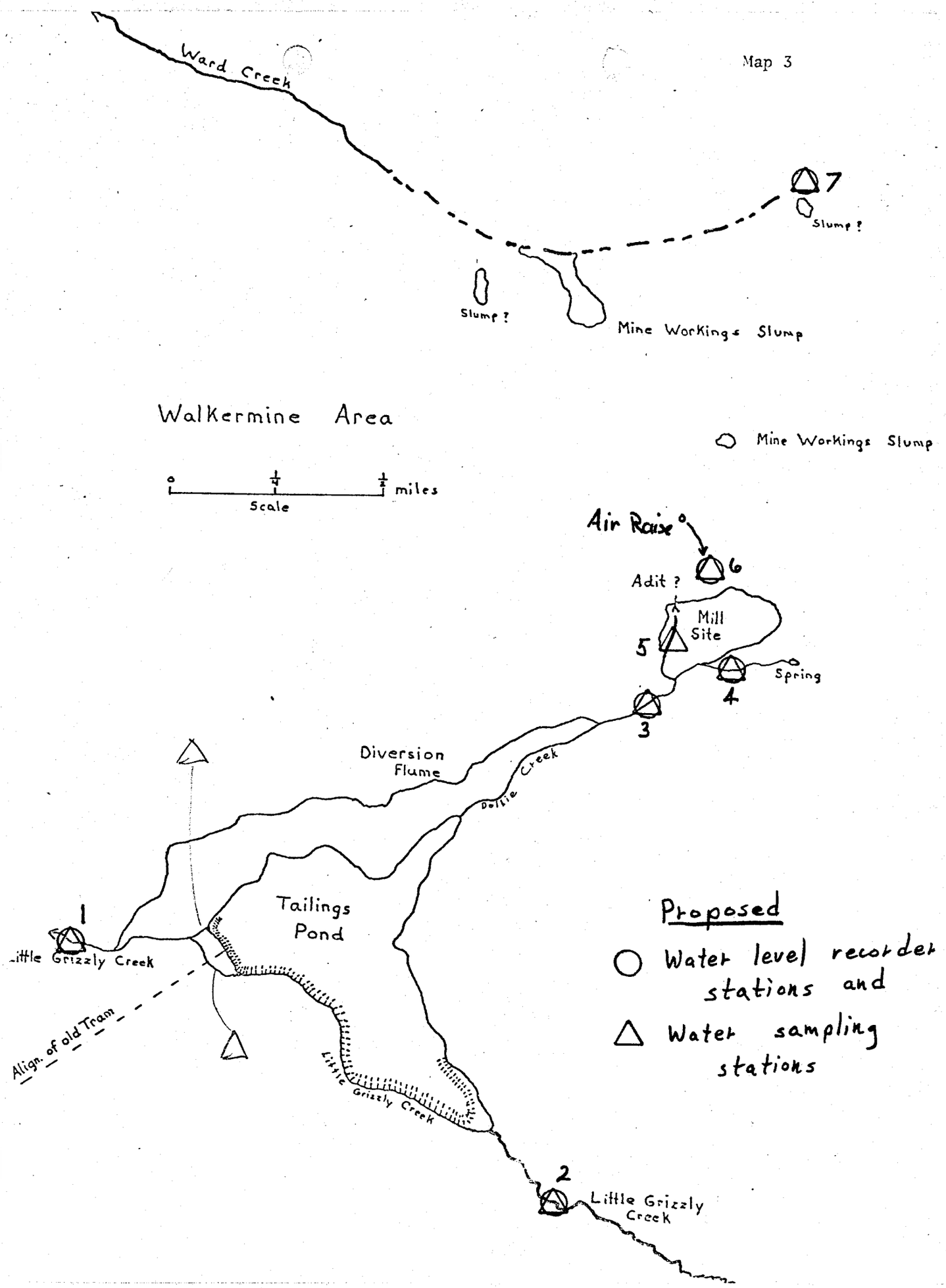

Ward Creek
7
Slump ?
Slump ?
Mine Workings Slump
Walkermine Area
Mine Workings Slump
0
1/4
1/2
miles
Scale
Air Raise
6
Adit ?
Mill Site
5
Spring
4
3
Diversion Flume
Dollie Creek
Tailings Pond
1
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
2
Little Grizzly Creek
Proposed
Water level recorder stations and
Water sampling stations

Table 1

PRICE LIST

Cost Estimate

Per Recorder Station	
Installation	$ 170
Observation for 5 months @ $90 per month	450
Materials	50
Reduction of data	150
TOTAL cost June through October	$ 820
Per Water Sample (sample bottles included)	
Standard minerals analysis	$ 32.50
Standard metals analysis	49.50
Spectrographic analysis	27.50
Partial analysis	22.00
One Associate Geologist	$1,337/month
Field expenses	$ 22/day

Total costs using the estimates quoted above

	Proposal 1	Proposal 2	Proposal 3
Installation, observation, and data reduction of six water level recorder stations for five months--June through October @ $820 per station	$ 4,920	$ 4,920	$ 4,920
Chemical analyses for "standard minerals" and "standard metals" (Nos. 1 and 2 on DWR Chemical Laboratory price list) of water samples taken at 7 stations. The costs shown from left to right were derived from the sampling schedules shown on Tables 2, 3, & 4 respectively	$ 9,363	$ 5,219	$ 1,845
One Associate Geologist for four man-months for concurrent program and data evaluation and final report preparation @$1337 per month	$ 5,348	$ 5,348	$5,348
Field expenses for 10 days @ $22 per day	$ 220	$ 220	$ 220
TOTAL *	$19,851	$15,707	$12,333

*Each proposal consists of an independent and complete study

Table 2

Water Sample Collecting Schedule - Proposal 1

Frequency of sample collecting - once every week

Complete analyses every 4 weeks

Date	Wet chemical analysis: Standard minerals analysis	Wet chemical analysis: Standard metals analysis	Wet chemical analysis: Partial analysis	Dry analysis: Spectro-graphic analysis	Specific conductance	Cost
1 Apr	1	1		1	✓	$ 766 50
1 May	1	1		1	✓	766 50
26	1	1		1	✓	766 50
2 Jun	1	1		1	✓	766 50
9			1		✓	154
16			1		✓	154
23			1		✓	154
30	1	1		1	✓	766 50
7 Jul			1		✓	154
14			1		✓	154
21			1		✓	154
23	1	1		1	✓	766 50
4 Aug			1		✓	154
11			1		✓	154
13			1		✓	154
25	1	1		1	✓	766 50
1 Sep			1		✓	154
[illegible]			1		✓	154
12			1		✓	154
22	1	1		1	✓	766 50
29			1		✓	154
6 Oct			1		✓	154
13			1		✓	154
20	1	1		1	✓	766 50
27			1		✓	154
				Total estimated	cost	$ 9362 50

Table 3

000060

Water Sample Collecting Schedule - Proposal 2

Frequency of sample collecting - once every 2 weeks

Complete analyses every 8 weeks

Date	Wet chemical analysis: Standard minerals analysis	Wet chemical analysis: Standard metals analysis	Wet chemical analysis: Partial analysis	Dry analysis: Spectro-graphic analysis	Specific conductance	Cost
1 Apr	1	1		1	✓	$ 766 50
1 May	1	1		1	✓	766 50
2 Jun			1		✓	154
16			1		✓	154
30			1		✓	154
14 Jul	1	1		1	✓	766 50
28			1		✓	154
11 Aug			1		✓	154
25			1		✓	154
8 Sep	1	1		1	✓	766 50
22			1		✓	154
6 Oct			1		✓	154
20			1		✓	154
27	1	1		1	✓	766 50
					Total estimated cost	$ 5218 50

Water Sample Collecting Schedule - Proposal 3

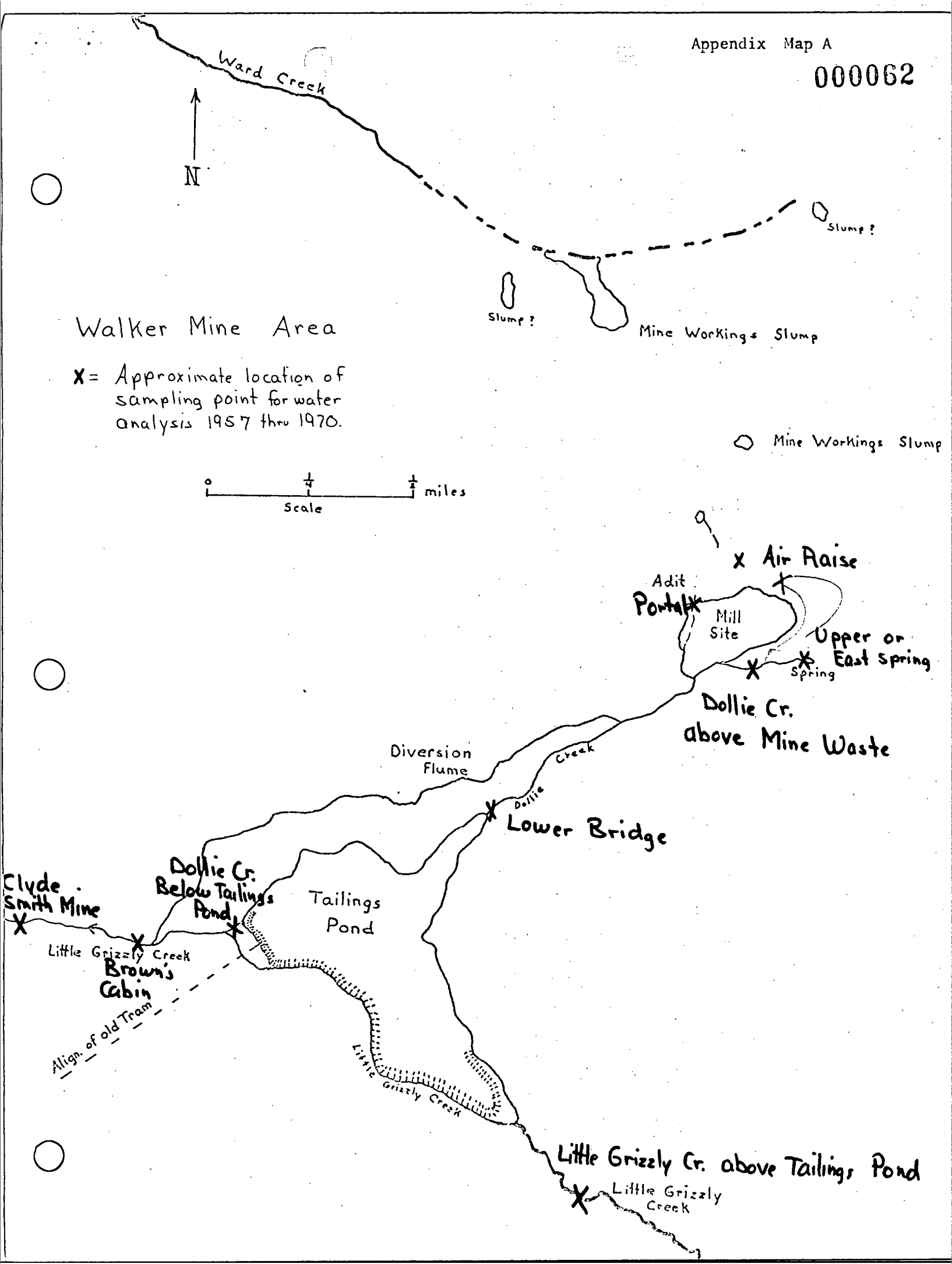
Table 4

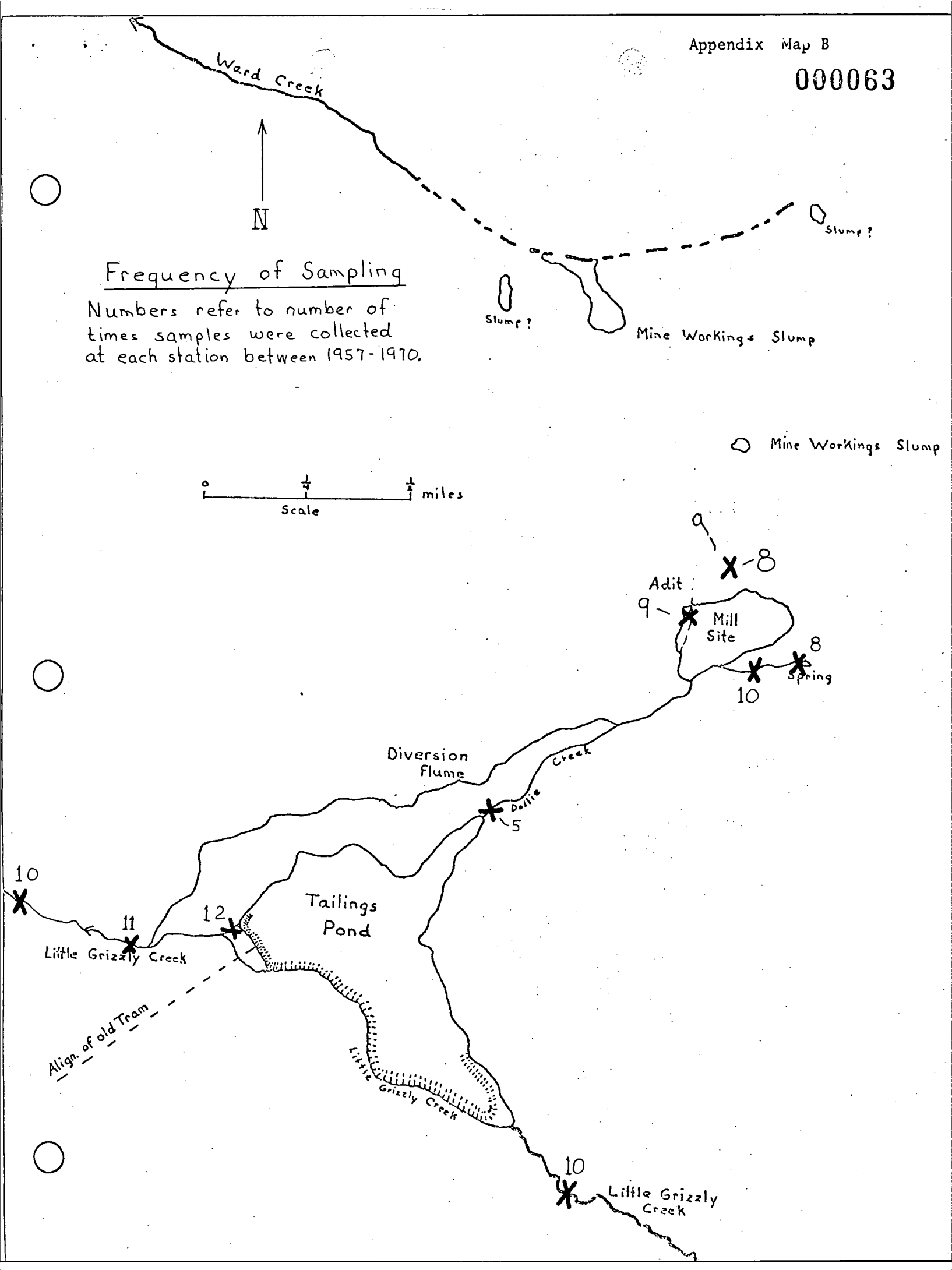
Frequency of sample collecting - once every 4 weeks

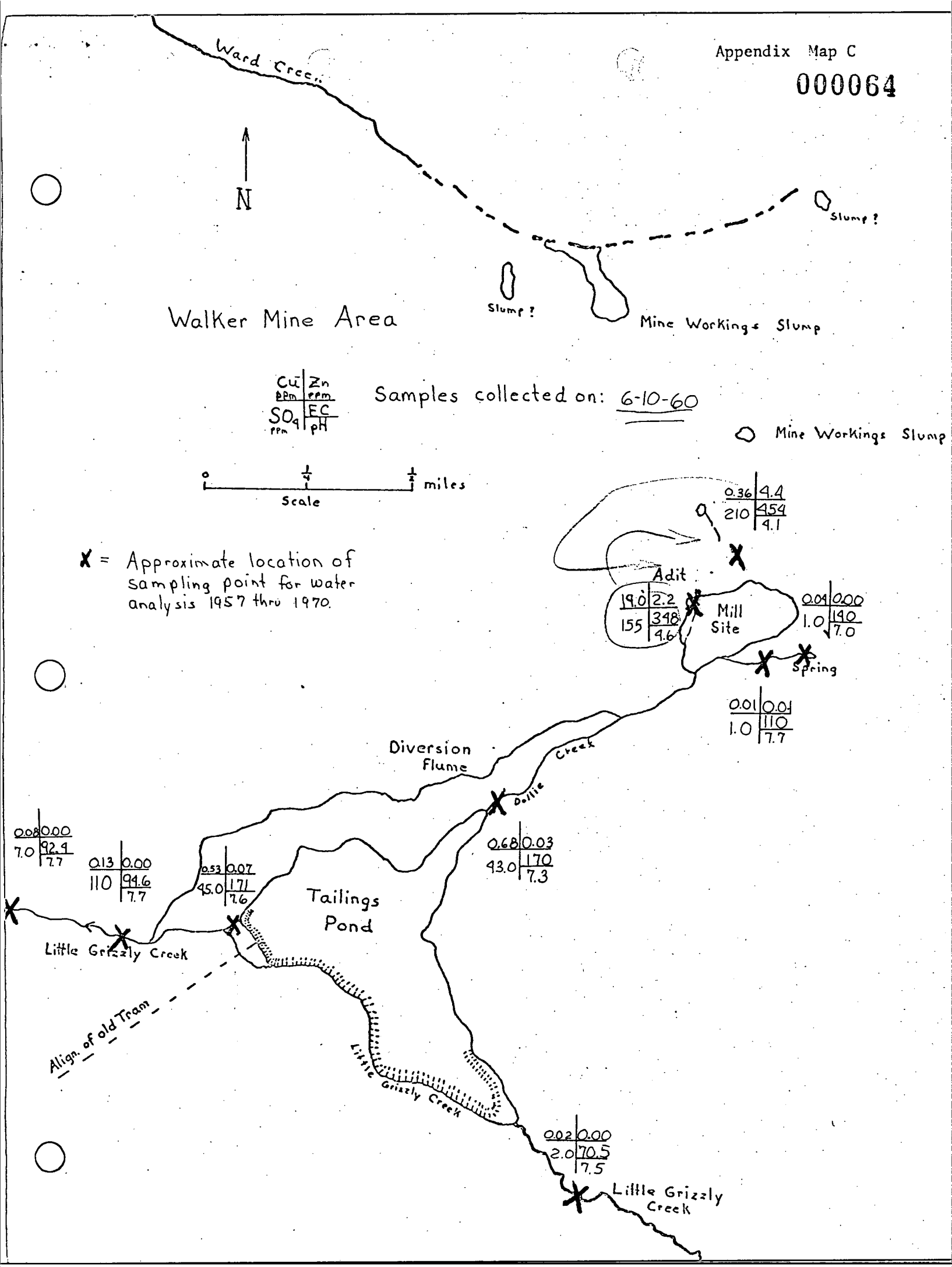
Complete analyses one time only

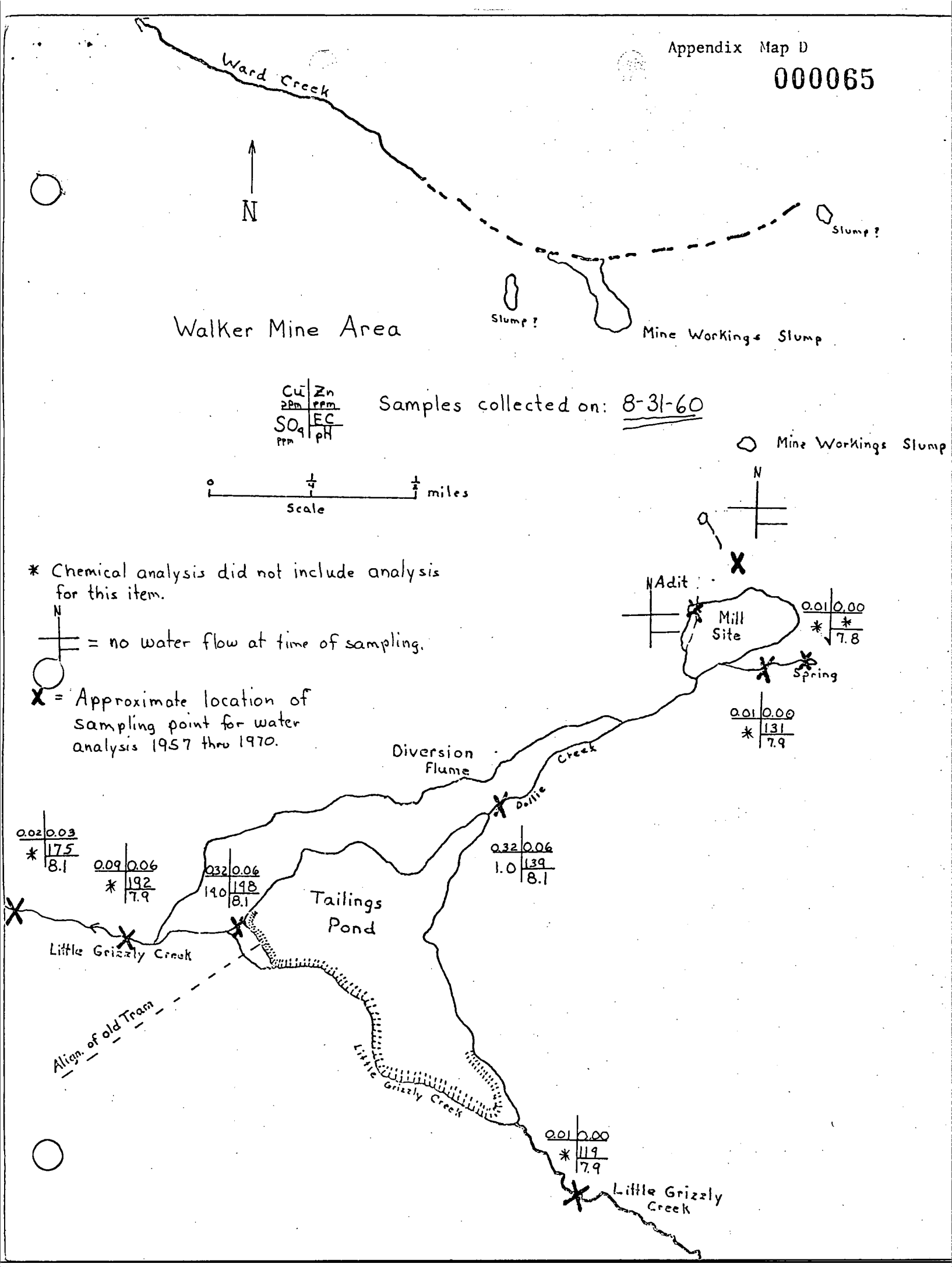
000061

Date	Wet chemical analysis: Standard minerals analysis	Wet chemical analysis: Standard metals analysis	Wet chemical analysis: Partial analysis	Dry analysis: Spectro-graphic analysis	Specific conductance	Cost
1 Apr	1	1	1		✓	$ 766 50
1 May				1	✓	154
2 Jun				1	✓	154
30				1	✓	154
28 Jul				1	✓	154
25 Aug				1	✓	154
22 Sep				1	✓	154
20 Oct				1	✓	154
				Total estimated cost		$ 1844 50


Ward Creek
N
Slump ?
Slump ?
Mine Workings Slump
Walker Mine Area
X = Approximate location of sampling point for water analysis 1957 thru 1970.
Mine Workings Slump
0
1/4
1/2 miles
Scale
X Air Raise
Adit
Portal
Mill Site
Upper or East Spring
Spring
Dollie Cr. above Mine Waste
Diversion Flume
Dollie Creek
Lower Bridge
Clyde Smith Mine
Dollie Cr. Below Tailings Pond
Tailings Pond
Little Grizzly Creek
Brown's Cabin
Align. of old Tram
Little Grizzly Creek
Little Grizzly Cr. above Tailings Pond
Little Grizzly Creek


Ward Creek
N
Slump ?
Slump ?
Mine Workings Slump
Frequency of Sampling
Numbers refer to number of times samples were collected at each station between 1957-1970.
Mine Workings Slump
0 1/4 1/2 miles
Scale
9
8
Adit
9
Mill Site
8
Spring
10
Diversion Flume
Creek
Dolite
5
10
11
12
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
10
Little Grizzly Creek


Ward Creek
N
Slump ?
Slump ?
Mine Workings Slump
Walker Mine Area
Cu ppm | Zn ppm
SO4 ppm | EC
pH
Samples collected on: 6-10-60
Mine Workings Slump
0 1/4 1/2 miles
Scale
X = Approximate location of sampling point for water analysis 1957 thru 1970.
0.36 | 4.4
210 | 454
4.1
Adit
19.0 | 2.2
155 | 348
4.6
Mill Site
0.04 | 0.00
1.0 | 190
7.0
Spring
0.01 | 0.04
1.0 | 110
7.7
Diversion Flume
Dollie Creek
0.68 | 0.03
43.0 | 170
7.3
0.08 | 0.00
7.0 | 92.9
7.7
0.13 | 0.00
110 | 94.6
7.7
0.53 | 0.07
45.0 | 171
7.6
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
0.02 | 0.00
2.0 | 70.5
7.5
Little Grizzly Creek


Ward Creek
N
Slump ?
Slump ?
Mine Workings Slump
Walker Mine Area
Cu ppm | Zn ppm
SO4 ppm | EC pH
Samples collected on: 8-31-60
Mine Workings Slump
0 1/4 1/2 miles
Scale
N
X
* Chemical analysis did not include analysis for this item.
N
= no water flow at time of sampling.
X = Approximate location of sampling point for water analysis 1957 thru 1970.
N Adit
Mill Site
0.01 | 0.00
* | *
7.8
Spring
0.01 | 0.00
* | 131
7.9
Diversion Flume
Creek
Dollie
0.32 | 0.06
1.0 | 139
8.1
0.02 | 0.03
* | 175
8.1
0.09 | 0.06
* | 192
7.9
0.32 | 0.06
1.0 | 198
8.1
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
0.01 | 0.00
* | 119
7.9
Little Grizzly Creek

Wes Strand
Les Brewer

PLANS TO PROCEED

TOWARD ABATEMENT OF THE

WATER POLLUTION PROBLEMS INCIDENT

TO WATER EMANATING FROM

THE WALKER MINE,

PLUMAS COUNTY

FORMULATED BY THE

CALIFORNIA DIVISION OF MINES AND GEOLOGY

PURSUANT TO INTERAGENCY CONTRACT #1-4-45

WITH THE

STATE WATER RESOURCES CONTROL BOARD

MARCH 25, 1972

STATE OF CALIFORNIA—RESOURCES AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION

DIVISION OF FORESTRY
DIVISION OF MINES AND GEOLOGY
DIVISION OF OIL AND GAS
DIVISION OF SOIL CONSERVATION

SACRAMENTO, CALIFORNIA
1416 Ninth Street

March 25, 1972

Bill B. Dendy, Executive Officer
State Water Resources Control Board
Room 1140, 1416 Ninth Street
Sacramento, California 95814

Dear Mr. Dendy:

I am pleased to transmit herewith five copies of the report entitled "Plans to Proceed Toward Abatement of the Water Pollution Problems Incident to the Water Emanating from the Walker Mine, Plumas County", dated March 25, 1972, the preparation of which was initiated under Interagency Contract #1-4-45 between the State Water Resources Control Board and the Department of Conservation. These final copies replace the preliminary copies dated and delivered to you March 15, 1972.

The Walker Mine problem has been with us for more than a score of years. It is hoped that a plan for control of toxic water from the mine will be implemented soon.

This report outlines the essential framework of a study to determine how to abate this problem. It describes two alternative paths the State may follow to control this toxicity problem: one more direct but less reliable; the other based on the collection of ample background data to understand the problem thoroughly.

The decision as to which control approach to pursue rests with the State and Regional Boards.

Sincerely,

James G. Stearns, Director

STATE OF CALIFORNIA—THE RESOURCES AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION

DIVISION OF MINES AND GEOLOGY

DIVISION HEADQUARTERS

RESOURCES BUILDING, ROOM 1341

1416 NINTH STREET

SACRAMENTO, CA 95814

District Offices: LOS ANGELES
Junipero Serra Bldg., Rm. 1065
107 South Broadway
90012

SACRAMENTO
Resources Bldg., Rm. 118
1416 Ninth Street
95814

SAN FRANCISCO
Ferry Building
94111

March 25, 1972

Honorable James G. Stearns, Director
Department of Conservation
Room 1505, 1416 Ninth Street
Sacramento, California 95814

Dear Mr. Stearns:

Enclosed is a copy of the Division's report on the preliminary study phase of the Walker Mine pollution control study.

This report contains recommendations, cost estimates and time schedules for a study (or studies) designed to determine how to control toxicity from this mine.

The high cost of measuring, sampling and testing physical, chemical and biologic parameters in remote localities is stressed throughout. The estimated costs are intended only as guides to choose between alternative tasks. Actual costs may range widely from the minimum estimates.

This report was prepared under contract with the State Water Resources Control Board.

Very truly,

Wesley G. Bruer

Wesley G. Bruer
State Geologist

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Department of Conservation
Division of Mines and Geology

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Division of Mines and Geology (1971)

Abstract

The California Division of Mines and Geology has developed alternative general plans to determine the nature and cause of toxicity in Little Grizzly Creek, Plumas County, so that the most economical, but effective control system may be designed and implemented.

The most practical method to control the toxicity contributed to Little Grizzly Creek by the Walker Mine will be determined by completion of a number of basic data gathering tasks. Topically, the tasks may be grouped as:

1. Stream gauging, sampling, and analysis
2. Toxicity testing of fish and insects
3. Geologic exploration of the mine area, and
4. Research on available methods of toxicity control.

The Problem

A condition of pollution exists in Little Grizzly Creek, Plumas County, California; trout are absent from the central and lower reaches of this stream. The absence of trout is believed to be due to the toxic materials in the effluent from the Walker Mine, its dump, and its tailings. The copper content of the mine effluent is sufficiently high to cause the death of rainbow trout, and therefore it is assumed that the presence of this substance, the precise source of which is unknown, is the primary cause of the problem. The total amount of copper and volume of toxic water reaching Little Grizzly Creek may be roughly approximated, but the variation of toxicity due to seasonal fluctuations is unknown and the controlling parameters are poorly understood.

Trout do survive when mine not discharg significant amt.

The preservation and enhancement of fish in Little Grizzly Creek is the ~~only~~ Principal beneficial use of these waters for which concern has been expressed. The re-establishment of the native rainbow trout, salmo gairdnerii, fishery can only be effected by cleaning up the polluted waters. & containment of tailings

esthetics & Stock

Attempts by the Central Valley Regional Water Quality Control Board (hereafter referred to as the Regional Board) to pursuade the mine owner to abate the pollution have failed.

Historical Background

The Walker mine was discovered in 1904. The principal periods of activity were from 1916 to 1932 and from 1935 to 1941. Mining ceased in November 1941, and shortly thereafter all mining and milling equipment was dismantled and removed. It is believed that a pollution problem has existed since that time (1941).

A "cement" copper recovery unit, which permitted extraction of copper directly from the mine effluent, was operated in the early days of ownership by R. R. Barry and associates (Larry Trumbull, personal communication). The recovery cells were located in the main haulage tunnel, but the system was soon abandoned for unknown reasons and the outer 300 feet of the tunnel was caved by blasting.

Based on the presence of a blue-green colored precipitate(?) on stream bottoms, on the fact that the Walker Mine was principally a copper producer, on the upstream location of its dump and tailings, and on the rumor that fishing in Little Grizzly Creek was generally better before the mine was closed than in recent years, it was concluded prior to 1957 that copper coming from the mine and the mill tailings was responsible for a disappearance of downstream aquatic life. This conclusion is weakened by inadequate data necessary to support such generalizations and assumptions. Bull!

Investigation of the problem of pollution of Little Grizzly Creek by the Regional Board began in 1957. Seven water samples from various locations in the mine area were analyzed for copper, zinc, sulfate, pH, and electrical conductivity. Temperature and flow rates were also recorded. Sampling and analysis of the waters continued to 1970 in a sporadic manner (See Appendix V, Chemical Analyses). Results of this sampling and testing program are inadequate for the selection of the most efficient toxicity control method. However, they do reveal that; True

1. Effluent from the air raise was observed flowing at rates of 0.33 to 1.5 cubic feet per second on eight of ten visits; there was no effluent on the other two visits (See Appendices IV, and V).

2. A comparison of sample temperatures of surface streams and springs suggests that the surface water is warmer than ground water, or that there is a bias (seasonal?) in the data collection.

3. Copper concentration in the sampled waters was highest at the air raise and portal stations; concentration at most other stations was generally on the order of 100 times less.

4. In general, electrical conductivity is directly proportional, and the pH is inversely proportional, to the metallic ion and sulfate content of the sampled waters.

5. Water sampled from the upper, or "East", Spring contains little to none of the ions of copper, zinc or sulfate. This suggests that ground water that percolates rock surrounding the mine contains virtually none of these substances.

6. Dollie Creek above the mine dump area and Little Grizzly Creek above the tailings area are usually "clean", but are toxic* occasionally. What evidence?

7. Copper content in the surface waters generally decreases as the distance from the mine adit increases, except for the possible slight contribution or non-dilution of copper concentration in the tailings area.

8. Surface waters are toxic* to trout at least two miles down stream from the mine portal (See Appendix V, Clyde Smith mine sample station data).

*Water containing greater than 10 parts per billion (ppb) copper is considered to be toxic to rainbow trout.

The Regional Board has issued requirements to reduce the copper content of the effluent and in 1963 issued a cease and desist order. The District Attorney of Plumas County was informed but declined to prosecute the violators.

In 1970, Norandex (mineral exploration company), the mine lessee, proposed to the Regional Board a method of toxicity control involving draining the mine, diverting the mine water around the tailings, reconditioning an old diversion ditch on Ward Creek, constructing settling ponds to reduce toxicity, and maintaining diversion ditches to prevent water from entering the discovery shaft. This offer was refused by the Regional Board because the company could abandon the property when its lease ran out and consequently no one would remain to maintain the system. Barry would not assume responsibility

Not so. Norandex wanted clean bill of health when they drained mine

In March 1971, the California Division of Mines and Geology submitted a report to the Regional Board at the Board's request. The report contained recommendations and cost estimates for a study of the effects of mine water drainage in the Little Grizzly Creek watershed. The report included a brief history of the mine, several maps, and a water sampling, analysis, and gauging plan. Also included were several photographs of the Walker Mine vicinity, and several tables of results of chemical analyses obtained by the Regional Board staff (interpreted above). Three alternative plans, differing in cost ($19,851; $15,707; $12,333) and extent of sampling and analysis to be obtained, were submitted.

A different type of report was desired by the State Water Resources Control Board (hereafter referred to as the State Board), however, and a revision of the report was requested.

Introduction

Objective. The objective of this report is to present the scope and cost of a study to determine how to control toxicity contributed to Little Grizzly Creek from the Walker Mine (See Appendix II, Contract).

Scope. The scope of this report is to devise a plan to determine:

1. What toxic substances are present,
2. What indigenous species are affected,
3. How these species are affected,
4. How an effective plan may be evolved to counter the effects of the toxic substances at the most reasonable cost.

Sources of toxicity other than the Walker Mine, its dump, and its tailings have not been considered in this report because of contract specifications (See Appendix II, Contract).

Determinations

General Statement: Options. There are two general courses of action available to the State Board, other than doing nothing about the problem. The first, and most direct, is a remedial plan to design a toxicity control method based upon presently known data or strongly suspected conditions, implement this control method, observe the results and follow up with additional testing and modifications of the method as necessary. The second is a data collection plan to achieve a higher level of understanding of the exact nature, cause, and effect of the pollution of Little Grizzly Creek, such that a higher assurance of success in the remedial stage may be obtained. The completion of all of the tasks outlined in this proposal would not guarantee complete success in restoration of the fishery, however, the results of the investigations are expected to increase the probability of success of the control measure selected.

Alternative I: Remedial Plan

At the present time, based on a cursory understanding of the problem, it is recommended that a toxicity control system using soil filtration, evaporation ponds, pH adjustment, copper precipitation, mine inflow reduction, and mine air restriction be favorably considered. This plan was chosen mainly because of low initial cost, simplicity of operation and low maintenance factors, and because it will probably reduce copper content of the resultant effluent; thereby improving water quality in the fishery. It will be a step in the right direction even if it doesn't completely solve the problem.

If this course of action is chosen, preliminary design criteria should be obtained, preferably by short term investigations (See Appendix III, p. 51). These investigations may be reasonably performed by Regional or State Board staff, or by outside contractors at an estimated cost of $10,000.

Alternative II: Data Collection Plan

If alternative II is selected, it is recommended that the tasks which have been described in Appendix III be performed in order of priority (task sequence) of usefulness to subsequent studies or tasks (See Appendix III, Table 1).

It is emphasized that the performance of these tasks is designed to provide knowledge necessary to abate the pollution problem. Even performance of all tasks may not assure adequate knowledge; however, the performance of any task in sequence should enhance the storehouse of knowledge so that the probability of selecting the correct remedial plan is improved.

Alternative II provides, in effect, twenty-five options; a cut-off is possible upon the completion of any task. However, it is recommended that blocks of tasks be undertaken. Thus, the first ten tasks provide for general background data and knowledge necessary to answer such vital questions as:

1. How much is known about the toxicity of copper to trout?
2. What are the sources, concentration ranges, and synergistic effects of the toxic substances present?
3. What are the tolerances of the indigenous species to these toxicants?
4. What is the nature of the local hydrology?

Easy for DF&G

The cost of these ten tasks is estimated to be $102,000 to $204,000. No.

Most of these tasks will take one year or less to complete; however, the few monitoring tasks will logically continue for as many years as is practical.

The second block of tasks are those with priorities eleven through sixteen. These tasks will provide additional basic data to answer questions such as:

1. What is the affect of the mine dump and mill tailings on the problem?
2. What is the nature and affect of the geologic and hydrologic framework on the problem?
3. What is the status of research on similar problems throughout the world?

The cost of these tasks is estimated to be between $63,000 and $126,000; and take at least one year. NO.

The last block of tasks described are those with priorities from seventeen to twenty-five. These deal with supplemental data and work programs that provide specific types of information and may take several years to complete. The results of these tasks may provide answers to such questions as:

1. What is the source, nature and flow rates of the mine water?
2. What and where are the specific sources of toxicity?
3. What is the rate and direction of regional ground water movement?
4. What influence will the selected method have on the local environment?

These tasks are estimated to cost $896,000 to $1,792,000.

At the completion of each block of tasks a group or panel of experts representing appropriate disciplines should evaluate all data collected to:

1. Select the best toxicity control method,
2. Decide whether to move on to the next block of tasks, or
3. Choose new or different tasks to provide needed information not previously anticipated.

The appropriate disciplines include aquatic biology, water chemistry, hydrology, water quality technology, mining engineering, civil engineering, and soil science.

Those tasks identified as having a high priority should be performed as soon as is practical, if a decision is made to proceed with the data gathering alternative.

The methods of toxicity control considered at this time deal, in general, with the following processes:

1. Influent exclusion
2. Effluent dilution
3. Physical extraction
4. Dissolution prevention, and
5. Chemical precipitation.

The application of a combination of two or more of these methods probably will be most efficient and economical (See Appendix III, Contract Item 6).

Recommendations

It is recommended that the State Water Resources Control Board resolve to:

a. Adopt Alternative I, and begin a toxicity control program based on present knowledge,

or

b. Adopt Alternative II, and begin a program of comprehensive and costly testing and sampling tasks to aid in the design of a toxicity control system.

Appendix I

Schedules for

Data Collection Plan

Task Priorities

Priorities are based on a "need-to-know" basis. The tasks with higher priorities are those which will provide the most essential information to the understanding of the problem, those which will be most useful in other tasks, and those which can be done somewhat independently of the other test and sampling tasks. Results and interpretations of completed high priority tasks may radically alter the priorities of later tasks, or may even suggest new tasks or methods of study.

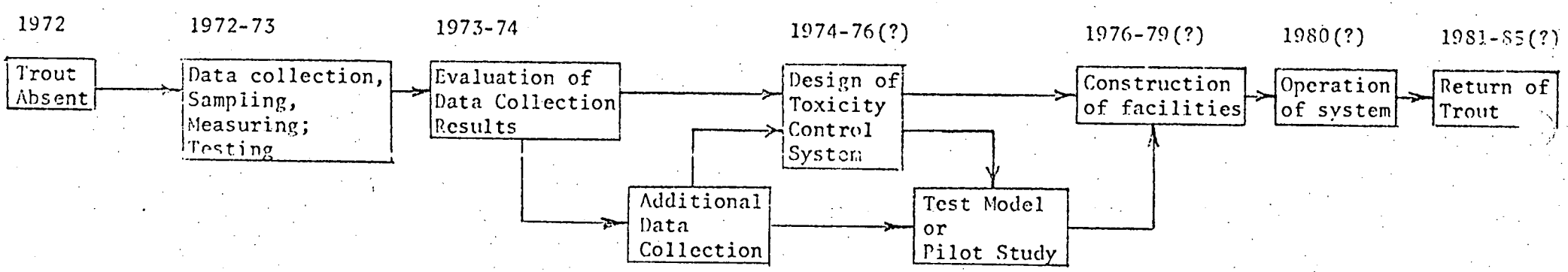
Task Sequence	Contract Item Number	Block Number/Task
		Block I: High Priority
1	4(a-b)	Literature search
2	"(")	Stream habitat survey, regional
3	"(")	Dilution tests
4	3(a-b)	Qualitative tests
5	"(")	Quantitative tests
6	2(a)	Hydrologic survey, local
7	3(a-b)	Stream gauges & records
8	"(")	Stream bed samples
9	4(a-b)	Trout toxicity tests
10	"(")	Insect toxicity tests
		Block II: Medium Priority
11	3(a-b)	Dump samples
12	"(")	Tailing samples
13	6	Technical awareness
14	1(a)	Detailed surface map
15	1(b,3)	Regional hydrologic study
16	1(")	Spring gauges and records
		Block III: Low Priority
17	1(b,1)	Dewater mine
18	"(")	Open passageways
19	"(")	Survey mine workings
20	1(b,2)	Underground geologic map
21	2(a)	Monitor-well construction
22	"(")	Core logging & hole measurement
23	4(a-b)	Soil survey and tests
24	"(")	Toxicity control methods tests
25	5	Title search, history

Table I. Classification of work order sequence number and contract item by priority grade.

Toxicity Control Schedule

for

Data Collection Plan



Appendix II

Contract Agreement

Authorizing

This Report

INTERAGENCY AGREEMENT

STATE OF CALIFORNIA
STD. 13 (REV. 4/70)

NUMBER
1-4-45

THIS AGREEMENT is entered into this 1st day of September, 1971, by and between the undersigned State Agencies:

(Set forth services, materials, or equipment to be furnished, or work to be performed, and by whom, time for performance or completion, and provision for payment per 1280 and 8760-8760.2 SAM.)

Distribution:
Agency providing services
Agency receiving services
Department of General Services (unless exempt from DGS approval)
Controller

As required in Exhibit A attached hereto and incorporated by reference and made a part hereof.

APPROVED
Alfred S. Roxburgh

NAME OF STATE AGENCY: State Water Resources Control Board	NAME OF STATE AGENCY: Division of Mines and Geology, Department of Conservation
CALLED ABOVE (SHORT NAME): Board	CALLED ABOVE (SHORT NAME): Department
AUTHORIZED SIGNATURE: E. P. Klussman	AUTHORIZED SIGNATURE: Wesley G. Bruer
TITLE: Chief, Div. of Adm. Services	TITLE: STATE GEOLOGIST

(Continued on ____ sheets which are hereby attached and made a part hereof)

FUND: General

DEPARTMENT OF GENERAL SERVICES APPROVAL (UNLESS EXEMPT 1281 SAM)

by L. Cassano

AMOUNT OF THIS ESTIMATE: $ 5,000

UNENCUMBERED BALANCE: $

ADJ. INCREASING ENCUMBRANCE: $

ADJ. DECREASING ENCUMBRANCE: $

APPROPRIATION: Support

ITEM	CHAPTER	STATUTES	FISCAL YEAR
215	266	1971	71/72

FUNCTION: OE&E

LINE ITEM ALLOTMENT: Contractual Service 142G

I Hereby Certify upon my own personal knowledge that budgeted funds are available for this encumbrance.

T.B.A. NUMBER:

B.R. NUMBER:

SIGNATURE OF ACCOUNTING OFFICER: E. P. Klussman

42165-750 4-70 50M 033

Exhibit A to
Interagency Agreement #1-4-45
Between the
State Water Resources Control Board
and the
Department of Conservation
DIVISION OF MINES AND GEOLOGY

TITLE: Development of a Study to determine methods of controlling toxicity from the Walker Mine, Plumas County.

OBJECTIVE OF THE REPORT: Present the (1) scope and (2) cost of a study to determine how to control toxicity contributed to Little Grizzly Creek from the Walker Mine.

REPORT: The eventual control of toxicity will require at least a knowledge of the geology of the mine area, the extent of underground works in the mine, the relationship between inflow to the mine and outflow, the hydrology of the entire mine area, the sources and nature of toxicity at various times of the year, land ownership, and possible treatment or control methods suitable for the particular situation. The department will perform the following tasks:

1. (a) Determine geological information available and
   (b) Estimate work involved to obtain remaining information necessary to determine
      (1) the extent of underground workings,
      (2) the location of principle mineralized zones or other sources of toxicity and
      (3) the movement of underground water.
      % of effort 18% estimated

2. Devise a plan to
   (a) Determine the relationship between inflow and outflow of water from the mine and
   (b) feasibility of reducing the total toxic flow.
      % of effort 16% estimated

3. Plan a sampling program coordinated with a toxicity testing program to determine
   (a) sources and
   (b) Seasonal volume of toxic water.
      % of effort 14% estimated

4. Include a toxicity testing program which will assist
   (a) in the determination of sources of toxic material and
   (b) in the selection of any proposed control methods.
      % of effort 24% estimated

5. Estimate the effort which may be considered necessary to determine land ownership of
   (a) surface and
   (b) underground holdings
   (c) water rights which could be affected by control or diversion of inflow to the mine or outflow from the mine and

(d) mineral rights which could be affected by control programs.
% of effort 6% estimated

6. Plan a program to obtain information from
   (a) references
   (b) technical consultants and
   (c) other sources on alternative methods of control of toxicity from the mine, together with any testing or pilot studies which must be involved.
   % of effort 12% estimated

7. Prepare and submit five copies of a report with recommendations and cost estimates for a study designed to determine how to control toxicity from the Walker Mine area.
   % of effort 10% estimated

Ownership of Data

Information, data, computations, and working papers developed in this study by the Department shall be the property of the Department. The Board shall have the right to the use of such information, data, computations and working papers.

Payment

In consideration of the performance of the foregoing in a satisfactory manner, the Board agrees to pay the Department an amount equal to the latter's cost of performance hereunder computed in accordance with Section 8760 of the State Administrative Manual.

The study shall be completed and the final report submitted by March 1, 1972. The amount payable under this contract shall not exceed a total of $5,000.00

Appendix III

Task Schedule Explantion

Details
of
Contract Items
1 through 6

1. Geologic Information
2. Mine Water Studies
3. Sampling Program
4. Toxicity Testing
5. Land Ownership Search
6. Toxicity Control Methods Review

Item 1(a)*

Geologic Information

The geology of the Walker Mine and its environs is poorly known. Little work has been done in detail with the possible exception of mapping of the mine workings. The mine records are the property of the mine owner who was not contacted in this regard.

Regional Geology

On a regional basis the principal source of reliable geologic information is in the published and unpublished work of Dr. Cordell Durrell, and in the unpublished work of Jad d'Allura, a graduate student at the University of California, Davis.

Local Geology

The local geology reveals a complex history of sedimentation, metamorphism, volcanism and repeated faulting. Exposures are generally poor and geologic mapping is difficult, consequently, structural interpretations usually have been made on meager evidence and are therefore open to question.

*Item numbers are the same as those specified in Agreement #1-4-45.

General references:

1. Averill, C. V., 1937, Mineral resources of Plumas County: California Jour. Mines and Geology, v. 33, no. 2, p. 79-143.

2. Durrell, Cordell, 1959, Tertiary stratigraphy of the Blairsden quadrangle, Plumas County, California: California Univ., Dept. of Geol. Sci. Bull., v. 34, no. 3, p. 161-162.

3. _____, 1959, The Lovejoy Formation of northern California: California Univ., Dept. Geol. Sci. Bull., v. 34, no. 4, p. 193-220.

4. _____, 1966, Tertiary and Quaternary geology of the northern Sierra Nevada, in Geology of northern California, Bailey, E.H., ed: California Div. Mines and Geology, Bull. 190, p. 185-197.

5. McMath, V. E., 1966, Geology of the Taylorsville area, northern California, Bailey, E. H., ed: California Div. Mines and Geology, Bull. 190, p. 173-183.

6. Smith, A. R., 1970, Trace elements in the Plumas copper belt, Plumas County, California: California Div. Mines and Geology, Spec. Rept. 103, 26 pp.

7. Turner, H. W., 1897, Description of the Downieville quadrangle [California]: U. S. Geol. Survey Geol. Atlas, Folio 37.

Detailed geologic information must be provided to enable an understanding of the physical framework of the Walker Mine and its vicinity. This information will not solve the problem directly, but it may be extremely valuable, permitting the contractor to capitalize on favorable geologic features and to avoid hazardous features. It will contribute to the overall efficiency and reliability of any control system used.

Geologic Mapping

Geologic maps of the surface features should be prepared at a scale of one inch equals 200 feet. It is anticipated that sixteen square miles centering on the mine shaft location is the maximum area to be covered at this scale. The central four square mile area above the main mine workings is considered to be the most important.

Supplementary maps at a scale of one inch equals 40 feet should be prepared for, portal and collar areas, important contact and fault exposures, and all construction and excavation sites.

Map Emphasis

The field work and the resulting map should emphasize rock fractures, chemical composition, texture, weathering, alteration, and surficial units and processes.

Map Uses

The resultant data will be used for, the estimation of bedrock fracture spacing and ground water permeability, chemical background information in the local geochemical sampling program, background information for any of the geophysical studies, the determination of suitable foundation sites and construction materials source areas, the determination of zones of mineralization and sources of toxic materials, and the determination of

areas of active geologic processes which might affect any toxicity control facilities.

The geologic map and associated information may also be used in:

1. the local hydrologic survey,
2. the selection of stream gauge stations,
3. regional hydrologic study,
4. spring gauging and other ground-water evaluation,
5. selection of monitor wells,
6. core logging and other subsurface correlations,
7. dewatering the mine, reopening and rehabilitating the mine,
8. stream habitat survey,
9. stream bed sampling, and
10. evaluating any of the possible toxicity control methods.

Cost

It is estimated that a geologic map at a scale of 1 inch = 200 feet, data compilation, and a report can be prepared for approximately $13,000; and should take about six man-months to complete.

Priority

The priority for the detailed geologic map of the mine vicinity is low: 14th of 25 tasks, largely because other tasks (relating more directly to control methods) are more significant to a direct solution, and can be carried out without this information.

The geologic mapping does not have an inherent sequential priority. It can be done at any time, and it may be undertaken very early in the overall data gathering process to good advantage. The map and data compilation may be modified and supplemented as new exposures, access to underground workings, or drill hole data become available.

Soil Survey Coordination

A soil survey and sampling program can be effectively coordinated with the geologic mapping. This program will mainly result in the determination of the suitability of local soils to filter and neutralize mine effluent. Soil depth, chemical composition, and other features should be identified and compiled to determine the feasibility of such a control method. The details of this task are explained on page 39.

Task Augmentation

Geophysical Surveys

The importance of geophysical examination of the Walker Mine area cannot be properly predicted until after the preparation and interpretation of the geologic map.

Information which may be obtained from geophysical examinations include the determination of:

1) Depth of weathering,
2) Depth to water,
3) Thickness of free-water body,
4) Porosity of rock and soil,
5) Density of bedrock,
6) Location of faults,
7) Location and attitudes of fracture zones,
8) Location of mineralized zones.

The type of geophysical examination to be undertaken can best be chosen by coordinating the detailed geologic map with the information needed. Seismic surveys might disclose the most precise information, but would probably cost the most, perhaps $10,000; and take two to three weeks of crew effort.

Resistivity (or other electrical) surveys would seem to provide the most useful information per unit of cost. A resistivity survey of appropriate detail of the mine area is expected to cost about $5,000 and take about three weeks to complete. If precisely surveyed stations are available, gravimetric and magnetic surveys might be done for $1,000 each and take only several days. Precise leveling surveys for the gravity stations might cost an additional $3,000.

Item 1 (b)(1)

Underground Workings

The underground workings of the Walker Mine include all of the openings excavated during mining activities as well as all voids created by subsequent caving.

Mine Surveying

The determination of the extent of the underground workings should be obtained by an engineering survey. The most useful presentation of this information would be as a map at a scale of one inch equals 200 feet. This scale will facilitate comparison of data with the 1941 Anaconda Company maps. Survey precision should be commensurate with this map scale.

The data derived in this task can be used to compute the total potential open reservoir volume of toxic water readily available for surface water pollution. This would also provide data concerning the volume of backfill material needed to seal the mine if such a remedial method is chosen. Separate maps indicating location and extent of stopes and shafts should be prepared for each mine level.

Base Maps

Data of the underground workings presented in this way can be readily used as base maps for subsurface geologic mapping, and thereby greatly expedite the compilation and presentation of the mine geology.

Previous Work

The extent of the underground workings of the Walker Mine, at the time of its closure, is known from mine maps on file in the Sacramento District Office, California Division of Mines and Geology. These maps, supplied by the Anaconda Company, were prepared in 1941 at a scale of

one inch equals 200 feet. They show approximately 13 miles of tunnels and 3,300 feet of shafts. The extensive stopes, or mined out areas, which must exist are not shown. Natural caving during the last 30 years may have greatly altered the shape and size of the underground workings.

Timing

In order to determine the exact physical description and condition of the underground workings it will be necessary to dewater, re-enter and survey the mine. This is likely to be a long, hazardous and expensive project; however, it is the necessary first step of any remedial method involving the underground portion of the mine. Work schedules may be quite variable. Dewatering may preceed retimbering and mapping by a few days or weeks (or months); or if drainage is particularly slow or irregular, it may be necessary to drain the entire mine and let it dry out before it is safe to begin retimbering and mapping.

Cost

Dewatering and re-opening the mine will be the costliest part of a program to survey the underground workings. These tasks should be done on a cost-plus basis with about $100,000 budgeted for the first year.

The cost to resurvey and compile the data of the underground workings should be about $13,000 and take about three months to complete.

Resource Conservation

Admission by State of value of mineral

The cost of certain control methods, such as sea[illegible] mine or even the mere retimbering of the mine, may ca[illegible] abandon the mine and thus reduce, if not eliminate, th[illegible] using this deposit for mineral production in the futur[illegible] add greatly to the overall cost to our society in terms of lost mineral

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Resource Conservation

The cost of certain control methods, such as sealing or grouting the mine or even the mere retimbering of the mine, may cause the owner to abandon the mine and thus reduce, if not eliminate, the possibility of ever using this deposit for mineral production in the future. Such a result would add greatly to the overall cost to our society in terms of lost mineral

resources. In this context, it should also be noted that the value of the minerals to our society is considerably more than the dollar amounts which these commodities now bring in the market.

Coordination

Dewatering, retimbering, engineering mapping, and geologic mapping may precede grouting and sealing very closely. The feasibility of this method for all, part or none of the mine will have to be ascertained.

It may be possible to coordinate all underground activities so that remedial or control measures are implemented soon upon completion of the data gathering tasks, and only local or isolated parts of the mine may need to be treated at any one time.

Environmental Considerations

Even before the mine can be dewatered an effluent treatment method or facility must be put into operation to neutralize these toxic waters. The capacity of the effluent treatment system will be a factor limiting the rate at which the mine can be dewatered. Inflow into the mine at present is on the order of a few hundred gallons per minute, but this rate may increase several fold as the free water surface is lowered and differential pressures are increased. Pumping is regarded as the most feasible method to dewater the mine below the main haulage or 700 level. This is about the midpoint of the mine depth. A total maximum lift of abou[illegible] expected to be necessary to drain the lowest or 1,200 le[illegible]

Metal extraction
300-606

If the rate of infiltration is low, the mine may b[illegible]. If the rate is high, however, it may be essentially imp[illegible] mine completely. Treatment facilities for this effluent, such as a me[illegible] extraction system, may cost $300,000 to $600,000 to construct.

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If the rate of infiltration is low, the mine may be drained in a few years. If the rate is high, however, it may be essentially impossible to dewater the mine completely. Treatment facilities for this effluent, such as a metal extraction system, may cost $300,000 to $600,000 to construct.

Reopening of the mine, including removal of caved rock and retimbering heavy ground, should be done on a cost-plus basis. Funds required to re-establish a safe portal on the main haulage level are estimated to be about $50,000. It may take only five to ten seasons at $50,000 per season to reopen the mine if rock conditions are favorable; however, if conditions are unfavorable, a mine plant equal in size to the original, and costing several million dollars might be necessary.

Item 1(b)(2)

Mineralized Zones

The location of principal mineralized zones may be reasonably assumed to correlate with the places where the mining was done. These zones are recognized by tunnel development at several mine levels along the main ore zone as shown on the mine maps of 1941. The location of bodies of non-ore sulfide minerals (gangue), or those mineral zones too small to mine, or of low grade, may not be approximated in this way.

Toxicity Source

It is believed that the Walker Mine is the source of toxic substances in Little Grizzly Creek. Treatment of the entire mine will be very expensive, however, a simpler and less expensive control program may be selected, if a particular zone of sulfide minerals can be identified as contributing most of this toxicity.

Mining Geology

To determine the location and present concentration of mineralized zones in the mine, it will be necessary to dewater the mine, reopen the passageways and prepare a geologic map of the underground workings. This map should be compiled on the above-mentioned (page 9) engineering base of 1:2400 (one inch equals 200 feet), and show rock type, alteration, mineralization, faults and principal joint sets. The rock fracture systems probably are the main controls of ground-water flow into the mine, and should be mapped and correlated as precisely as possible. This information may be used to plan a mine sealing and grouting program to prevent influence and the generation of toxic waters.

Cost

The underground geologic map at a scale of one inch equals 200 feet can be prepared at a cost of about $25,000 and will require about five months for a small survey crew to prepare, after safe access throughout the mine is available. If, however, extensive wall washing, staging construction, or other supplemental preparations are necessary, or if unfavorable conditions prevail, the cost and time may be twice these amounts.

Priority

The information obtained from the underground geologic map will be useful in planning any control measures to treat the subsurface materials. The relatively high cost of preparation, the cost of preparatory tasks, and the usefulness to so few other tasks, indicate a low priority for the mapping of mineralized zones: presently 19th on a list of 25.

Coordination

The compilation of this geologic data may be coordinated with the engineering map preparation and retimbering and dewatering of the mine. All of these steps may be concomitants of a pressure grouting program of toxicity control to good advantage, because much of the experience gained in dewatering the mine, opening the caved zones, and mapping will be very useful in planning and implementing such a water control system.

Augmentation

Mine sampling, precise mineral identification, assaying and other chemical examinations should be held to the absolute minimum number, but nevertheless, a systematic study of such tasks may be quite useful to identify and locate unpredicted (blind) ore bodies or sources of toxicity.

Item 1(b)(3)

Ground-water Movement

Ground-water moves from higher pressure to lower pressure in a confined water system, or from a higher point to lower point on a free-water surface. Some precipitation above the mine infiltrates the rocks through connecting fractures, and issues lower on the hillside as springs of excellent quality water. These springs occur on slopes above and below the mine and several flow throughout the year. Water also percolates through the subsurface fracture system to enter the mine workings; here it comes in contact with sulfide minerals and possibly other sources of toxicity.

Regional Hydrologic Survey

A regional hydrologic survey is an essential preliminary requirement to any detailed local study or monitoring program of either surface and underground-water movement. Such a hydrologic survey should be of a reconnaissance nature dealing with surface streams, springs, precipitation characteristics, vegetation type, and evaporation potential. It should take full advantage of all precipitation records and be designed to aid in the preparation of a stream flow measurement system and the planning of toxicity control methods. It will include the location of the most useful stream gauging stations.

Subsurface Flows

The springs on the north and west slopes of Mt. Ingalls are an important source of ground-water movement data. Such information as the rate of flow, size and hydraulic continuity of the ground-water reservoir may be anticipated from precise and systematic monitoring of these

springs. This information, when correlated with results of the regional hydrologic survey, may be used to estimate the movement of ground water.

Correlations

Rates and periods of subsurface flow may be used to anticipate inflow contributions to the subsurface mine workings, and correspondingly, the potential volume and fluctuations of toxic water from the mine.

Timing

The regional hydrology and spring monitoring tasks may be done at any time. But, it is important to begin this work early in the data gathering process because a year or several years of records of spring flows may be necessary before sufficient data for a meaningful evaluation is collected. This survey should precede and contribute directly to the selection of the location of stream gauging and water sampling stations.

Cost

The regional hydrologic survey should cost about $3,000 and take about six months to complete. Installed gauges for all ten springs will cost about $15,000. Normal maintenance for the ten gauges may be had for about $1,000 per year, but many of these gauges may be reused as stream gauges later in the data gathering process and thereby reduce charges against this task.

Record keeping and interpretation may be obtained for about $1,000 a year. It can be combined with nearly any other data gathering task at slight cost.

Priority

This regional hydrologic survey will not result in any direct solution to the toxicity control problem and is considered low in relative task priority; it is 15th in a list of 25.

Coordination

The regional hydrologic survey can be most easily coordinated with, and is a logical preliminary step to, the local hydrologic study, stream gauging and water sampling. Dewatering of the mine, or any other alteration of the ground-water body, will undoubtedly invalidate conclusions or change the results of the subsurface water studies.

Item 2(a)

Mine Water

Quantity of Water

The total volume of water flowing into the mine is equal to the total volume of water flowing from the mine. More simply stated, surface plus subsurface inflow must equal surface plus subsurface outflow,over an extended period of time. The retention (water storage) within the mine, and the relative contributions from surface and subsurface sources may be estimated by the results of testing.

In the fall of 1971, approximately one-half million gallons of water per day was observed issuing through the ventilation shaft collar as surface outflow. No surface inflow was observed. It may be concluded that this outflow was caused by subsurface inflow or depletion of mine water storage.

The main tests to determine the relationship between mine water inflow and outflow involve stream flow volume and composition, mine effluent volume,and changes in volume and composition of surrounding ground water.

Paths of Flow

The paths of water movement in general are controlled by surface streams, underground rock fracture systems, open mine workings, and the local hydraulic gradients. To determine the paths of inflow and outflow from the mine it will be necessary to determine the rates of flow at several points in the inflow-outflow system. Flow rates should be obtained by stream gauges whenever possible.

Rate of Flow

To determine surface flow rates and measure possible loss of surface water to the mine, stream gauges should be installed in surface streams above and below suspected points of infiltration to the mine or ground-water body, and at the mine outflow points. Water circulating completely within the ground-water system need not be determined for this item.

The rate of flow within the mine might be determined by the use of tracer dyes or radioactive tracer elements. Rate of flow and hydraulic continuity might also be determined by slug or surge tests. The rate of subsurface flow through the mine might be determined by monitoring water depth, composition, temperature, or other factors in a series of wells surrounding the mine.

The rate of flow and path of flow information will be useful to determine how long these waters are in contact with toxic sources, the dilution or concentration of toxicity that takes place within the mine, and where possible control measures may be applied most efficiently.

Coordination

The extended monitoring of stream gauges and wells may readily be coordinated with, and performed concurrently with, the environmental sampling program (Item 3). The determination of mine water movement should be made before the mine dewatering program (Task 17) is begun.

In conjunction with the monitor well drilling program, it would be prudent to incorporate a detailed core logging project. This core logging project would provide data on the location and extent of mineralized zones or sources of toxic materials, as well as the location and identity of the more

important rock fracture systems and ground-water conduits. Professional geologic services for this work will cost about $40,000 and should run for the same two-year (drilling) period.

Costs and Uses

It is estimated that the installation of thirteen stream gauges will cost about $20,000 and take one to two man-weeks each. The locations of these gauges should be determined in the regional hydrologic survey, however, it may be discovered after they are all operational that some should be relocated or abandoned if their measurements are redundant or predictable.

Approximately one hundred monitor wells (300 feet apart, and averaging 700 in depth) completely surrounding the mine will cost about $700,000 and take five drill crews two years to complete. These wells will be used for the introduction and interception of tracer materials as well as determinations of the shape, slope, and elevation of the ground-water table.

The local (detailed) hydrologic survey will cost about $9,000 for the first three months. The probably necessary continued monitoring, adjustment, and supplemental work of obtaining the most useful hydrologic information from local conditions and facilities will add to this, however, these maintenance chores may be incorporated with other data gathering tasks at little or no additional cost. This initial cost will cover only the collection, reduction, and interpretation of data from stream gauges, flow measurements, chemical tests, monitor well data, and correlation with the regional hydrologic study (if it has been performed beforehand).

Priority

The local hydrologic survey and the installation of stream gauges are considered to be very important to subsequent tasks and are given a high

priority: 6 and 7, respectively in the list of 25 tasks. The monitor wells (and core logging) are given a low priority of 20 (and 21), because of the uncertainty of the satisfactory completion of the task, the relatively high cost, the long term of preparatory drilling (two years), and low use factor for additional data gathering tasks.

Item 2(b)

Toxic-flow Reduction

Toxic water is considered here to be any water containing more than 10 parts per billion of copper, or containing any substance in sufficient concentration by itself or in combination with other substances to cause a condition of chronic toxicity to rainbow trout. Reduction of total toxic flow may involve a reduction of volume of polluted water, a reduction of the concentration of toxic substance below the chronic toxic limit, or a combination of these.

Reduction of Volume

Reduction of the volume of polluted water reaching Little Grizzly Creek may be accomplished by such measures as effluent evaporation, redirection of subsurface flow, or inflow reduction.

Reduction of Concentration

Reduction in the concentration of toxic substances in polluted waters may be accomplished by dilution of effluent, extraction or precipitation of toxicants, dissolution retardation, or exclusion of toxic source materials.

Effluent Evaporation: Surface Disposal

Diversion of neutralized and treated water through ditches and ponds about the barren slopes below the Walker Mine would probably result in direct return of this water to the atmosphere, to vegetative plant uses and to ground-water storage. A disposal system of this type would require little maintenance if thorough and comprehensive practices of planning, design, and construction are used.

Redirection of Subsurface Flow

Redirection of subsurface flow might be accomplished by the selective or complete pressure grouting of open fractures in or about the mine. Subsurface flow through the mine might also be reduced by plugging the lower exits of mine water, allowing the mine to fill, and thereby reducing or eliminating inflow and outflow.

Inflow Reduction: Surface Diversions

It may be feasible to prevent all or most of the surface waters from entering the mine if the relationship between mine influence and effluence are favorable. A toxic-flow reduction method based on such a concept might use ditches, flumes, and/or pipes to reroute surface streams away from, or around, mine openings or infiltration zones.

Dilution of Effluent

It may be feasible, if the total toxicity of the mine effluent is not too great, to dilute the concentration of toxicants by using clean water imported from Lake Davis or from wells developed higher on the slopes of Mt. Ingalls. This method might also be used in conjunction with other toxicity reduction systems to discharge a uniformly non-toxic effluent.

Extraction of Toxicants: Copper

The extraction of metallic copper ("cement" copper) from copper laden waters by the use of scrap iron is a well known metallurgical method of metal recovery. The iron that dissolves is generally less toxic than copper, and commonly precipitates as ferric hydroxide after sufficient aeration. Inert concrete or wooden troughs, boxes, or containers are generally used for the copper recovery. The complete design of special systems such as this should be left to a competent professional, i.e. extractive metallurgist, to achieve the greatest efficiency.

Precipitation of Toxicants: pH Control

The solubility of copper in mine waters may be greatly reduced by elevating the pH of the effluent. The acidity and pH of acid mine water is commonly related to its sulfuric acid content. Addition of calcium carbonate (limestone) or some other readily available non-toxic, low priced, basic salt is a simple method to provide at least partial control. Soil filtration is probably an adequate method of separating the inert sludge from the aqueous effluent which results from the neutralization of acid mine waters.

Dissolution Retardation: Air Sealing

Sealing the mine against free-air circulation might aid in reducing total toxicity by retarding the dissolution of toxicity producing minerals. This may be accomplished by installing airtight doors on all portals and collars. Mine "breathing" might still introduce oxygen to the mine air, and subsequently to the mine water, but this control method should reduce the air exchange materially.

Exclusion of Toxic-Source Materials

The toxic-source materials within the mine may be separated from the mine waters by complete removal (mining), or by surrounding the mineralized zones with an impermeable grout curtain which would exclude them from the mine-water system.

Timing and Cost

The design, and correspondingly the cost, of a toxic-flow reduction or control system of those types described above will depend on criteria derived from the gauging, sampling, and testing programs explained throughout this appendix. (See also Contract Item 6: Alternative Toxicity Control Methods.)

Feasibility: Alternative Effort

All of the above mentioned general methods of reducing total toxic flow are feasible for unlimited fishery protection. However, the least expensive and most practical method, at this time, is a combination of dissolution retardation, inflow reduction, copper extraction, sulfate precipitation and effluent evaporation, in that order.

It may be feasible, if the cost of the data-gathering program is judged to be prohibitive, to begin an experimental implementation project based on available information concerning identified toxicants, approximate rates of water flow, trout as pollution indicators, and extremely conservative tactics to control, reduce, or mitigate the toxic water contribution to Little Grizzly Creek.

Item 3

Sources and Seasonal Volume of Toxic Water
(Sampling Program)

The effective toxicity of Little Grizzly Creek results from a combination of water quality modifiers contributed by the Walker Mine effluent, Dollie Creek and Little Grizzly Creek itself. The identity and range of these modifiers must be determined.

A sampling program to determine the sources and seasonal volume of toxic water contributed to Little Grizzly Creek is essential to an understanding of the problem and the preparation of a remedial plan. The toxic substances, the animals to which they are toxic, and the concentrations in which toxicity occurs will be identified in this task and below (see: Toxicity Testing). The toxic or detrimental effect of each constituent must be determined to establish its contribution to the loss of the fishery. The separate and synergistic toxic effects of all constituents identified will be determined from the literature, and by standard bioassay procedures or other methods of equal accuracy.

Toxicity

Toxicity as used herein is the poisonous quality of polluted water attributable to the concentration of any substances such that rainbow trout cannot live to attain legal catchable size. Chronic toxicity is usually implied.

Test Species

The test species used to determine toxicity will be chosen from results of the regional stream habitat survey (Task 2) and the toxicity testing programs described below (Item 4) and should include rainbow trout (eggs, fry, and adults), indigenous insects (caddis fly, larvae, etc.), and

other biologic agents of high sensitivity to the toxicants found.

Stream Gauges

To determine the sources and seasonal volume of toxic water (as well as clean water) contributed to Little Grizzly Creek, it will be necessary to establish stream gauges on all of its tributaries and to sample these waters for toxic substances. The location and type of gauge can best be determined after the reconnaissance (regional) hydrologic study (Task 15) has been made. It is expected that thirteen, to as many as sixteen stations will need to be established initially, but that several of these may be relocated or abandoned after stream flow characteristics are determined. The remaining gauges may need to be monitored for an indefinite period to establish long-term trends or characteristics. The thirteen gauges should cost approximately $20,000 installed; and should be monitored at least three years at $2,000 per year. The task priority for the stream gauges is relatively high (7th) because of the direct relationship between stream flow variation and any remedial control system that will be employed.

Local Sampling

The Walker Mine is considered to be the main source of toxicity for this investigation (See Appendix II, Contract). Therefore, local sampling programs will be adequate to identify the sources of toxicity and their importance.

Toxic Elements

Qualitative tests (Task 4) of a precision of one part per billion (ppb) should be performed on the water mine effluent, and on water obtained from

other key stations for the following elements:

1) aluminum	7) calcium	13) molybdenum	19) sulfur
2) antimony	8) copper	14) potassium	20) tin
3) arsenic	9) iron	15) selenium	21) titanium
4) bismuth	10) lead	16) silicon	22) uranium
5) boron	11) magnesium	17) silver	23) zinc
6) cadmium	12) manganese	18) sodium	

Additions to this list are anticipated!

Additional Tests

Tests for the presence of phenols, bacteria, insecticides, herbicides, and other toxicants should be performed periodically at appropriate sampling stations. The mine effluent should be tested for bacteria to determine if bacteria aid in the sulfide oxidation and dissolution within the mine.

Sampling Frequency

Samples of surface waters (or ground water) should be taken at time intervals that do not permit important changes in constituent concentrations to go undetected. If the water quality variability is large throughout the year, many measurements, perhaps even continuous monitoring may be needed to adequately describe this characteristic. If, on the other hand, the variability is small, sample frequency may be much less. Sampling frequency should be no greater than the frequency of significant volume changes in naturally controlled flows.

Compositional Variability

Compositional variability of the natural streams and springs of the Little Grizzly Creek watershed is unknown, but there is no reason to believe that the chemical composition of these waters is now constant. The greatest

changes, however, are expected to take place in the mine effluent, in streams which intercept the mine effluent, and in streams which drain mine dumps, tailings, or natural slopes rich in toxicity producing substances.

Controlling Parameters

Changes in chemical composition of the mine effluent might be correlated with seasonal stream and spring flows, total or periodic runoff volume, rainfall intensity or duration, total annual precipitation, evapo-transpiration changes, or other natural variables.

Sample Accuracy

The sampling program must include a test of the accuracy of the methods used. A systematic testing program using standard laboratory precisions and procedures for the determination of toxic substances in concentration ranges of trout toxicity must be employed to determine if more than occasional random samples of water are significant.

The chemical variance between two samples can be established only if the variance with each sample is known. Each sample represents the toxicant concentration of the stream for a given interval of time. Concentrations of specific toxicants may have to be identified as a range of values during a given time period. This range may reveal characteristics of the examined waters, or the limitations of the sampling and analytical procedures.

The variation in toxicant concentration from one sample to the next may be so great that a high degree of precision of field procedures and laboratory methods are unwarranted. Random scatter of the results of a sampling program may indicate that only occasional samples are necessary.

If the test results display a broad range of values or random scatter, it may be feasible to take bulk or mixed samples. However, at this time, it is believed that the most practical approximation of continuous monitoring is the best procedure to follow.

Previous Work

Sampling of the surface waters about the Walker Mine has been going on spasmodically for many years, and the results obtained from the analysis of such samples reveal that copper and zinc are occasionally present in concentrations toxic to trout in parts of Dollie Creek and Little Grizzly Creek. It would be prudent, therefore, to sample and monitor these waters for these two metals, as well as, pH or sulfate content until other toxicants are identified. Monitoring of the waters of Little Grizzly Creek watershed for toxic materials for several months to a few years is necessary to develop a comprehensive plan for toxicity control.

Copper-Zinc Sampling

The sampling program for copper and zinc will result in a knowledge of how the concentrations of these two metals fluctuate throughout the year. The periods of highest and lowest concentrations may be correlated with seasonal or other factors and indicate some basic causes that are operative. This knowledge will be essential to the design of any toxicity control system, even if other contributory factors are identified in the qualitative testing for additional toxicants.

Representative Samples

To determine the concentration of copper and zinc in these waters over a representative and useful period, it will be necessary to establish (1) the minimum size of a representative sample, (2) the variance in concentration

from different parts of the flow at a single station; and the variance in concentration at intervals of (3) five minutes, (4) one hour, (5) one day, and (6) one week.

Sample chores (1) and (2) above are essential background information and may be determined from twelve and thirty-six samples respectively. Concentration determinations for copper and zinc in chores (3), (4), (5), and (6) above will require 60, 100, 30, and 50 samples respectively. Seasonal calibration of verification of sampling datum techniques may be obtained by repeating the five-minute, hourly, and daily intervals in one hour, one day, and one week respectively, for a total of 45 samples four times a year, or 180 samples. The total numbers of samples is calculated to be 470 per station per year.

Continuous Records

An attempt should be made to correlate the copper and zinc concentrations with continuous recordings of pH and electrical conductivity to establish the feasibility of extended chemical monitoring for several months or years. Annual variations must be evaluated because they probably will provide significant input which will be required to design any toxicity control measure.

Cost

An approximation of the total cost for ten stations for one year is about $24,500. Sample chores (1) and (2) need to be done at only one station, chores (3) and (4) at probably only two stations, chores (5) and (6) at all ten stations, and verification at two stations. These will total 1,468 samples costing $7,340 at $5 each.

Laboratory determinations of the concentrations of copper and zinc may be had for $2.50 each, according to staff at the Nimbus Laboratory, California Department of Fish and Game. Expenses for 140 days field time would cost $3,080, and salary and support including data reduction would cost $14,000.

Coordination

Spectrographic analyses (qualitative testing) for additional toxic metals should be performed weekly for each station, yielding a total of 500 analytical results per year. Spectrographic analyses should be available at a cost of about $20 each, or less, for such a large number. These tests will cost $10,000 per year.

Priority

The priority on these sampling tasks is high because all of the subsequent testing, planning, and design work for a remedial system depend directly on these results.

Mine Sources

If the mine is reopened, the specific fracture zones or mineralized rock bodies contributing the heavy metal toxicity may be identified. This information would provide an additional basis for selection of toxicity control options.

Sampling of Solids

The sampling of solid materials for the identification of sources of toxicity in the water of Little Grizzly Creek will probably be a simpler chore than water sampling because these substances are likely to remain stable over short time intervals.

Sediment Sampling

Rock or sediment materials from the mine dump, tailings pond, and stream beds of Dollie Creek and Little Grizzly Creek will be sampled on a reconnaissance basis until significant sources of toxicity are discovered. Semi-quantitative spectrographic analyses for all suspected toxic materials should be performed on these samples.

Mine Dump Samples

The mine dump at the Walker Mine may be appropriately sampled at twenty stations in three days. Sampling and analysis are expected to cost $2,000.

Mill Tailings Samples

It has been learned from U.S. Forest Service officials that the Walker Mine tailings are complexly stratified; therefore, it is impossible to plan a detailed sampling program for these materials before a preliminary evaluation is made. However, the estimated cost is $10,000, and the estimated duration is one month to sample the tailings in three dimensions.

Stream Bed Samples

The total bed load of the streams should be sampled; including flood-stage terraces and tributary fans. Approximately fifteen sampling locations should be selected in Dollie Creek and Little Grizzly Creek above and below points of suspected pollution. The cost of this task will be about $3,000. It should take six days to do the field work and an additional week for laboratory and data reduction work.

Priority

The priority of the sediment sampling tasks are all of medium grade because most of the conditions identified here will probably also be

indicated by the results of the water sampling program described above.

Conclusion Regarding Stream Bed Sampling and Results

If the stream bed of Little Grizzly Creek is found to contain an abundance of toxicity-source materials, very costly methods of fishery rehabilitation, such as thorough dredging and filling, will be required.

Item 4

Toxicity Testing

A toxicity testing program to assist in the selection of pollution control methods as well as to identify sources of toxic material includes a task to collate and evaluate all of the data gathering and sampling tasks considered in this report. This program will be necessary to determine the tolerable ranges of toxic substances for the essential species, native rainbow trout and its food chain.

Testing Tasks

The testing tasks will include:

(1) determination of available literature bearing on the problem,

(2) selection of appropriate test species,

(3) dilution tests,

(4) trout toxicity tests,

(5) insect and food chain toxicity tests,

(6) determination of the environmental impact of control measures to be implemented to reduce or control the toxicity contributed to Little Grizzly Creek, and

(7) the feasibility of using local soils for effluent neutralization.

Literature Search

A thorough search of the literature on trout toxicity must be made before any testing is begun. This survey should include an examination and evaluation of "all" publications treating the subject of direct and indirect toxic effects of natural and artificial pollutants, emphasizing the effects of heavy metals on trout and on the trout food-chain.

State of the Art

A very valuable report and annotated bibliography resulting from this library research will serve as a firm basis from which to plan and direct toxicity testing programs for this study and future studies of similar scope and content. It should summarize what is known about heavy metal toxicity to trout, as well as identify needed information.

This task should be performed by a competent fisheries biologist in about 60 days and at a cost of about $2,000.

This task has the highest priority of the entire study, primarily because information derived from this work will indicate what has been done, what information may be approximated, and what specific testing will need to be done in the laboratory.

Test Species

To sustain a rainbow trout fishery in Little Grizzly Creek it is necessary that the food chain be re-established. Toxicity testing will have to be performed on indigenous species, or at least animals which would be present if Little Grizzly Creek were not polluted. To determine these species, stream surveys of watersheds similar to Little Grizzly Creek in central Plumas County should be made. Conditions of water quality favorable to the proliferation of aquatic insects and other animals consumed by trout will have to be determined.

Stream Habitat Survey

The aquatic life of Red Clover, Hosselkus, Ward, Last Chance and Little Grizzly Creeks should be examined, sampled and described. These surveys should be of a reconnaissance nature and should have as objectives the determination of the type and availability of food, general water

quality, native fish species, and other characteristics deemed pertinent or significant by a competent aquatic biologist.

The field work, together with an appropriate level of identification, should cost about $2,000 and take about 15 days to complete.

This task has a very high priority because the design of all toxicity testing studies will depend on the results obtained.

Dilution Tests

The level of toxicity of Little Grizzly Creek and of the mine effluent should be established by testing critical species in various dilutions of these waters by standard bioassay methods. Determinations in the laboratory should give information which will carry over into actual field conditions, although perhaps not duplicate them exactly. Rainbow trout and food insects, preferably native, should be used. Results from the literature search and the regional stream habitat surveys should indicate specific species, their life stage, or possible substitutes for use in these tests.

Two tests on fish and two on insects for a total of four bioassays of a broad range of dilutions should be sufficient to provide the needed information. If continuous-flow bioassay tests are considered best for both fish and insects, the cost will be about $8,000 and take 90 days, if run concurrently.*

These tests are essential to make a rapid judgement about the degree to which the quality of the waters of Little Grizzly Creek must be improved to sustain a fishery.

The priority on this task is high, because the results may also suggest the feasibility of effluent or fishery dilution as a toxicity control method.

*Ideally they should be repeated seasonally (four times annually), because they may become the basic data for the determination of the total or combined synergism of all toxicants from the tested waters. This would result in a total cost of $32,000. Hopefully, this could be reduced by some technological, statistical, or reference achievement.

Trout Testing

Rainbow trout are the only fish species considered for the rehabilitated fishery of Little Grizzly Creek. At present the factors accounting for the exclusion of this native fish are unknown, but they are thought to be attributable to the Walker Mine effluent. The toxic substances and their ranges contained in this effluent will be identified in the sampling tasks (Item 3).

Trout toxicity for each of the single toxic substances found in the mine effluent and fishery waters should be determined. The number of bioassays which are to be performed will be determined by the number of toxic components identified in the qualitative analyses of the sampling program. The total number of toxic substances cannot be determined at this time, but, at least, five metalic ions and one acid radical are likely to be found. These are copper, lead, zinc, aluminum, manganese, and sulfate.

Tests should be performed on the most sensitive stage of the native rainbow trout to attempt to establish the lower limit(s) of chronic toxicity of these substances. They should be performed as soon as practical. The results will be used as controlling parameters in the design of any remedial measures for the lost fishery.

Cost

Continuous-flow bioassays for the six substances listed above will cost about $12,000 ($2,000 each) and take about 90 days to complete. It must be remembered that six is probably a minimum number of toxic constituents present, and that more are likely to be found.

Insect Tests

The toxicity of a sensitive and critical insect, or other factor of the trout food chain, should be determined in a manner similar to the fish toxicity tests. If continuous-flow bioassay methods are used, for the same test period, the cost will be the same: $12,000. If biostatic tests rather than chemistatic tests are considered sufficiently precise, then a modest cost saving might be realized. Such a decision must be left to a competent aquatic biologist.

Combined Synergism

The total synergistic effect of the combined components of the mine effluent (or the fishery) waters, can be identified by comparing the results from the single element bioassays with the results of the effluent (or fishery) dilution bioassays. The synergism of each two components is probably meaningless in this context, because of the probable large number of solution components.

The priority of these tasks is considered medium because of the need for the preliminary work of toxicant (heavy metal) identification and the given requirement that rainbow trout are to be re-established.

Environmental Impact

The methods used to control the toxicity to Little Grizzly Creek by the Walker Mine will probably alter these waters and the surrounding environment in many ways. These effects should be examined in a special comprehensive and broad ranging environmental impact study; or alternatively, this study may be integrated with related phases of the original data gathering, sampling and testing tasks. The study will consider all direct and indirect effects of any proposed control methods on the fishery.

The soil filtration method of mine water treatment should be evaluated in terms of toxicity contributions to the fishery. The synergism or antagonism, as well as direct toxicity, of soil leachate metals and radicals such as sodium, calcium, magnesium, iron, silicon, and carbonate to trout should be determined. If this information is not available from the literature, continuous-flow bioassays may be run on these six substances at a cost of about $12,000 and 90 days running time.

In any case, the impact of any toxicity control measures used in the pollution abatement must show favorable results before the control measures can be implemented. A low priority for this task is recommended because the results of this work will be applied indirectly to the toxicity control problem.

Supplemental Tests

Additionally, it may be advisable to run bioassays on trout which are fed only insects or other animals of the trout food chain which have survived the highest level of heavy metal or other toxicant concentrations. This would be done to determine if some food sources which survive high dosages of these substances, say, 2, 4-D for example, are toxic to trout.

This type of testing appears to be extremely complex because of the large number of variables, however, much of this type of information on cumulative build-up of toxic substances in fish is available in the literature.

If the food chain is also toxic to trout then tests of long duration, and great complexity and cost are indicated. At this time, this line of investigation is neither recommended nor rejected, and funds for this work are not included in the cost estimates.

Soil Survey

It is generally known that certain natural soils have a high capacity to transmit water; whereas others absorb it. Grassland soils and those developed from alkaline parent materials commonly have a basic or alkaline pH potential in chemical reactions.

Functional Parameters

The suitability of soils of the Walker Mine area to function as an acid-buffering and sludge-filtration medium will be determined by a testing and mapping program.

Parameters which must be determined for the soils on the slopes below the Walker Mine are, in order of importance:

1. Distribution and thickness of all soil or surficial material,
2. pH and total alkalinity of each of the main soil horizons,
3. Permeability and expansion ratio.
4. Soil type and characteristic vegetation,
5. Parent materials of each soil type,
6. Slope and rate of erosion,
7. Type and rate of mass-wasting,
8. Regional and local climate characteristics.

If these factors are favorable, the local soils may be used to neutralize the acidity of the Walker Mine effluent and filter out any resultant sludge materials, in part, if not completely. The size and cost of spreading basins for this purpose will be determined by the quality of each of the above parameters.

Coordination

This survey can be carried out most effectively after the detailed geologic map (Task 14) and regional hydrologic surveys (Task 15) are completed. A pedologist or soil scientist will be an essential participant in this investigation.

Local Fractures

The number, size, and spacing of faults and joint systems of the bedrock are fundamental limiting parameters of the soil infiltration control measure. If the detailed geologic mapping proposal is deferred or rejected, then a comprehensive examination of local bedrock fractures will have to be included in this task.

Time and Charges

This soil survey and testing study should cost about $6,000 and take about six months to complete. The field work might cover as many as twenty square miles on the north and west slopes of Mt. Ingalls. Toxic substances which might be leached from the soil or rock may be discovered in this work, but no provision is made in the above cost estimate for extensive testing for these substances.

A supplemental task may be undertaken to obtain information on copper, iron, and sulfate resistant plants. This should be of sufficient detail to determine the feasibility of cultivating such plant propagation in or about the effluent filtration basins.

Item 5

Property Ownership

The ownership of the surface, underground holdings and mineral rights of the patented claims portion of the Walker Mine are in the name of the

Calicopia Corporation
c/o Robert R. Barry
8500 Wilshire Blvd. Penthouse
Beverly Hills, California 90211

The surface rights of the unpatented claims are the property of the U.S. Government and administered by the U.S. Forest Service. There are no valid grazing permits in this area.

Mineral Rights

The underground holdings and mineral rights on the unpatented claims are the property of the Calicopia Corporation, but may revert to the U.S. Government should they become invalid for any reason. The lands of the unpatented claims may be available for mineral entry if they are abandoned by the present claimant.

The water rights of the Walker Mine area have not been appropriated. The mine owner, R. R. Barry, for the corporation, has denied ownership or responsibility for the mine waters at a public hearing in Sacramento on January 22, 1971.

There are several other patented claims owned by other persons, groups or corporations within approximately one mile of the Walker Mine main portal. Assessor's maps showing these relationships are included below.

Water Uses

Additional time and money may be spent to determine land ownership history and property rights "...which could be affected by (toxicity)

control programs..."; but this does not seem necessary at this time. It is doubtful if the beneficial uses of the water of Little Grizzly Creek will be adversely affected by any thoroughly considered control program except perhaps, for the esthetic enjoyment of slopes that contain treatment ponds, infiltration basins, or other control features. The State of California probably will have to acquire the mine with all attendant features, or at least trespass privileges, before any major testing or treatment facilities are constructed.

The determination of present ownership of surface and underground holdings, water rights, and mineral rights may be determined in one day at a cost of $100 (a trip to Quincy, the Plumas County Seat).

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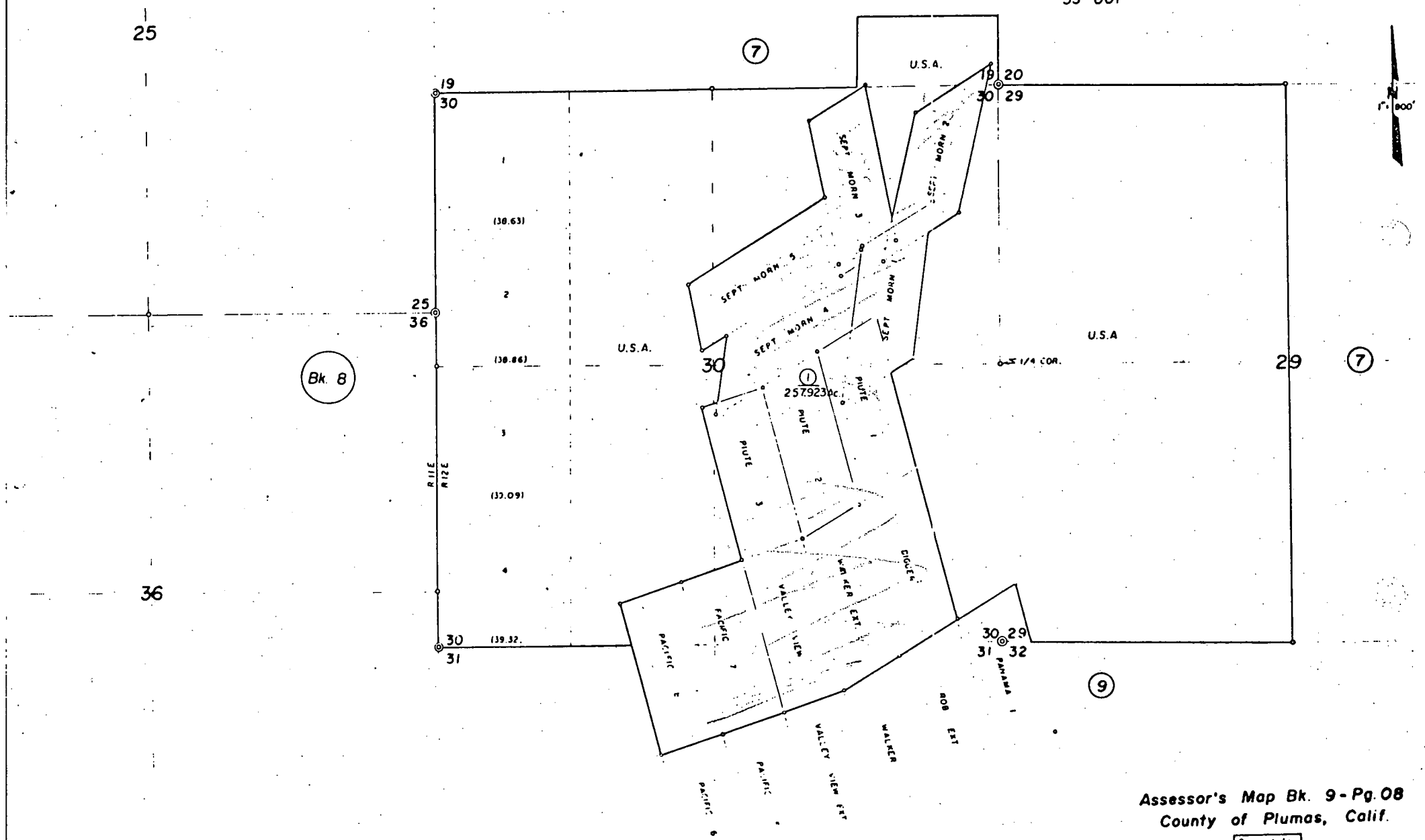
Tax Area Code
53-001

9-08



Assessor's Map Bk. 9 - Pg. 08
County of Plumas, Calif.

Current to

NOTE – Assessors Block Numbers Shown in Ellipses
Assessors Parcel Numbers Shown in Circles

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POR SEC 5 T24N R12E MDM
POR SEC 29,30,31, & 32, T.25N., R.12E., M.D.M.

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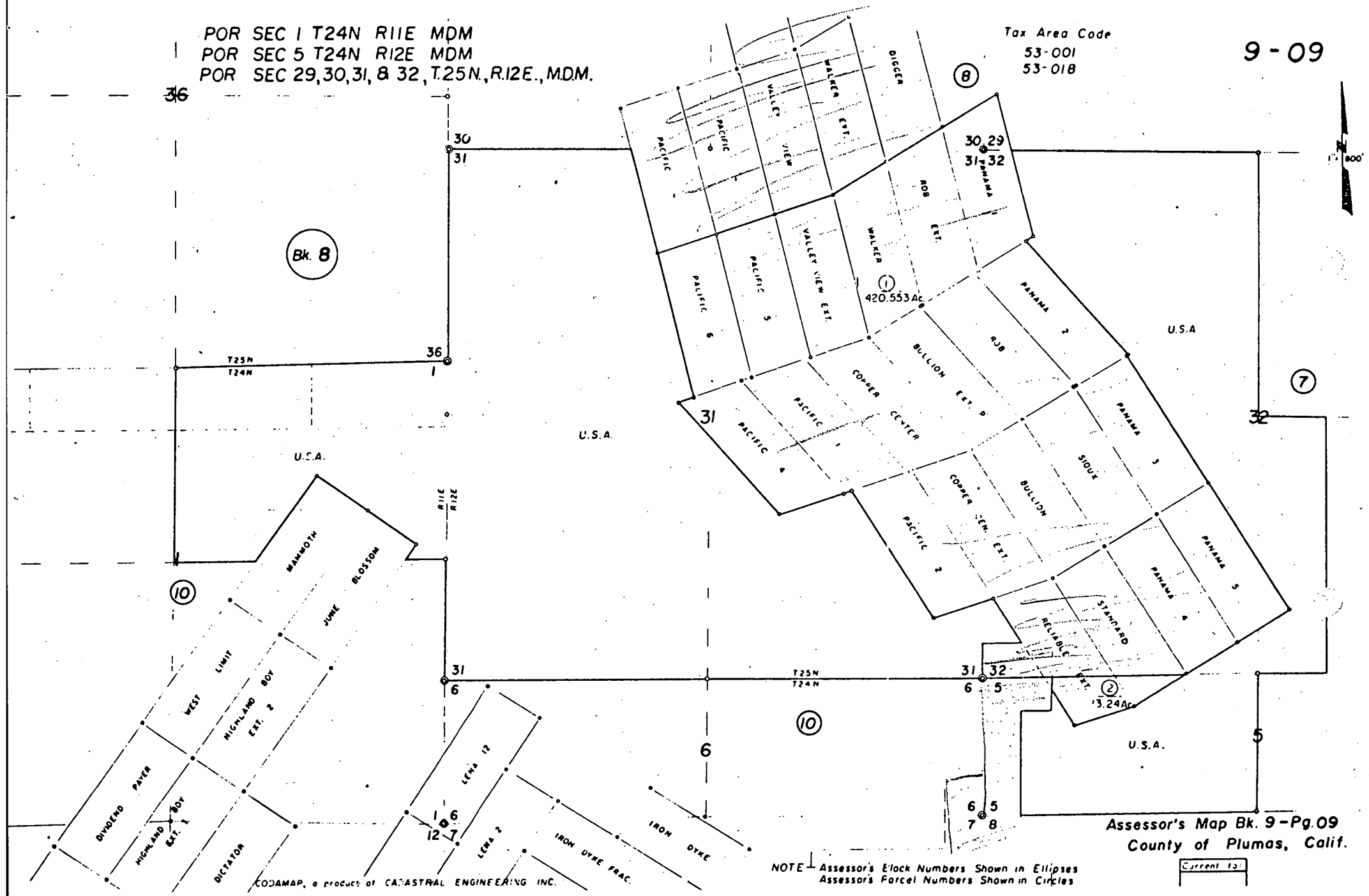
53-018

9-09



NOTE ⊥ Assessor's Block Numbers Shown in Ellipses
Assessor's Parcel Numbers Shown in Circles

Assessor's Map Bk. 9 - Pg. 09
County of Plumas, Calif.

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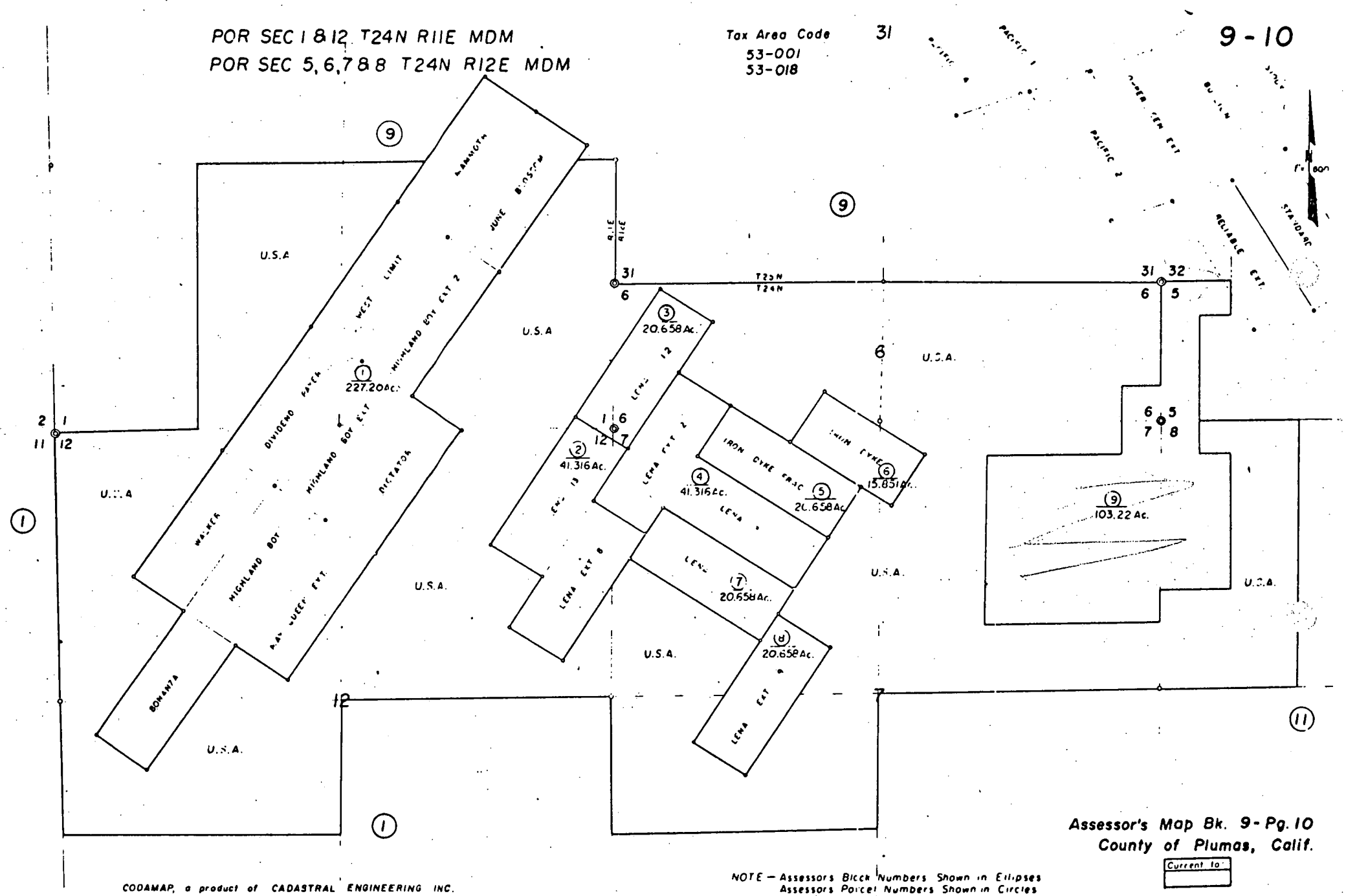

Assessor's Map Bk. 9-Pg. 10
County of Plumas, Calif.

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NOTE — Assessors Block Numbers Shown in Ellipses
Assessors Parcel Numbers Shown in Circles

Plumas County Assessor's Maps
Walker Mine and vicinity

Map Book 9, Page 08:

Parcel 1 — Calicopia Corporation
% Robert R. Barry
8500 Wilshire Blvd. Penthouse
Beverly Hills, California 90211

Map Book 9, Page 09: ——→ parcel #1 Calicopia Corporation

Parcel 2 — Calicopia Corporation
% Robert R. Barry
8500 Wilshire Blvd. Penthouse
Beverly Hills, California 90211

Map Book 9, Page 10:

Parcel 1 — Consolidated Gold & Metals Company
% Barlett Wicks
475 E. 2nd
Salt Lake City, Utah

Parcel 2 — United Smelting and Refining Company (USARCO)
19th Floor, University Club Bldg.
136 East South Temple Street
Salt Lake City, Utah

Parcel 3 — United Smelting and Refining Company
19th Floor, University Club Bldg.
136 East South Temple Street
Salt Lake City, Utah

Parcel 4 — 2/3 John B. Sobrero & Clan (Sobrero Principle Owner)
Taylorsville, California

1/3 United Smelting and Refining Company
19th Floor, University Club Bldg.
136 East South Temple St.
Salt Lake City, Utah

Parcel 5 — United Smelting and Refining Company
19th Floor, University Club Bldg.
136 East South Temple Street
Salt Lake City, Utah

Parcel 6	2/3 John B. Sobrero & Clan Taylorsville, California
	1/3 United Smelting and Refining Company 19th Floor, University Club Bldg. 136 East South Temple Street Salt Lake City, Utah
Parcel 7	2/3 United Smelting and Refining Company 19th Floor, University Club Bldg. 136 East South Temple Street Salt Lake City, Utah
	1/3 John B. Sobrero & Clan Taylorsville, California
Parcel 8	United Smelting and Refining Company 19th Floor, University Club Bldg. 136 East South Temple Street Salt Lake City, Utah
Parcel 9	Calicopia Corporation % Robert R. Barry 8500 Wilshire Blvd. Penthouse Beverly Hills, California 90211

Item 6

Toxicity Control

The several alternative methods of toxicity control considered in this study deal with: (1) influent exclusion, (2) effluent dilution, (3) physical extraction, (4) dissolution prevention and (5) chemical precipitation.

Selection of Method

A method using chemical precipitation is favored at this time probably because it appears to be the least expensive, and is the easiest to comprehend. The effective implementation of such a plan will result in elimination of the pollution of the fishery by the Walker Mine.

One beneficial characteristic of the over all problem of the Little Grizzly Creek fishery loss is that it is not getting worse. Neither the area of influence, nor the severity of pollution seems to be increasing. This fact affords considered and deliberate judgements to be incorporated in the control method decisions.

Influent Exclusion

The most permanent control of toxicity would require sealing the mine interior from percolating ground water. A grouting program to provide such a seal may be undertaken only after the mine has been dewatered and mapped in detail, and after the significantly large water carrying fractures are found. This is probably one of the most expensive control methods; perhaps costing on the order of $500,000 to $1,000,000.

Consultants required for such a plan would include professional mining engineers or tunnel engineers experienced in grouting and water control. References on this topic are few, but the best include publications of the U. S. Army Corps of Engineers, Bureau of Reclamation, and the American Institute of Mining Engineers.

Effluent Dilution

An alternative to the pollution of Little Grizzly Creek is dilution of the toxic water with clean water from Lake Davis, or from wells penetrating the ground-water body below Mt. Ingalls. To fulfill this plan it might be necessary to purchase water from Lake Davis, if an unappropriated surplus of water does not exist. Technical consultants experienced in the development of wells in crystalline and volcanic rock, and hydraulic engineers with experience in pipeline and penstock design will be needed. Specific reference to this method of control is unknown.

Physical Extraction

The metal extraction methods of water treatment (reverse osmosis and ion exchange) which usually are reserved for potable water production seem to be much too expensive for consideration here. A water desalination plant for this purpose might cost on the order of $1,000,000, but operation and maintenance for an indefinite period would add greatly to this amount.

In addition these plants generally work at about 70 to 90 percent conversion efficiency and are somewhat experimental at this time. Present indications, based on copper concentration for example, suggest

That a metal extraction system working along will need to be on the order of 97 to 99 percent efficient in water conversion to effect toxicity control at the Walker Mine. However, it might be feasible to use a plant of this type to dewater the mine or provide temporary relief until more permanent controls can be provided. Progress in the research, development and utilization of these systems should be monitored in anticipation of technological advancements.

Dissolution Prevention

Another method of toxicity control is to backfill the mine. This might be successful, but because of the extensive, intricate and largely unknown underground workings it can be considered to be only a "shot-in-the-dark" at this time. This method might retard water and air circulation to a degree, but only the surface shafts would be plugged unless the mine were reopened and fill-material were hauled or piped to the remote stopes and raises. This method does not seem feasible at this time.

Chemical Precipitation

Toxicity control will result most economically, at this time, from an integrated series of simple steps. The resultant non-toxic discharge water from this system may flow to Little Grizzly Creek when the system is operating to capacity; however, seasonally, part of the mine effluent will be returned to the atmosphere by consumptive

use. The sequential steps of the system are:

1. Elimination of free-air circulation into the mine,
2. Reduction of surface-water inflow,
3. Metallic copper precipitation using scrap iron, or other method(s),
4. Effluent aeration,
5. pH elevation and control using limestone,
6. Effluent evaporation from spreading basins,
7. Soil infiltration for sludge control, and
8. Ground water storage and vadose circulation.

Important and restricting limitations to this system are immediately obvious, however, when comprehensively considered against the other alternatives, it seems to have the highest feasibility. Extreme care is recommended in planning, design, construction, operation and maintenance of this system, because none of the "links in the chain" are believed to have great reserve capacity, or substitution potential. Each step is dependent upon another for satisfactory water quality achievement.

Design Criteria

This procedure is essentially experimental, and the necessity for many adjustments and correction should be anticipated. A minimum "safety factor" of three should be used in the design of this system. A larger factor of five or more would be preferable. A single annual maintenance period should also be designed into this system.

The basic information which must be obtained to design this system are the determination of the:

1. Locations of the best filter soils,
2. Locations of gentle slope (meadows) for pond construction,
3. Sources of suitable limestone for pH control,
4. Locations of steep slopes (scarps) for effluent aeration (turbulent flow),
5. Sources of scrap iron,
6. Sites appropriate for copper precipitation cells,
7. Locations of water influence to the mine, dump and tailings.
8. Locations of openings which permit air to enter the mine.

Design items 1,2,4,6,7, and 8 may be obtained by Regional or State Board staff, or by outside contractors at an estimated cost of $10,000. A contract should call for a plane-table map and report of the mine vicinity depicting local conditions, and any other information deemed significant. It should take about four to six man-months to prepare a map of ten square miles, at a scale of 1"=500'; with a contour interval of five feet. The overall area to be considered lies between the elevation of the ventilation shaft collar and Little Grizzly Creek, or other bodies of water to be protected.

A detailed map of about one square mile of the lower slopes of the Dollie Creek watershed should also be provided, at a scale of 1"=50' and a contour interval of one foot.

The details of items 3 and 5, above, should be obtained by local inquiry (i.e., Portola; vicinity) if possible.

A contract for the design of the control system should be let based upon the results and interpretation of this data. This may be subcontracted through one of the state agencies experienced in the construction of water conveyance or treatment facilities. The construction, operation, and maintenance of the system might also be managed by such agency.

Many of the data gathering tasks mentioned above in this report will aid in the planning, design, and operation of this system.

It is beyond the scope of this report to estimate the cost of such a toxicity control measure, however construction of this system will mainly use relatively inexpensive features such as doors, flumes, ditches, ponds, and other water conveyance structures.

Research Groups

The U. S. Environmental Protection Agency and the U. S. Bureau of Mines have published many reports on acid mine drainage and its treatment. These agencies, as well as the large mining companies, have continuing research programs dealing with acid mine water and copper leaching processes. In addition several private research groups have fulfilled testing program contracts with EPA in the eastern United States and published reports and circulars on the subject.

Technical Awareness

A plan to obtain information from references, technical consultants and other sources on the methods to control toxicity from the mine will cost approximately $20,000 per year for an indefinite period. At the present time the technical references are spread through several ten's of bulletins, journals, newsletters, and publication services in a dozen or more scientific, engineering, "professional", and political diciplines. The technical consultants or experts are spread just as widely throughout the professions and their number is growing, just as fast, if not faster than the literature. Each day an untold number of these experts are born, inspired, graduated, contracted for, assigned, knighted, volunteered, or otherwise given the authority for doing something about the worldwide water pollution problem. Any program to obtain information of toxicity control will involve review of the literature communication with colleagues, laboratory testing, field experimentation, and pilot studies. This effort is estimated to take one man-year per year; or more likely, because of the broad range of skills and competence involved, at least three men each for one-third man year.

Appendix IV

MAPS

Chico Geologic Map Sheet 1" = 4 miles

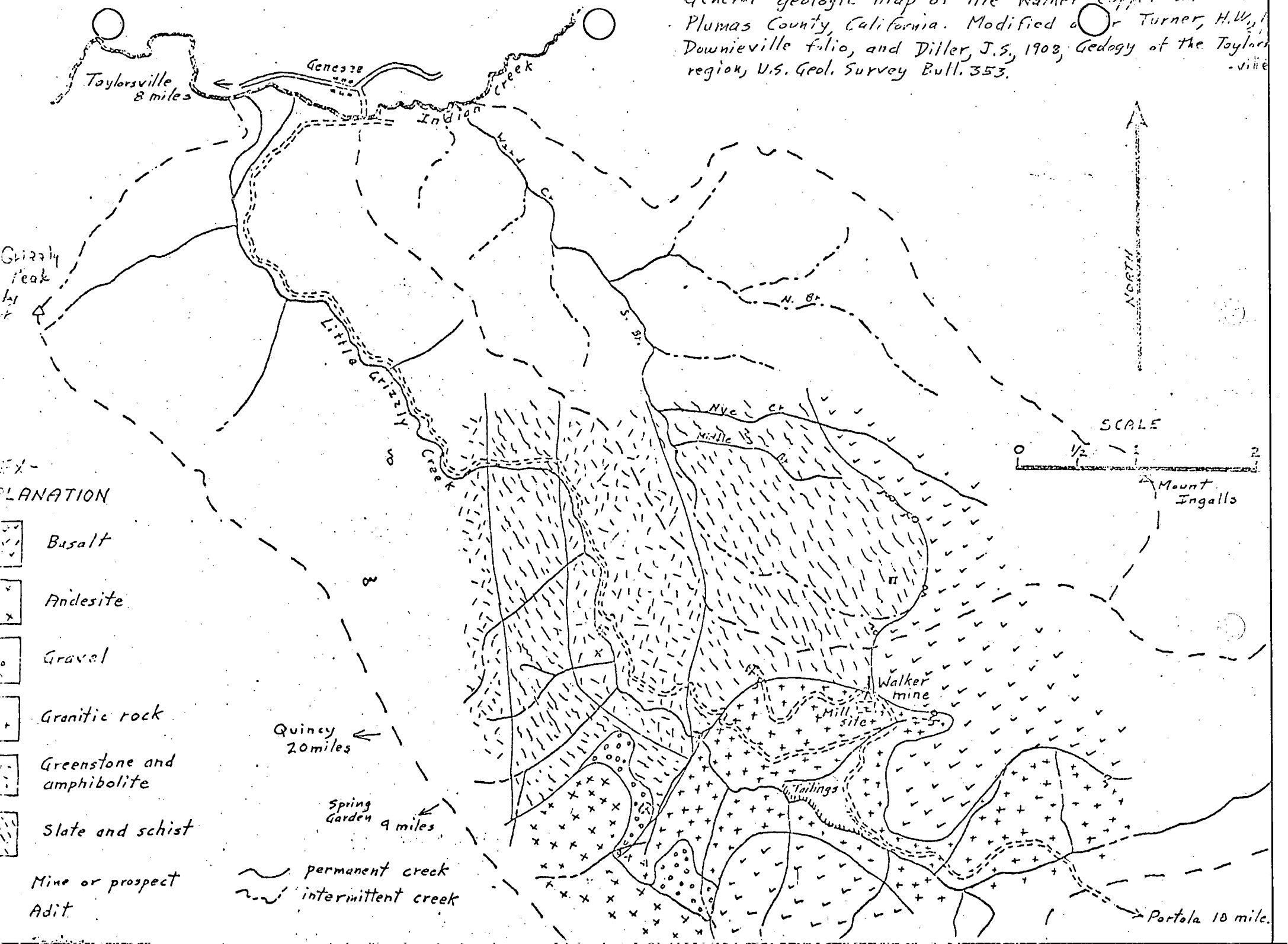
Westwood Geologic Map Sheet 1" = 4 miles

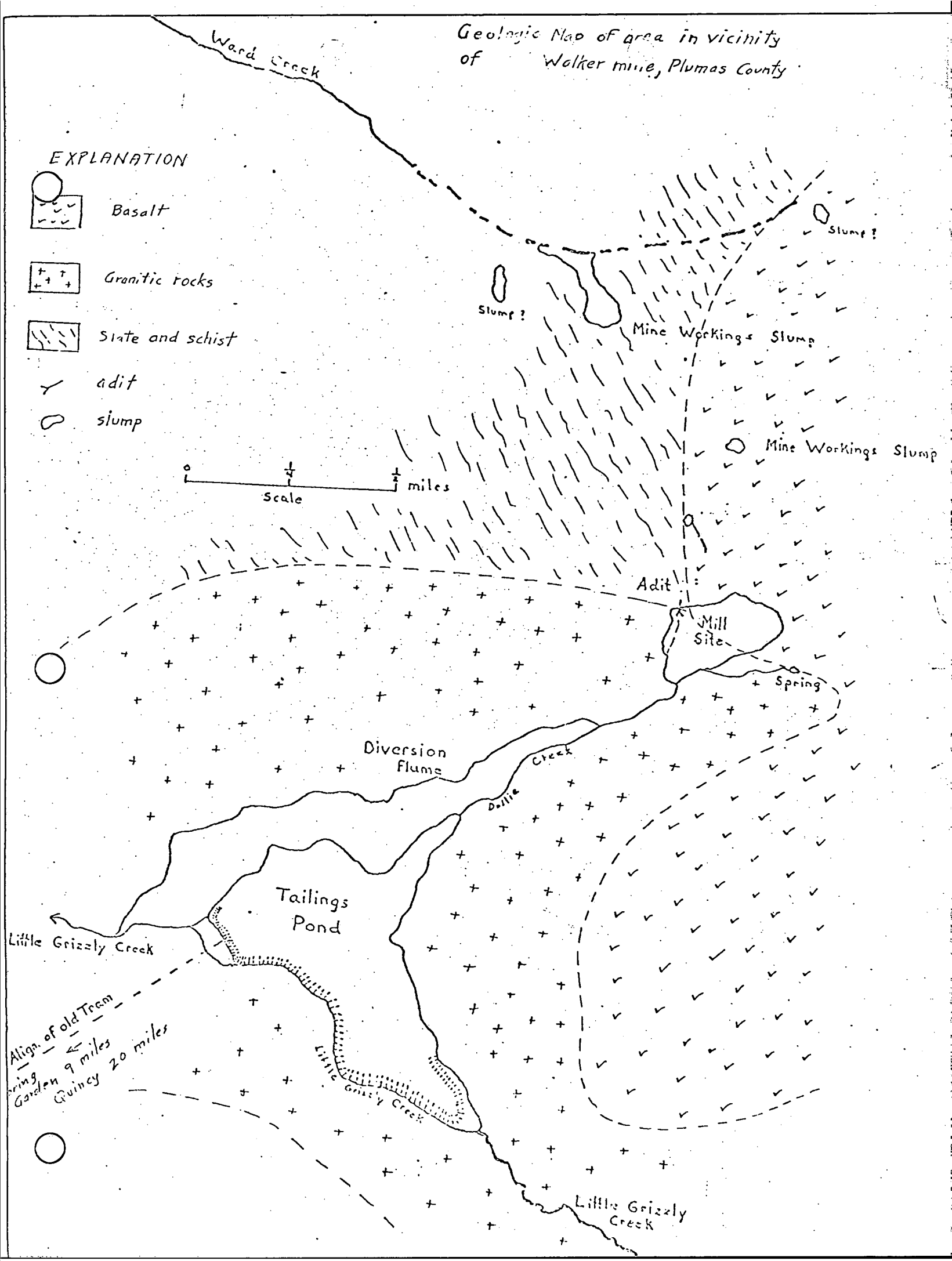
General Geologic Map Walker Mine Area 1" = 1 mile

Geologic Map of Walker Mine Vicinity 1" = 1/4 mile

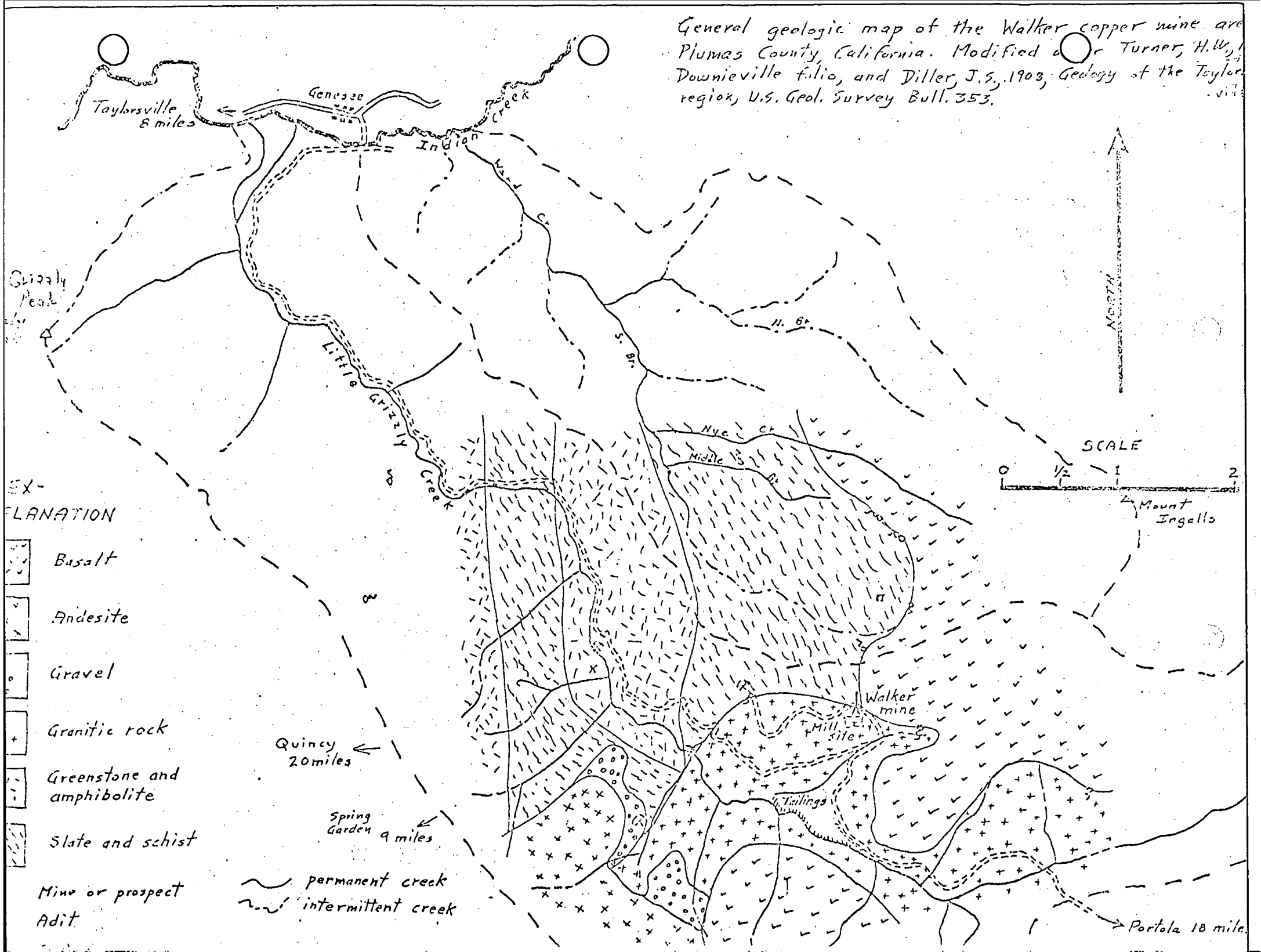
Blairsden (topographic) Quadrangle 1" = 1 mile

General geologic map of the Walker copper mine area, Plumas County, California. Modified after Turner, H.W., Downieville folio, and Diller, J.S., 1903, Geology of the Taylorsville region, U.S. Geol. Survey Bull. 353.




Geologic Map of area in vicinity of Walker mine, Plumas County
Ward Creek
EXPLANATION
Basalt
Granitic rocks
Slate and schist
adit
slump
Slump ?
Slump ?
Mine Workings Slump
Mine Workings Slump
0
1/4
1/2
miles
Scale
Adit
Mill Site
Spring
Diversion Flume
Dollie Creek
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Spring Garden 9 miles
Quincy 20 miles
Little Grizzly Creek
Little Grizzly Creek

General geologic map of the Walker copper mine area, Plumas County, California. Modified after Turner, H.W., Downieville folio, and Diller, J.S., 1903, Geology of the Taylorsville region, U.S. Geol. Survey Bull. 353.



Appendix V

Analyses of Surface Waters

Central Valley Regional Water Quality Control Board Staff 1957-70

California Division of Mines and Geology 1970

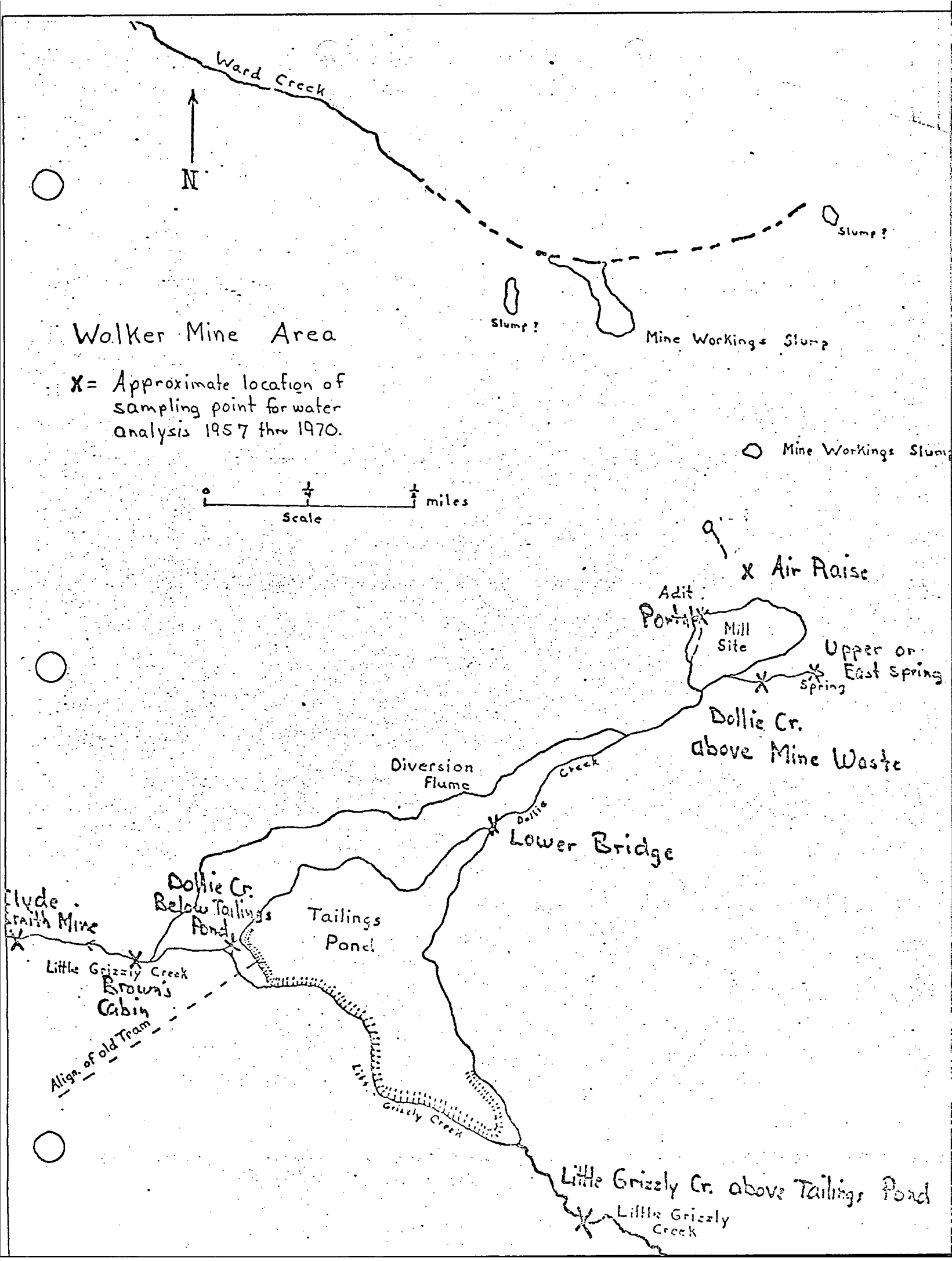
California Division of Mines and Geology 1971

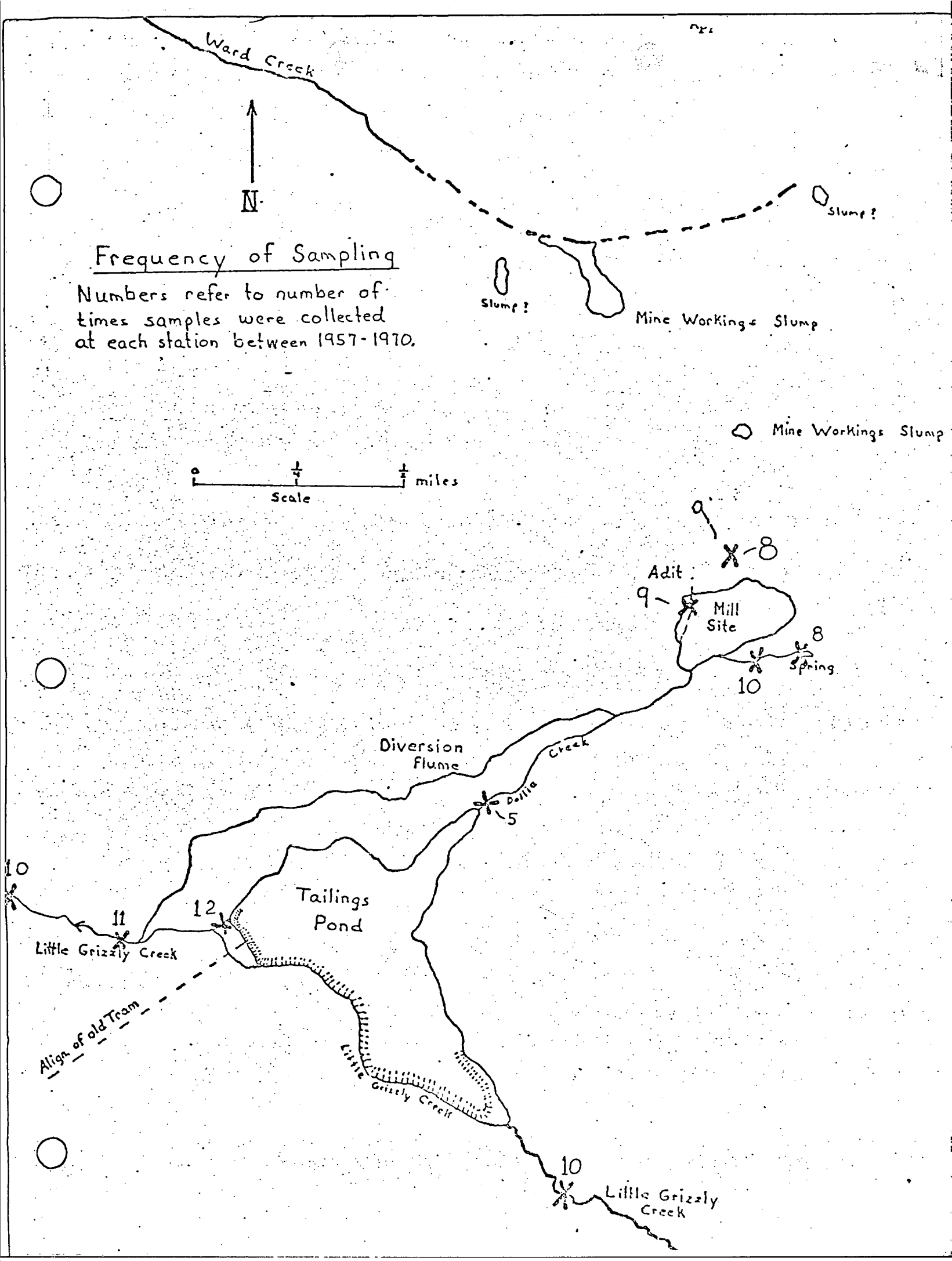
Surface Water
Samples

1957-1970

by

Central Valley
Region
Water Quality Control
Board Staff


Ward Creek
N
Slump ?
Slump ?
Mine Workings Slump
Walker Mine Area
X = Approximate location of sampling point for water analysis 1957 thru 1970.
Mine Workings Slump
0
1/4
1/2
miles
Scale
Air Raise
Adit
Portal
Mill Site
Upper or East Spring
Spring
Dollie Cr. above Mine Waste
Diversion Flume
Dollie Creek
Lower Bridge
Dollie Cr. Below Tailings Pond
Tailings Pond
Clyde Smith Mine
Little Grizzly Creek
Brown's Cabin
Align. of old Tram
Little Grizzly Creek
Little Grizzly Cr. above Tailings Pond
Little Grizzly Creek


Ward Creek
N
Frequency of Sampling
Numbers refer to number of times samples were collected at each station between 1957-1970.
Slump ?
Slump ?
Mine Workings Slump
Mine Workings Slump
0
1/4
1/2
miles
Scale
9
8
Adit
9
Mill Site
8
Spring
10
Diversion Flume
Creek
Dolliver
5
10
11
12
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
10
Little Grizzly Creek

Chemical analysis of Water

Appendix Table A

1 of 9

Walkermine Study

Station name: Air Raise

Date Sampled	Flow Est Cfs	Temp. F°	Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm	Ph	EC Mmhos
6-25-57	0.5	—	22.0	5.5	125	—	—	3.7	328
10-5-57									
5-27-58			29.0	2.5	150	—	—	3.5	430
6-5-58	—	—	20.0	1.6	117	—	—	3.3	340
7-11-58			19.0	1.9	—	—	—	4.2	—
10-29-59	0.00								
4-28-60									
5-19-60									
6-4-60									
6-10-60	0.5	46	0.36	4.4	210	—	—	4.1	454
8-31-60									
6-23-61									
8-2-61									
5-[illegible]-62									
5-29-62			54.0	3.4	276	—	—	3.7	593
6-14-62									
6-19-62	1.5	44	44.0	2.8	206	—	—	3.5	501
7-18-62	0.0								
8-20-70	.33	—	14.0	0.6	83	—	—	4.3	249

Walkermine Study

Station name: Portal

Date Sampled	Flow est CFS	Temp. °F		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos	
6-25-57	0.1	—		12.0	3.2	105	—	—		4.6	259	
10-5-57												
5-27-58				21.0	2.1	124	—	—		4.3	303	
6-5-58												
7-11-58				12.0	1.6	—				4.8	—	
10-29-59												
4-28-60	—	—		0.53	0.17	8.2	—	—		6.4	95.3	
5-19-60												
6-4-60				9.7	1.3	137	.01	1.9		5.2	307	
6-10-60	0.2	46		19.0	2.2	155				4.6	348	
8-31-60												
6-23-61												
8-2-61												
5-[illegible]62												
5-29-62												
6-14-62	0.25	44		38.0	2.2	182	—			4.3	420	
6-19-62												
7-18-62	5 gpm ~~0.23~~	54		.94	0.2	145				4.6	350	
8-20-70	—	—		14.0	0.6	93.0				4.6	254	

Walkermine Study

Station name: Upper or "East" Spring

Date Sampled	Flow Est CFS	Temp. F°	Cu PPm	Zn PPm	SO_4 PPm	Fe PPm	Mn PPm	Ph	EC µmhos
6-25-57	1.0	—	.01	.02	0.0	—	—	7.6	107
10-5-57			0.00	0.00	—	—	—	7.7	—
5-27-58									
6-5-58									
10-18-58									
~~7-11-58~~	0.25		0.00	0.00	—	—	—	7.3	145
10-29-59			0.02	0.00	1.0	—	—	7.6	139
4-28-60	0.33	—	0.00	0.02	2.0	—	—	7.4	139
5-19-60									
6-4-60									
6-10-60	1	43	0.04	0.00	1.0			7.0	140
8-31-60	0.25	44	0.01	0.00	—	—	—	7.8	—
6-23-61			0.01	0.00	—			7.8	140
8-2-61									
5-[illegible]-62									
5-29-62									
6-14-62									
6-19-62									
7-18-62									
8-20-70									

Walkermine Study

Station name: Upper end of tailings or (Lower Bridge)

Date Sampled	Flow Est CFS	Temp. F°		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos	
6-[illegible]-57												
10-5-57												
5-27-58												
6-5-58												
7-11-58												
10-29-59												
4-28-60	1	—		0.19	0.04	7.0	—	—		7.6	99.0	
5-19-60	1	—		0.15	0.00	6.0	—	—		7.8	109	
6-4-60												
6-10-60	2	63		0.68	0.03	43.0	—	—		7.3	170	
8-31-60	0.4	65		0.32	0.06	1.0	—	—		8.1	139	
6-23-61				0.1	0.00	1.0	—	—		8.2	124	
8-2-61												
5-[illegible]-62												
5-29-62												
6-14-62												
6-19-62												
7-18-62												
8-20-70												

42-383

Walkermine Study

Station name: Dollie Creek below Tailings Pond

Date Sampled	Flow Est CFS	Temp. F		Cu PPM	Zn PPM	SO_4 PPM	Fe PPM	Mn PPM		Ph	EC Mmhos	
6-25-57	2.0	—		0.27	0.12	37.0	—	—		7.5	135	
10-5-57												
5-27-58												
6-5-58	—	—		8.2	0.98	50.0	—	—		5.5	136	
10-18-58 ~~11-58~~	0.5	—		0.30	0.05	—	—	—		7.8	169	
10-29-59				0.90	0.05	18.0	—	—		7.8	180	
4-28-60	1	—		0.48	0.10	2.0	—	—		7.6	114	
5-19-60												
6-4-60				0.82	0.11	14.0	0.9	0.2		7.9	148	
6-10-60	2	88		0.53	0.07	45.0	—	—		7.6	171	
8-31-60	0.5	76		0.32	0.06	19.0	—	—		8.1	148	
6-23-61				0.40	0.04	11.0	—	—		8.2	138	
8-2-61												
[illegible]-62				0.62	0.12	15.0	—	—		7.4	100	
5-24-62												
6-14-62	1.5	58		1.7	0.75	82.0	—	—		6.5	208	
6-19-62												
7-18-62	1.5	58		0.21	0.04	28.0	—	—		7.7	128	
8-20-70												

NATIONAL 42-393

Walkermine Study

Station name: Brown's Cabin (Little Grizzly Creek)

Date Sampled	Flow Est cfs	Temp. F		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos
6-25-57	4.5			0.32	0.08	9.6	—	—		7.8	102
10-5-57											
5-27-58											
6-5-58	—	—		0.24	0.03	7.7	—	—		6.5	63
9-13-58	1.0	—		0.12	0.00	13.0	—	—		7.7	151
10-29-59				0.17	0.03	17.0	—	—		7.7	193
4-28-60	7.0	—		0.09	0.04	5.0	—	—		7.7	66.9
5-19-60											
6-4-60				0.18	0.03	12.0	0.68	0.15		7.9	138
6-10-60	7.0	—		0.13	0.00	11.0	—	—		7.7	94.6
8-31-60	2.0	64		0.09	0.06	—	—	—		7.9	192
6-23-61											
8-2-61				0.09	—	—				8.0	184
5-[illegible]-62											
5-29-62											
6-14-62	30	52		0.47	0.1	10.0				7.3	90
6-19-62											
7-18-62	3.0	20		0.16	0.05	9.0				7.9	129
8-20-70											

Walkermine Study

Station name: Clyde Smith Mine (Little Grizzly Creek)

Date Sampled	Flow Est CFS	Temp. F°		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos
6-25-57											
10-5-57											
5-27-58											
6-5-58	—	—		0.14	0.03	4.2	—	—		6.5	52.2
9-13-58	1.0	—		0.03	0.00	16.0	—	—		7.6	161
10-29-59				0.03	0.00	10.0	—	—		7.9	176
4-28-60	10	—		0.05	0.06	9.0	—	—		7.7	70.7
5-19-60											
6-4-60				0.05	0.01	9.0	0.16	0.00		7.8	135
6-10-60	8	57		0.08	0.00	7.0	—	—		7.7	92.9
8-31-60	2.5	59		0.02	0.03	—	—	—		8.1	175
6-25-61											
8-2-61											
5-[illegible]62											
5-29-62				0.08	0.03	1.0	—	—		7.9	59
6-14-62	30+	50		0.26	0.05	8.0	—	—		7.2	78
6-19-62											
7-18-62	4.5	—		0.09	0.03	9.0	—	—		8.0	132
8-20-70											

Walkermine Study

Station name: Little Grizzly Creek above tailings area

Date Sampled	Flow Est CFS	Temp. F°		Cu PPm	Zn PPm	SO_4 PPm	Fe PPm	Mn PPm		Ph	EC Mmhos
5-25-57											
6-5-57											
5-27-58											
6-5-58	—	—		0.00	0.00	0.0	—	—		6.4	45.9
6-18-58	0.5	—		0.00	0.00	—	—	—		7.6	109
6-29-59				0.01	0.01	1.0				7.7	111
8-28-60											
5-19-60	10	—		0.01	0.00	1.0	—	—		7.8	52.7
6-4-60				0.00	0.01	<0.5	0.1	0.00		7.5	88
6-10-60	5	—		0.02	0.00	2.0	—	—		7.5	70.5
8-31-60	0.5	65		0.01	0.00	—	—	—		7.9	114
6-23-61											
8-2-61	~~0.5~~	~~65~~									
[illegible]-2				0.04	0.03	1.0	—	—		7.4	44
6-29-62				0.05	0.04	1.0	—	—		7.2	48
6-14-62	10	50		0.01	0.03	1.0	—	—		7.3	56
[illegible]-19-62	~~10~~	~~50~~									
7-18-62											
8-20-70											

Chem. analysis of water

Table A

Walkermine Study

Station name: Dollie Creek above Mine Waste area

Date Sampled	Flow Est CFS	Temp. F°		Cu PPM	Zn PPM	SO_4 PPM	Fe PPM	Mn PPM		Ph	EC Mmhos
6-25-57	0.5	—		0.01	0.02	0.00	—	—		7.8	96
10-5-57				0.00	0.00	—				7.6	—
5-27-58											
6-5-58	—	—		0.00	0.00	1.0	—	—		6.7	55.4
9-13-58 ~~7-11-58~~	0.3	—		0.16	0.00	8.6	—	—		7.5	241
10-18-58 ~~10-29-59~~	0.25	—		0.16	0.00	—	—	—		7.8	142
4-28-60	0.44			0.01	0.02	1.0	—	—		7.6	83.2
5-19-60											
6-4-60				0.01	0.00	7.0	0.13	0.00		7.7	129
6-10-60	0.75	63		0.01	0.01	1.0	—	—		7.7	110
8-31-60	0.25	44		0.01	0.00	—	—	—		7.9	131
6-23-61											
8-2-61											
5-[illegible]-62											
5-29-62											
6-14-62											
6-19-62											
7-18-62	.2	56		0.05	0.02	2.0	—	—		7.4	107
8-20-70											

Reconnaissance
Samples of

Surface Waters

Sampled
October 20, 1970

by

Division of Mines
and Geology
Staff

State of California

The Resources Agency

Memorandum

To : Robert Streitz

Date : December 1, 1970

From : Paul L. Anderson

Subject: Water Analyses

The four samples of water from the Walker Mine area that you submitted and asked to have analyzed have been completed. We have assigned sample numbers to your descriptions as follows:

#1 10' inside main portal adit

#2 Surface stream from above main adit

#3 Stream at main road to Ingles Mtn.; below spreading basin and mine dump

#4 Drain at apex of tailings just east of L. Grizzly Creek

The chemical analyses were provided by Hornkohl Laboratories, Inc., Bakersfield. In addition, I evaporated a 100 ml specimen of each sample onto cellulose and then made a qualitative analysis of the residue by x-ray spectrography. Each of the samples was analyzed in our laboratory for Cu, Pb, Zn, and Ag.

Copies of Hornkohl's analyses are enclosed. The qualitative x-ray spectrographic analysis confirmed the presence Mn, K, Ca, and S as determined by Hornkolhl. By XRS I looked specifically for As and Se but neither element was detected in any sample. XRS detected Cu in all four samples and Zn in samples #1 and #2. No silver or lead was detected in any sample. No other element was detected in the residue of any of the four samples.

We analyzed quantitatively for Cu, Pb, Zn, and Ag by atomic absorption spectrophotometry. The results are:

	SAMPLE 1	2	3	4
Cu, ppm	10.0	0.8	0.3	0.5
Pb, ppm	ND(1)	ND(1)	ND(1)	ND(1)
Zn, ppm	0.4	0.2	ND(2)	ND(2)
Ag, ppm	ND(2)	ND(2)	ND(2)	ND(2)

(1) Not detected; less than 0.2 ppm
(2) Not detected; less than 0.1 ppm

DMG 101

I hope this provides the information you need. My decision to have the "Water Quality Analyses" done commercially is because of the large number of "kinds" of analyses required for such a characterization. We could justify the procedure development for such an analytical scheme only if there were a large number of samples to be run. If the lab can be of further help please let us know.

PLA:a
Encl.

$21.00 for each sample

TELEPHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.

CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206044 *Marked* Walker Mine #1, H_2O from 10' inside Main Portal Adit

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Copper		10.0	
Carbonates, CO_3	--	0.0	0.00
Bicarbonates, HCO_3	--	2.4	0.14
Chlorides, Cl	--	5.0	0.29
Sulfates, SO_4	--	81.6	4.77
Sulfides, S	--	0.0	0.00
Ammonia, NH_3	--	Trace	Trace
Nitrites, NO_2	--	0.0	0.00
Nitrates, NO_3	--	Trace	Trace
Calcium, Ca	--	9.8	0.57
Magnesium, Mg	--	6.3	0.37
Sodium, Na	--	2.6	0.15
Iron, Fe (total)	--	0.32	0.02
Fluorides, F	--	0.10	0.01
Manganese, Mn	--	1.43	0.08
Potassium, K	--	0.92	0.05
Hardness as $CaCO_3$	--	50.5	2.95
Total Solids @ 105°C.	--	109.2	6.39

pH-Value @ 25°C. -- 5.4
Conductivity: Mhos/cm. x 10^5 @ 25°C. -- 19.0

Color : Water White
Odor : None
Turbidity: Clear (slight sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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PHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206045

Marked Walker Mine #2, H_2O from Surface Stream from above Main Adit

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

****

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	--	0.0	0.00
Bicarbonates, HCO_3	--	12.8	0.75
Chlorides, Cl	--	7.1	0.42
Sulfates, SO_4	--	52.8	3.09
Sulfides, S	--	0.0	0.00
Ammonia, NH_3	--	Trace	Trace
Nitrites, NO_2	--	0.0	0.00
Nitrates, NO_3	--	0.5	0.03
Calcium, Ca	--	10.3	0.60
Magnesium, Mg	--	6.0	0.35
Sodium, Na	--	3.3	0.19
Iron, Fe (total)	--	2.50	0.15
Fluorides, F	--	0.10	0.01
Manganese, Mn	--	1.35	0.08
Potassium, K	--	0.94	0.05
Hardness as $CaCO_3$	--	50.5	2.95
Total Solids @ 105°C.	--	91.3	5.34

pH-Value @ 25°C. — 6.9
Conductivity: Mhos/cm. x 10^5 @ 25°C. — 15.4

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, IN C.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS. AUTHORIZATION FOR PUBLICATION OF OUR REPORTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING THEM IS RESERVED PENDING YOUR WRITTEN APPROVAL AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES.

TELEPHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206046

Marked Walker Mine #3, H_2O from Stream at Main Road to Ingels Mtn; below Spreading Basin and Mine Dump

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	—	0.0	0.00
Bicarbonates, HCO_3	—	80.5	4.71
Chlorides, Cl	—	9.9	0.58
SUlfates, SO_4	—	11.5	0.67
Sulfides, S	—	0.0	0.00
Ammonia, NH_3	—	Trace	Trace
Nitrites, NO_2	—	0.0	0.00
Nitrates, NO_3	—	Trace	Trace
Calcium, Ca	—	10.5	0.61
Magnesium, Mg	—	9.8	0.57
Soidum, Na	—	3.3	0.19
Iron, Fe (total)	—	0.70	0.04
Fluorides, F	—	0.16	0.01
Manganese, Mn	—	0.20	0.01
Potassium, K	—	3.83	0.22
Hardness as $CaCO_3$	—	66.5	3.89
Total Solids @ 105°C.	—	90.2	5.27

pH-Value @ 25°C. — 7.5
Conductivity: Mhos/cm. x 10^5 @ 25°C. — 15.4

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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HORNKOHL LABORATORIES, Inc.

CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206047

Marked Walker Mine #4, H_2O from Drain at Apex of Tailings just East of L. Grizzly Creek

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	—	0.0	0.00
Bicarbonates, HCO_3	—	76.9	4.50
Chlorides, Cl	—	8.5	0.50
Sulfates, SO_4	—	10.6	0.62
Sulfides, S	—	0.0	0.00
Ammonia, NH_3	—	Trace	Trace
Nitrites, NO_2	—	0.0	0.00
Nitrates, NO_3	—	Trace	Trace
Calcium, Ca	—	9.8	0.57
Magnesium, Mg	—	8.6	0.50
Sodium, Na	—	3.4	0.20
Iron, Fe (total)	—	1.49	0.09
Fluorides, F	—	0.17	0.01
Manganese, Mn	—	0.20	0.01
Potassium, K	—	3.22	0.19
Hardness as $CaCO_3$	—	59.5	3.48
Total Solids @ 105°C.	—	84.5	4.94

pH-Value @ 25°C. -- 7.7
Conductivity: Mhos/cm. x 10^5 @ 25°C. -- 15.3

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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Reconnaissance sampling of surface waters about the Walker Mine, Plumas County, California

with determinations for

COPPER
LEAD
ZINC
and pH
concentrations

by

California Division of Mines
and Geology staff

on

September 22, 1971

State of California

The Resources Agency

Memorandum

To : Bob Streitz

Date : January ~~10~~ 12, 1972

From : Hasu Majmundar

Subject: Result of the Cu-Pb-Zn analysis of water samples from Walker Mines area
Samples taken September 22, 1971.

The final result of the analysis of the samples submitted by you is as follows:

Sample No.	pH	Cu (ppb)	Pb (ppb)	Zn (ppb)	
W-1	8.00	1	0.0	0.6	L. Grizzly Cr. above tails
W-2	6.17	2	0.0	0.9	Iron pipe @ 5 gpm
W-3	7.41	7	0.0	1.8	Sm. surface stream
W-4	5.30	232	0.7	24.0	Ventilator overflow @ 300 gpm
W-4'	5.23	248	0.7	44.0	
W-5	4.90	245	1.0	30.0	Ventilator shaft
W-8	5.27	235	1.0	25.0	Mine Portal
W-9	7.22	1	1.3	0.7	Spring @ 50 gpm
W-10	7.90	24	0.0	1.7	w/in dump @ 35 gpm
W-11	6.76	148	0.0	24.0	red stream
W-12	7.70	252	0.0	16.0	green stream
W-13	7.80	184	0.0	16.0	Dallie Cr. @ tailings apex
W-14	8.00	5	0.0	0.3	sl. turbidity
W-15	7.69	29	0.0	1.9	sl. turbidity
W-16	7.75	2	0.0	0.3	sl. turbidity
W-17	8.12	21	0.0	1.7	water clear
W-18	7.27	1	0.0	1.2	Indian Creek @ bridge, turbid

The white coating on solids samples W-6 and W-7 is Aluminum Sulfate.

All the above samples were tested for Hg and this element was found absent.

HASU MAJMUNDAR
Manager, Geochemical Section

HHM/jt

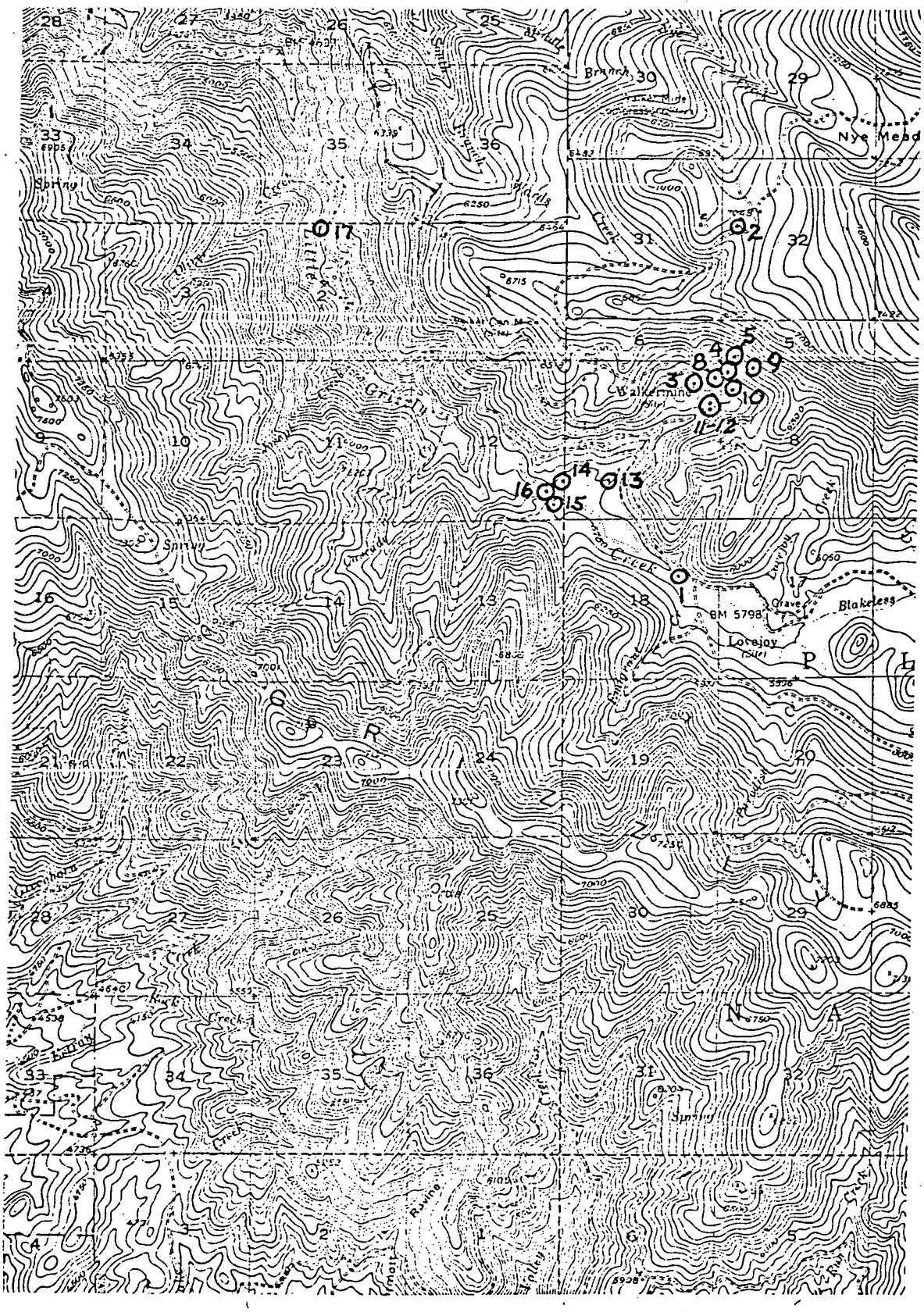
DMG 101

SAMPLE STATIONS

surface waters

September 22, 1971

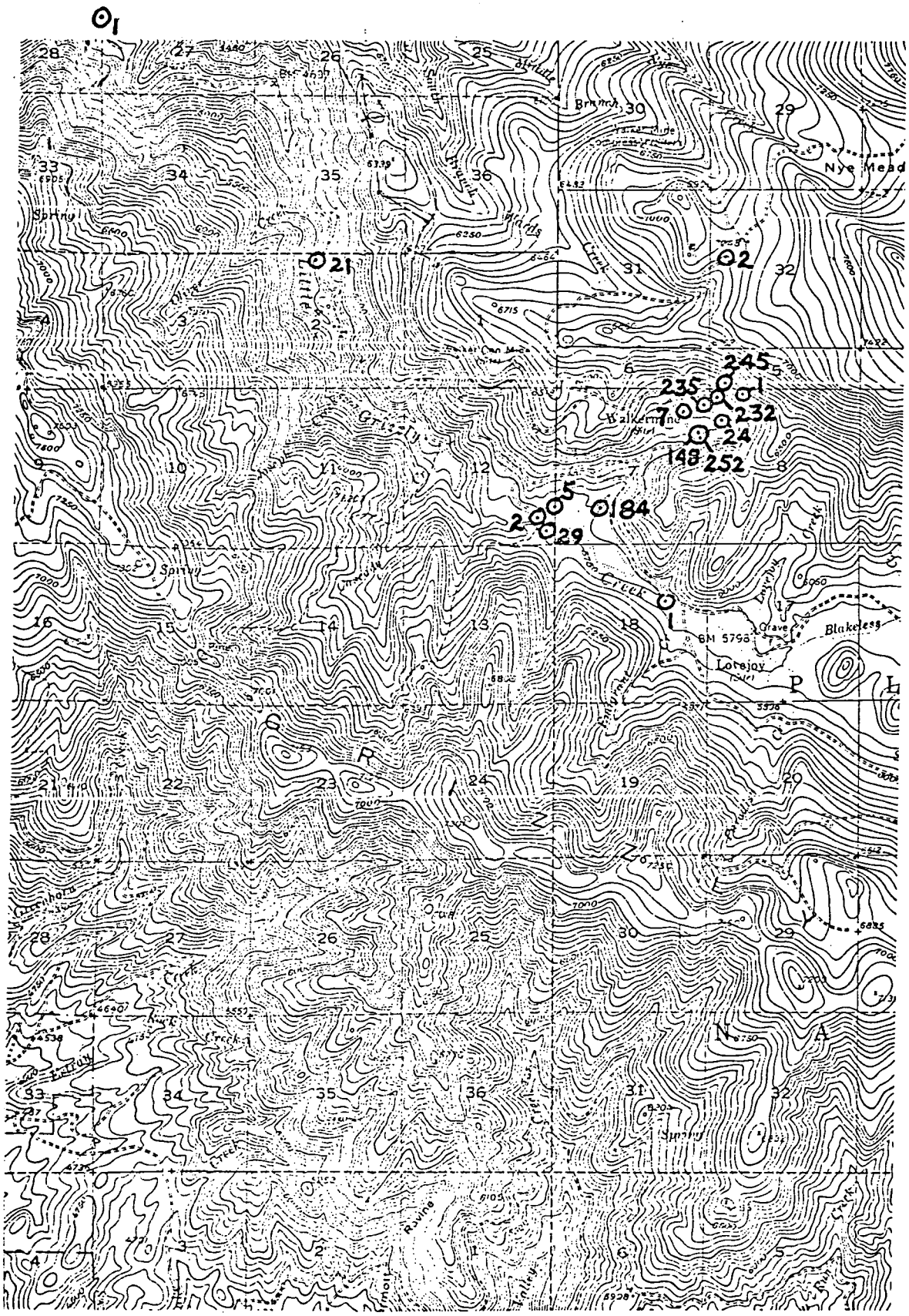
O18 (INDIAN CREEK AT BRIDGE)



COPPER, ppb

concentrations in water

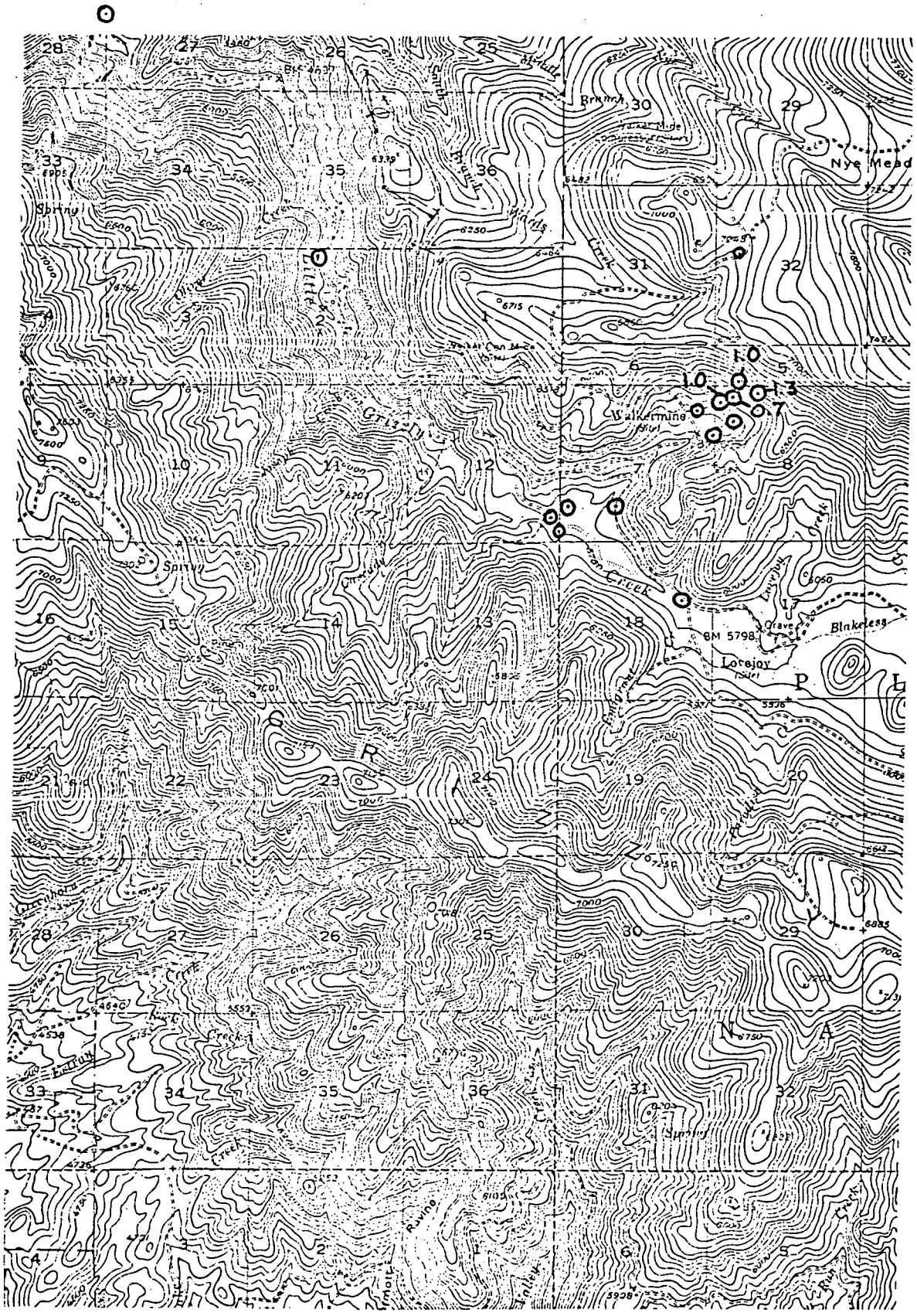
September 22, 1971



LEAD, ppb

concentrations in water

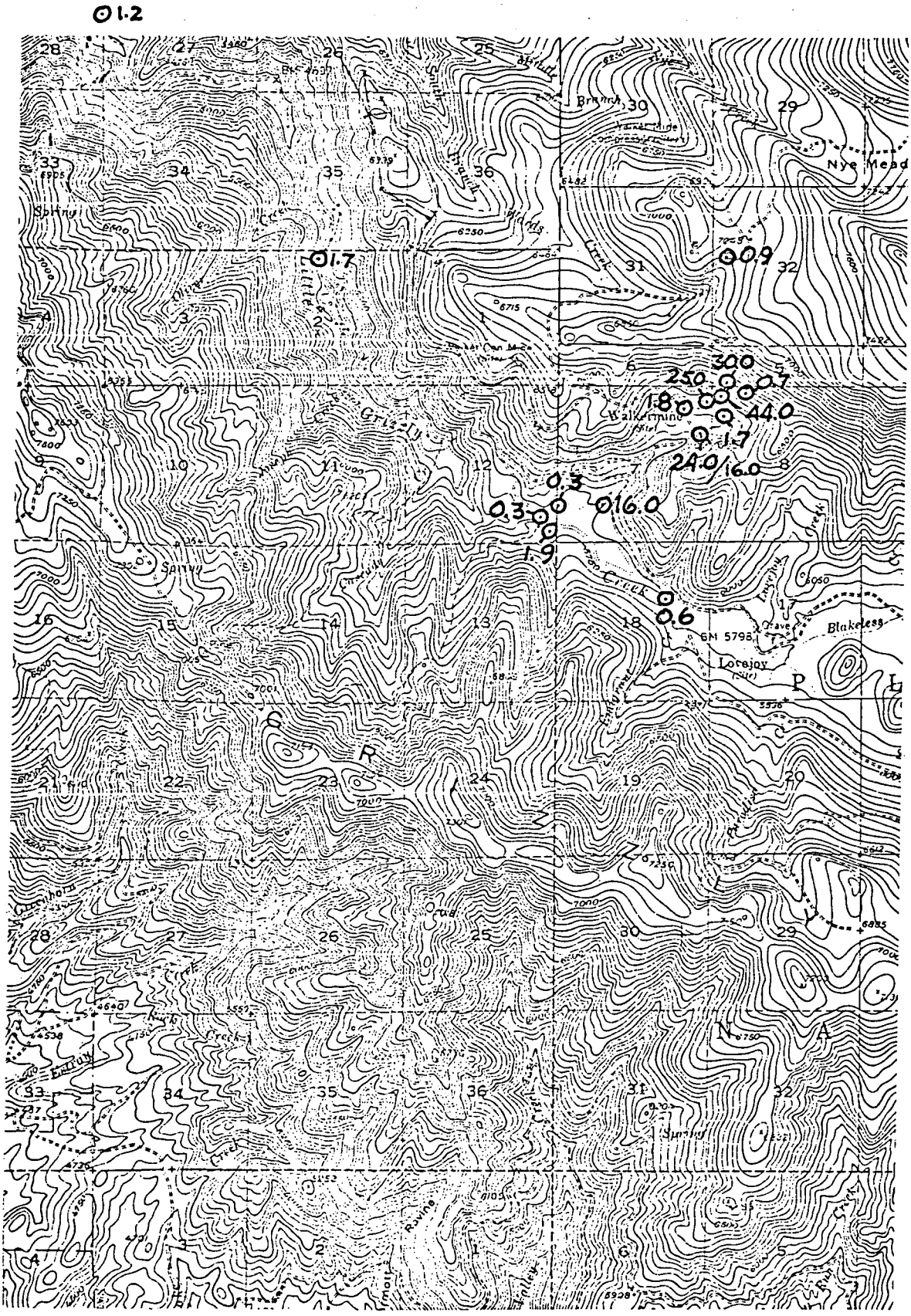
September 22, 1971

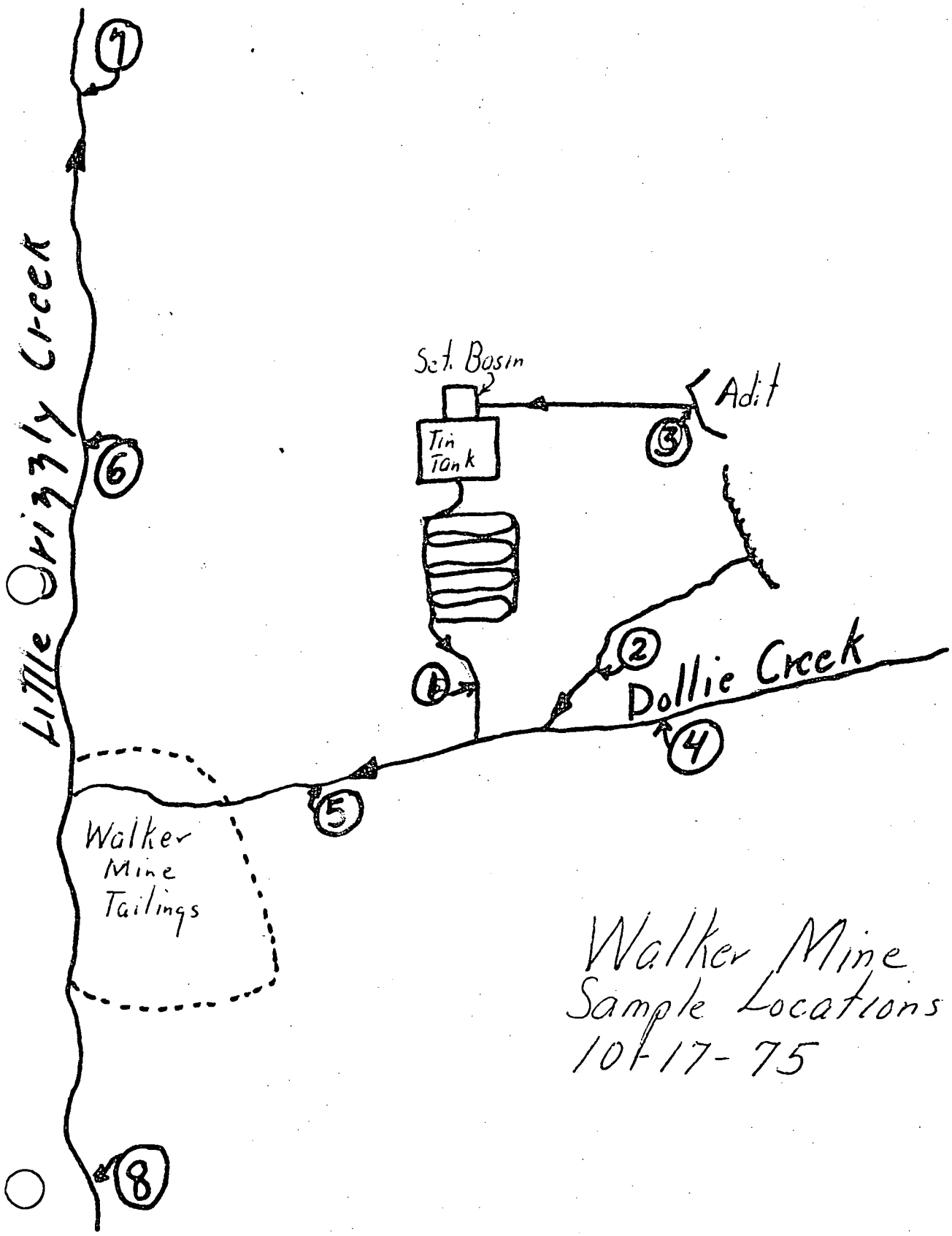


ZINC, ppb

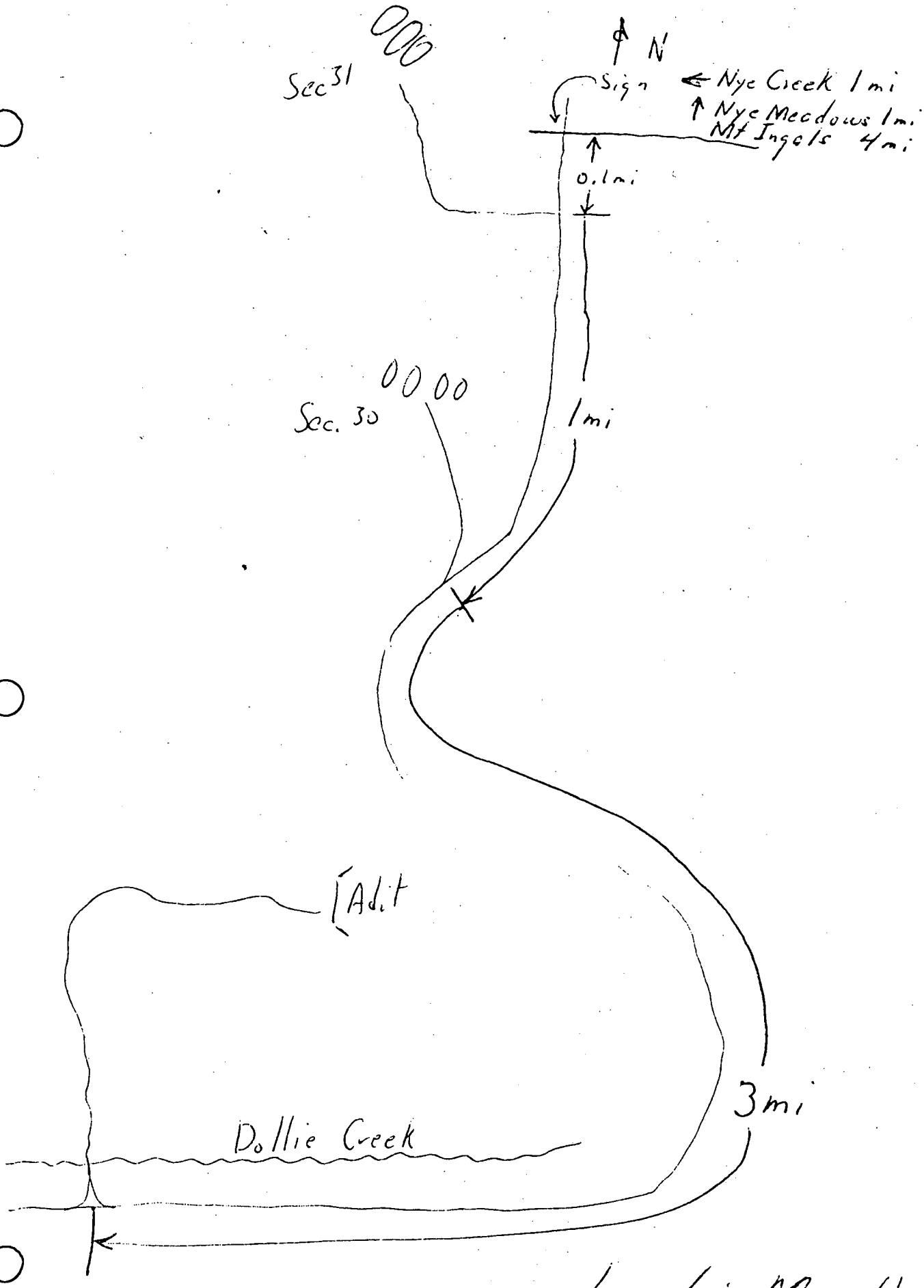
concentrations in water

September 22, 1971

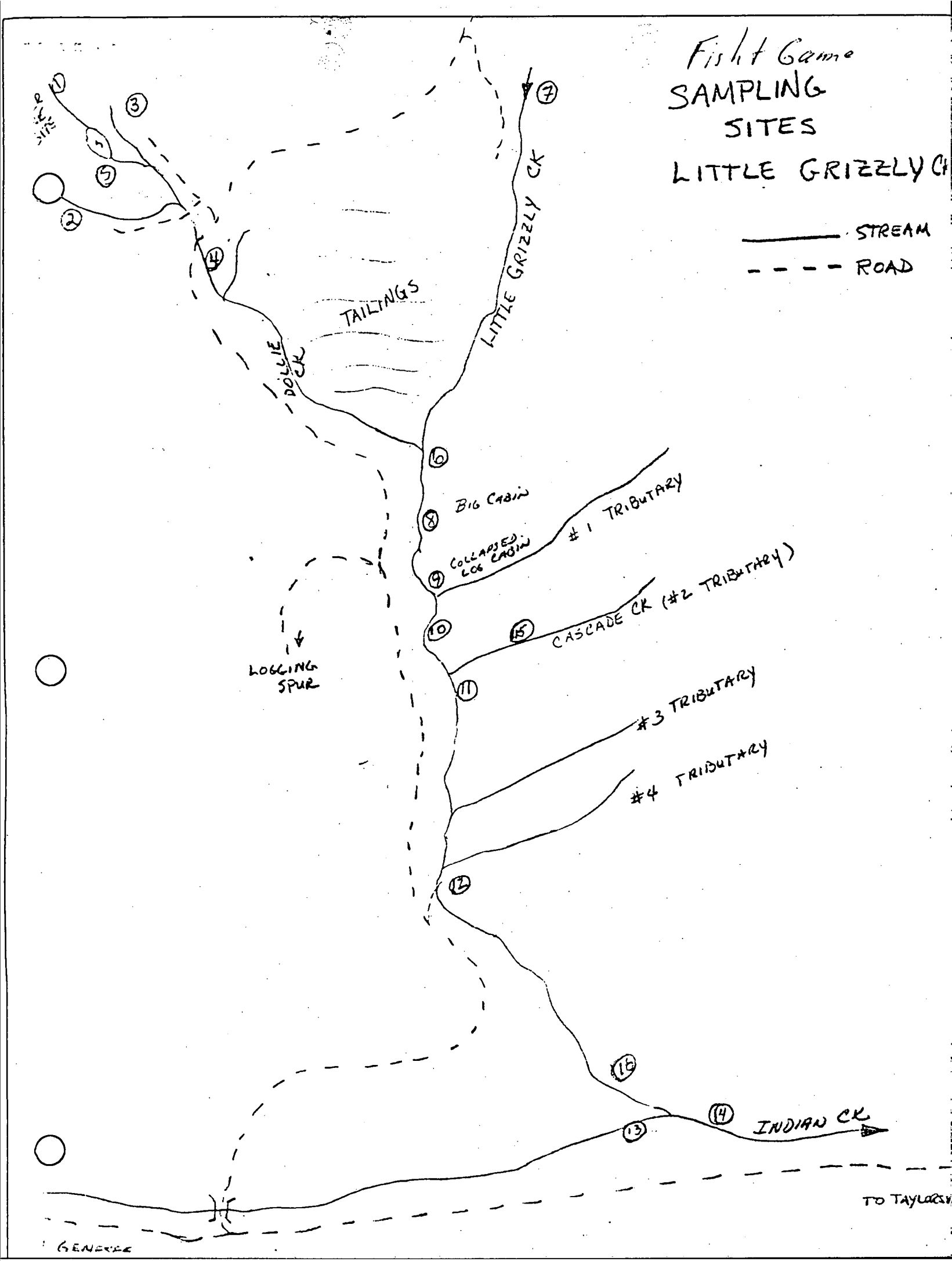


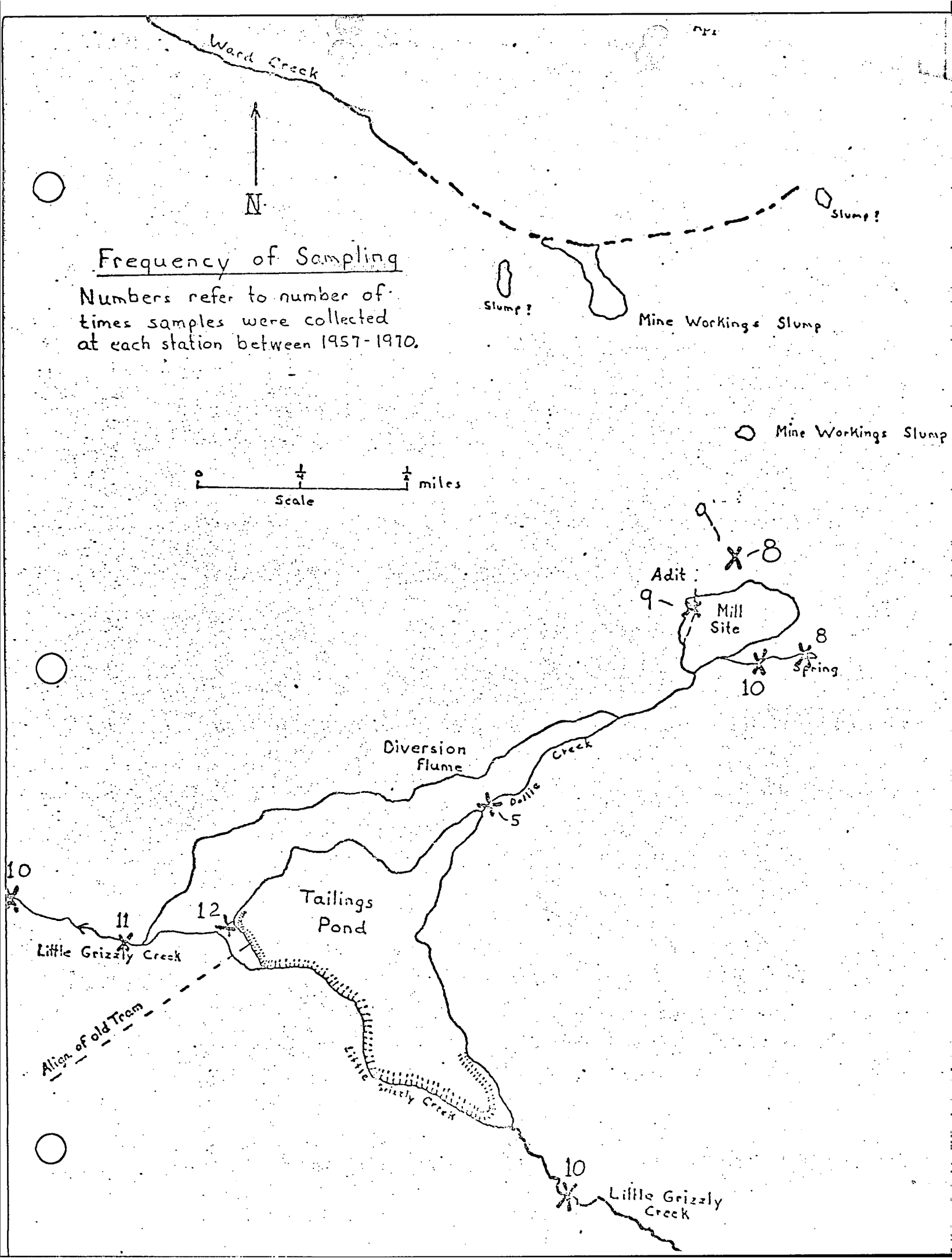


Walker Mine
Sample Locations
10-17-75



Location Map, Upper Workings, Walker Mine E.6.


Fish & Game
SAMPLING
SITES
LITTLE GRIZZLY CK
STREAM
ROAD
LITTLE GRIZZLY CK
TAILINGS
DOLLIE CK
BIG CABIN
COLLAPSED LOG CABIN
#1 TRIBUTARY
CASCADE CK (#2 TRIBUTARY)
LOGGING SPUR
#3 TRIBUTARY
#4 TRIBUTARY
INDIAN CK
TO TAYLOR
GENERIC


Ward Creek
N
Frequency of Sampling
Numbers refer to number of times samples were collected at each station between 1957-1970.
Slump ?
Slump ?
Mine Workings Slump
Mine Workings Slump
0
1/4
1/2 miles
Scale
9
8
Adit
9
Mill Site
8
Spring
10
Diversion Flume
Dollie Creek
5
10
11
12
Tailings Pond
Little Grizzly Creek
Align. of old Tram
Little Grizzly Creek
10
Little Grizzly Creek

Appendix V

Analyses of Surface Waters

Central Valley Regional Water Quality Control Board Staff 1957-70

California Division of Mines and Geology 1970

California Division of Mines and Geology 1971

Surface Water
Samples

1957-1970

by

Central Valley
Region
Water Quality Control
Board Staff

Chemical analysis of Water

Appendix Table A

1 of 9

Walkermine Study

Station name: Air Raise

Date Sampled	Flow Est CFS	Temp. F°	Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm	Ph	EC Mmhos
6-25-57	0.5	—	22.0	5.5	125	—	—	3.7	328
10-5-57									
5-27-58			29.0	2.5	150	—	—	3.5	430
6-5-58	—	—	20.0	1.6	117	—	—	3.3	340
7-11-58			19.0	1.9	—	—	—	4.2	—
10-29-59	0.00								
4-28-60									
5-19-60									
6-4-60									
6-10-60	0.5	46	0.36	4.4	210	—	—	4.1	454
8-31-60									
6-23-61									
8-2-61									
5-[illegible]-62									
5-29-62			54.0	3.4	276	—	—	3.7	593
6-14-62									
6-19-62	1.5	44	44.0	2.8	206	—	—	3.5	501
7-18-62	0.0								
8-20-70	.33	—	14.0	0.6	83	—	—	4.3	249

Walkermine Study

Station Name: Portal

Date Sampled	Flow Est CFS	Temp. °F		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos	
6-25-57	0.1	—		12.0	3.2	105	—	—		4.6	259	
10-5-57												
5-27-58				21.0	2.1	129	—	—		4.3	303	
6-5-58												
7-11-58				12.0	1.6	—				4.8	—	
10-29-59												
4-28-60	—	—		0.53	0.17	8.2	—	—		6.4	95.3	
5-19-60												
6-4-60				9.7	1.3	137	.01	1.9		5.2	307	
6-10-60	0.2	46		19.0	2.2	155				4.6	348	
8-31-60												
6-23-61												
8-2-61												
5-[illegible]-62												
5-29-62												
6-14-62	0.25	44		38.0	2.2	182	—			4.3	420	
6-19-62												
7-18-62	5 gpm ~~0.13~~	54		.94	0.2	145				4.6	350	
8-20-70	—	—		14.0	0.6	93.0				4.6	254	

Chem. analysis of water Table A 3 of 9

Walkermine Study

Station name: Upper or "East" Spring

Date Sampled	Flow Est CFS	Temp. F°		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos
6-25-57	1.0	—		.01	.02	0.0	—	—		7.6	107
10-5-57				0.00	0.00	—	—	—		7.7	—
5-27-58											
6-5-58											
10-18-58 ~~7-11-58~~	0.25			0.00	0.00	—	—	—		7.3	195
10-29-59				0.02	0.00	1.0	—	—		7.6	139
4-28-60	0.33	—		0.00	0.02	2.0	—	—		7.4	139
5-19-60											
6-4-60											
6-10-60	1	43		0.04	0.00	1.0				7.0	140
8-31-60	0.25	44		0.01	0.00	—	—	—		7.8	—
6-23-61				0.01	0.00	—				7.8	140
8-2-61											
5-[illegible]-62											
5-29-62											
6-14-62											
6-19-62											
7-18-62											
8-20-70											

NATIONAL 42-383

Walkermine Study

Station name: Upper end of tailings or (Lower Bridge)

Date Sampled	Flow Est CFS	Temp. F°		Cu PPm	Zn PPm	SO_4 PPm	Fe PPm	Mn PPm		Ph	EC Mmhos	
6-[illegible]-57												
10-5-57												
5-27-58												
6-5-58												
7-11-58												
10-29-59												
4-28-60	1	—		0.19	0.04	7.0	—	—		7.6	99.0	
5-19-60	1	—		0.15	0.00	6.0	—	—		7.8	109	
6-4-60												
6-10-60	2	63		0.68	0.03	43.0	—	—		7.3	170	
8-31-60	0.4	65		0.32	0.06	1.0	—	—		8.1	139	
6-23-61				0.1	0.00	1.0	—	—		8.2	124	
8-2-61												
5-[illegible]-62												
5-27-62												
6-19-62												
6-19-62												
7-18-62												
8-20-70												

Walkermine Study

Station name: Dollie Creek below Tailings Pond

Date Sampled	Flow Est CFS	Temp. °F		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos	
6-25-57	2.0	—		0.27	0.12	37.0	—	—		7.5	135	
10-5-57												
5-27-58												
6-5-58	—	—		8.2	0.48	50.0	—	—		5.5	136	
10-18-58 ~~11-11-58~~	0.5	—		0.30	0.05	—	—	—		7.8	169	
10-29-59				0.40	0.05	18.0	—	—		7.8	180	
4-28-60	1	—		0.48	0.10	2.0	—	—		7.6	114	
5-19-60												
6-4-60				0.82	0.11	14.0	0.9	0.2		7.9	148	
6-10-60	2	88		0.53	0.07	45.0	—	—		7.6	171	
8-31-60	0.5	76		0.32	0.06	19.0	—	—		8.1	148	
6-23-61				0.40	0.04	11.0	—	—		8.2	138	
8-2-61												
5-[illegible]-62				0.62	0.12	15.0	—	—		7.4	100	
5-29-62												
6-14-62	1.5	58		1.7	0.75	82.0	—	—		6.5	208	
6-19-62												
7-18-62	1.5	58		0.21	0.04	28.0	—	—		7.7	128	
8-20-70												

Walkermine Study

Station name: Brown's Cabin (Little Grizzly Creek)

Date Sampled	Flow est cfs	Temp. F°		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC µmhos
6-25-57	4.5			0.32	0.08	9.6	—	—		7.8	102
10-5-57											
5-27-58											
6-5-58	—	—		0.24	0.03	7.7	—	—		6.5	63
9-13-58	1.0	—		0.12	0.00	13.0	—	—		7.7	151
10-29-59				0.17	0.03	17.0	—	—		7.7	193
4-28-60	7.0	—		0.09	0.04	5.0	—	—		7.7	66.9
5-19-60											
6-4-60				0.18	0.03	12.0	0.68	0.15		7.9	138
6-10-60	7.0	—		0.13	0.00	11.0	—	—		7.7	94.6
8-31-60	2.0	64		0.09	0.06	—	—	—		7.9	192
6-23-61											
8-2-61				0.09	—	—				8.0	184
5-[illegible]-62											
5-29-62											
6-14-62	30	52		0.47	0.1	10.0				7.3	90
6-19-62											
7-18-62	3.0	70		0.16	0.05	9.0				7.9	129
8-20-70											

NATIONAL 42-383

Walkermine Study

Station name: Clyde Smith Mine (Little Grizzly Creek)

Date Sampled	Flow Est CFS	Temp. F°		Cu PPM	Zn PPM	SO_4 PPM	Fe PPM	Mn PPM		Ph	EC Mmhos
6-25-57											
10-5-57											
5-27-58											
6-5-58	—	—		0.14	0.03	4.2	—	—		6.5	52.2
7-13-58	1.0	—		0.03	0.00	16.0	—	—		7.6	161
10-29-59				0.03	0.00	10.0	—	—		7.9	176
4-28-60	10	—		0.05	0.06	4.0	—	—		7.7	70.7
5-19-60											
6-4-60				0.05	0.01	9.0	0.16	0.00		7.8	135
6-10-60	8	57		0.08	0.00	7.0	—	—		7.7	92.9
8-31-60	2.5	59		0.02	0.03	—	—	—		8.1	175
6-23-61											
8-2-61											
5-[illegible]-62											
5-29-62				0.03	0.03	1.0	—	—		7.9	59
6-14-62	30+	50		0.26	0.05	8.0	—	—		7.2	78
6-19-62											
7-18-62	4.5	—		0.09	0.03	9.0	—	—		8.0	132
8-20-70											

Walkermine Study

Station name: Little Grizzly Creek above tailings area

Date Sampled	Flow Est Cfs	Temp. °F		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC Mmhos
6-25-57											
10-5-57											
5-27-58											
6-5-58	—	—		0.00	0.00	0.0	—	—		6.4	45.9
10-18-58 ~~7-11-58~~	0.5	—		0.00	0.00	—	—	—		7.6	109
10-29-59				0.01	0.01	1.0				7.7	111
4-28-60											
5-19-60	10	—		0.01	0.00	1.0	—	—		7.8	52.7
6-4-60				0.00	0.01	<0.5	0.1	0.00		7.5	88
6-10-60	5	—		0.02	0.00	2.0	—	—		7.5	70.5
8-31-60	0.5	65		0.01	0.00	—	—	—		7.9	114
6-23-61											
8-2-61	~~0.5~~	~~65~~									
5-[illegible]-62				0.04	0.03	1.0	—	—		7.4	44
5-29-62				0.05	0.04	1.0	—	—		7.2	48
6-14-62	10	50		0.01	0.03	1.0	—	—		7.3	56
6-19-62	~~10~~	~~50~~									
7-18-62											
8-20-70											

Chem. anaylsis of water

Table A

42-333

Walkermine Study

Station name: Dollie Creek above Mine Waste area

Date Sampled	Flow Est Cfs	Temp. F°		Cu ppm	Zn ppm	SO_4 ppm	Fe ppm	Mn ppm		Ph	EC Mmhos
6-25-57	0.5	—		0.01	0.02	0.00	—	—		7.8	96
10-5-57				0.00	0.00	—				7.6	—
5-27-58											
6-5-58	—	—		0.00	0.00	1.0	—	—		6.7	55.4
9-13-58 ~~7-11-58~~	0.3	—		0.16	0.00	8.6	—	—		7.5	291
10-18-58 ~~9-29-58~~	0.25	—		0.16	0.00	—	—	—		7.8	142
4-28-60	0.44			0.01	0.02	1.0	—	—		7.6	83.2
5-19-60											
6-4-60				0.01	0.00	7.0	0.13	0.00		7.7	129
6-10-60	0.75	63		0.01	0.01	1.0	—	—		7.7	110
8-31-60	0.25	44		0.01	0.00	—	—	—		7.9	131
6-23-61											
8-2-61											
5-[illegible]62											
5-29-62											
6-14-62											
6-19-62											
7-18-62	.2	56		0.05	0.02	2.0	—	—		7.4	107
8-20-70											

Reconnaissance
Samples of

Surface Waters

Sampled
October 20, 1970

by

Division of Mines
and Geology
Staff

State of California | The Resources Agency

Memorandum

To : Robert Streitz

Date : December 1, 1970

From : Paul L. Anderson

Subject: Water Analyses

The four samples of water from the Walker Mine area that you submitted and asked to have analyzed have been completed. We have assigned sample numbers to your descriptions as follows:

#1 10' inside main portal adit

#2 Surface stream from above main adit

#3 Stream at main road to Ingles Mtn.; below spreading basin and mine dump

#4 Drain at apex of tailings just east of L. Grizzly Creek

The chemical analyses were provided by Hornkohl Laboratories, Inc., Bakersfield. In addition, I evaporated a 100 ml specimen of each sample onto cellulose and then made a qualitative analysis of the residue by x-ray spectrography. Each of the samples was analyzed in our laboratory for Cu, Pb, Zn, and Ag.

Copies of Hornkohl's analyses are enclosed. The qualitative x-ray spectrographic analysis confirmed the presence Mn, K, Ca, and S as determined by Hornkolhl. By XRS I looked specifically for As and Se but neither element was detected in any sample. XRS detected Cu in all four samples and Zn in samples #1 and #2. No silver or lead was detected in any sample. No other element was detected in the residue of any of the four samples.

We analyzed quantitatively for Cu, Pb, Zn, and Ag by atomic absorption spectrophotometry. The results are:

	SAMPLE 1	2	3	4
Cu, ppm	10.0	0.8	0.3	0.5
Pb, ppm	ND(1)	ND(1)	ND(1)	ND(1)
Zn, ppm	0.4	0.2	ND(2)	ND(2)
Ag, ppm	ND(2)	ND(2)	ND(2)	ND(2)

(1) Not detected; less than 0.2 ppm
(2) Not detected; less than 0.1 ppm

I hope this provides the information you need. My decision to have the "Water Quality Analyses" done commercially is because of the large number of "kinds" of analyses required for such a characterization. We could justify the procedure development for such an analytical scheme only if there were a large number of samples to be run. If the lab can be of further help please let us know.

PLA:a
Encl.

$21.00 for each sample

TELEPHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206044 *Marked* Walker Mine #1, H_2O from 10' inside Main Portal Adit

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Copper		10.0	
Carbonates, CO_3	--	0.0	0.00
Bicarbonates, HCO_3	--	2.4	0.14
Chlorides, Cl	--	5.0	0.29
Sulfates, SO_4	--	81.6	4.77
Sulfides, S	--	0.0	0.00
Ammonia, NH_3	--	Trace	Trace
Nitrites, NO_2	--	0.0	0.00
Nitrates, NO_3	--	Trace	Trace
Calcium, Ca	--	9.8	0.57
Magnesium, Mg	--	6.3	0.37
Sodium, Na	--	2.6	0.15
Iron, Fe (total)	--	0.32	0.02
Fluorides, F	--	0.10	0.01
Manganese, Mn	--	1.43	0.08
Potassium, K	--	0.92	0.05
Hardness as $CaCO_3$	--	50.5	2.95
Total Solids @ 105°C.	--	109.2	6.39

pH-Value @ 25°C. — 5.4
Conductivity: Mhos/cm. x 10^5 @ 25°C. — 19.0

Color : Water White
Odor : None
Turbidity: Clear (slight sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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PHONE (805) 327-8567 P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206045 *Marked* Walker Mine #2, H_2O from Surface Stream from above Main Adit

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

****

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	--	0.0	0.00
Bicarbonates, HCO_3	--	12.8	0.75
Chlorides, Cl	--	7.1	0.42
Sulfates, SO_4	--	52.8	3.09
Sulfides, S	--	0.0	0.00
Ammonia, NH_3	--	Trace	Trace
Nitrites, NO_2	--	0.0	0.00
Nitrates, NO_3	--	0.5	0.03
Calcium, Ca	--	10.3	0.60
Magnesium, Mg	--	6.0	0.35
Sodium, Na	--	3.3	0.19
Iron, Fe (total)	--	2.50	0.15
Fluorides, F	--	0.10	0.01
Manganese, Mn	--	1.35	0.08
Potassium, K	--	0.94	0.05
Hardness as $CaCO_3$	--	50.5	2.95
Total Solids @ 105°C.	--	91.3	5.34

pH-Value @ 25°C. — 6.9
Conductivity: Mhos/cm. x 10^5 @ 25°C. — 15.4

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, IN C.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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TELEPHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206046

Marked Walker Mine #3, H_2O from Stream at Main Road to Ingels Mtn; below Spreading Basin and Mine Dump

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	—	0.0	0.00
Bicarbonates, HCO_3	—	80.5	4.71
Chlorides, Cl	—	9.9	0.58
SUlfates, SO_4	—	11.5	0.67
Sulfides, S	—	0.0	0.00
Ammonia, NH_3	—	Trace	Trace
Nitrites, NO_2	—	0.0	0.00
Nitrates, NO_3	—	Trace	Trace
Calcium, Ca	—	10.5	0.61
Magnesium, Mg	—	9.8	0.57
Soidum, Na	—	3.3	0.19
Iron, Fe (total)	—	0.70	0.04
Fluorides, F	—	0.16	0.01
Manganese, Mn	—	0.20	0.01
Potassium, K	—	3.83	0.22
Hardness as $CaCO_3$	—	66.5	3.89
Total Solids @ 105°C.	—	90.2	5.27

pH-Value @ 25°C. — 7.5
Conductivity: Mhos/cm. x 10^5 @ 25°C. — 15.4

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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TELEPHONE (805) 327-8567

P.O. BOX 867

HORNKOHL LABORATORIES, Inc.
CHEMICAL AND TESTING ENGINEERS
714 TRUXTUN AVENUE
BAKERSFIELD, CALIFORNIA 93302

November 24, 1970

Laboratory No. 206047

Marked Walker Mine #4, H_2O from Drain at Apex of Tailings just East of L. Grizzly Creek

Sample Water

Received November 16, 1970

Submitted by State of California - The Resources Agency
Department of Conservation
Division of Mines and Geology
Division Headquarters, Resources Building, Room 1341
1416 Ninth Street
Sacramento, California 95814
Attn: Paul L. Anderson, Manager, Geochemical Section

* * * * * * *

CHEMICAL ANALYSIS OF WATER

Constituents:		Parts per Million	Grains per Gallon
Carbonates, CO_3	—	0.0	0.00
Bicarbonates, HCO_3	—	76.9	4.50
Chlorides, Cl	—	8.5	0.50
Sulfates, SO_4	—	10.6	0.62
Sulfides, S^{-}	—	0.0	0.00
Ammonia, NH_3	—	Trace	Trace
Nitrites, NO_2	—	0.0	0.00
Nitrates, NO_3	—	Trace	Trace
Calcium, Ca	—	9.8	0.57
Magnesium, Mg	—	8.6	0.50
Sodium, Na	—	3.4	0.20
Iron, Fe (total)	—	1.49	0.09
Fluorides, F	—	0.17	0.01
Manganese, Mn	—	0.20	0.01
Potassium, K	—	3.22	0.19
Hardness as $CaCO_3$	—	59.5	3.48
Total Solids @ 105°C.	—	84.5	4.94

pH-Value @ 25°C. -- 7.7
Conductivity: Mhos/cm. x 10^5 @ 25°C. -- 15.3

Color : Water White
Odor : None
Turbidity: Clear (sediment)

Respectfully submitted,
HORNKOHL LABORATORIES, INC.

E. R. Starbuck Jr.

E. R. Starbuck, Jr.,
Assistant Chief Chemist

ap

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Reconnaissance sampling of surface waters about the Walker Mine, Plumas County, California

with determinations for

COPPER
LEAD
ZINC
and pH
concentrations

by

California Division of Mines
and Geology staff

on

September 22, 1971

State of California

The Resources Agency

Memorandum

To : Bob Streitz

Date : January ~~10~~ 12, 1971

From : Hasu Majmundar

Subject: Result of the Cu-Pb-Zn analysis of water samples from Walker Mines area
Samples taken September 22, 1971.

The final result of the analysis of the samples submitted by you is as follows:

Sample No.	pH	Cu (ppb)	Pb (ppb)	Zn (ppb)	
W-1	8.00	1	0.0	0.6	L. Grizzly Cr. above tails
W-2	6.17	2	0.0	0.9	Iron pipe @ 5 gpm
W-3	7.41	7	0.0	1.8	Sm. surface stream
W-4	5.30	232	0.7	24.0	Ventilator overflow @ 300 gpm
W-4'	5.23	248	0.7	44.0	
W-5	4.90	245	1.0	30.0	Ventilator shaft
W-8	5.27	235	1.0	25.0	Mine Portal
W-9	7.22	1	1.3	0.7	Spring @ 50 gpm
W-10	7.90	24	0.0	1.7	w/in dump @ 35 gpm
W-11	6.76	148	0.0	24.0	red stream
W-12	7.70	252	0.0	16.0	green stream
W-13	7.80	184	0.0	16.0	Dollie Cr. @ tailings apex
W-14	8.00	5	0.0	0.3	sl. turbidity
W-15	7.69	29	0.0	1.9	sl. turbidity
W-16	7.75	2	0.0	0.3	sl. turbidity
W-17	8.12	21	0.0	1.7	water clear
W-18	7.27	1	0.0	1.2	Indian Creek @ bridge, turbid

The white coating on solids samples W-6 and W-7 is Aluminum Sulfate.

All the above samples were tested for Hg and this element was found absent.

HASU MAJMUNDAR
Manager, Geochemical Section

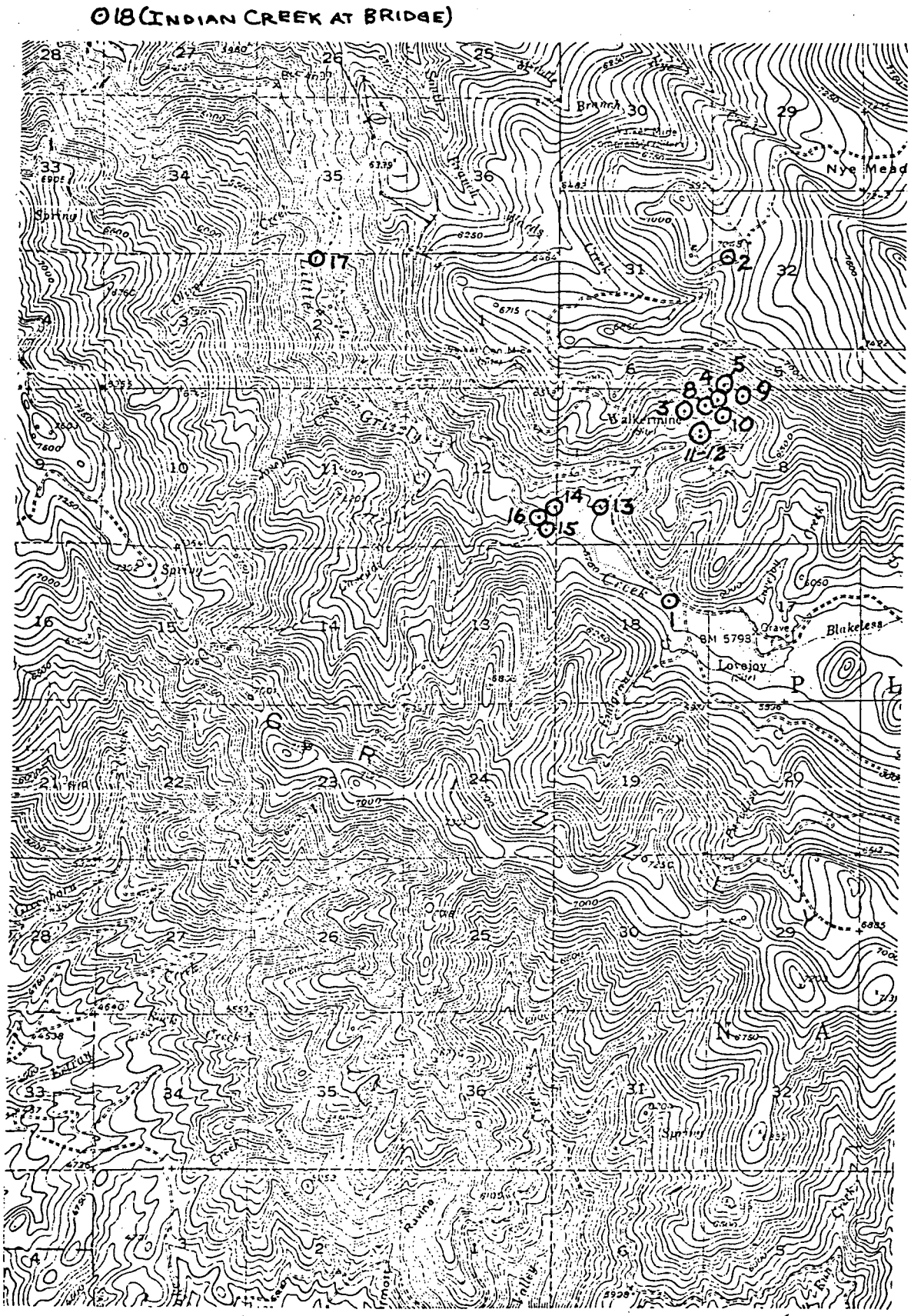
HHM/jt

DMG 101

SAMPLE STATIONS

surface waters

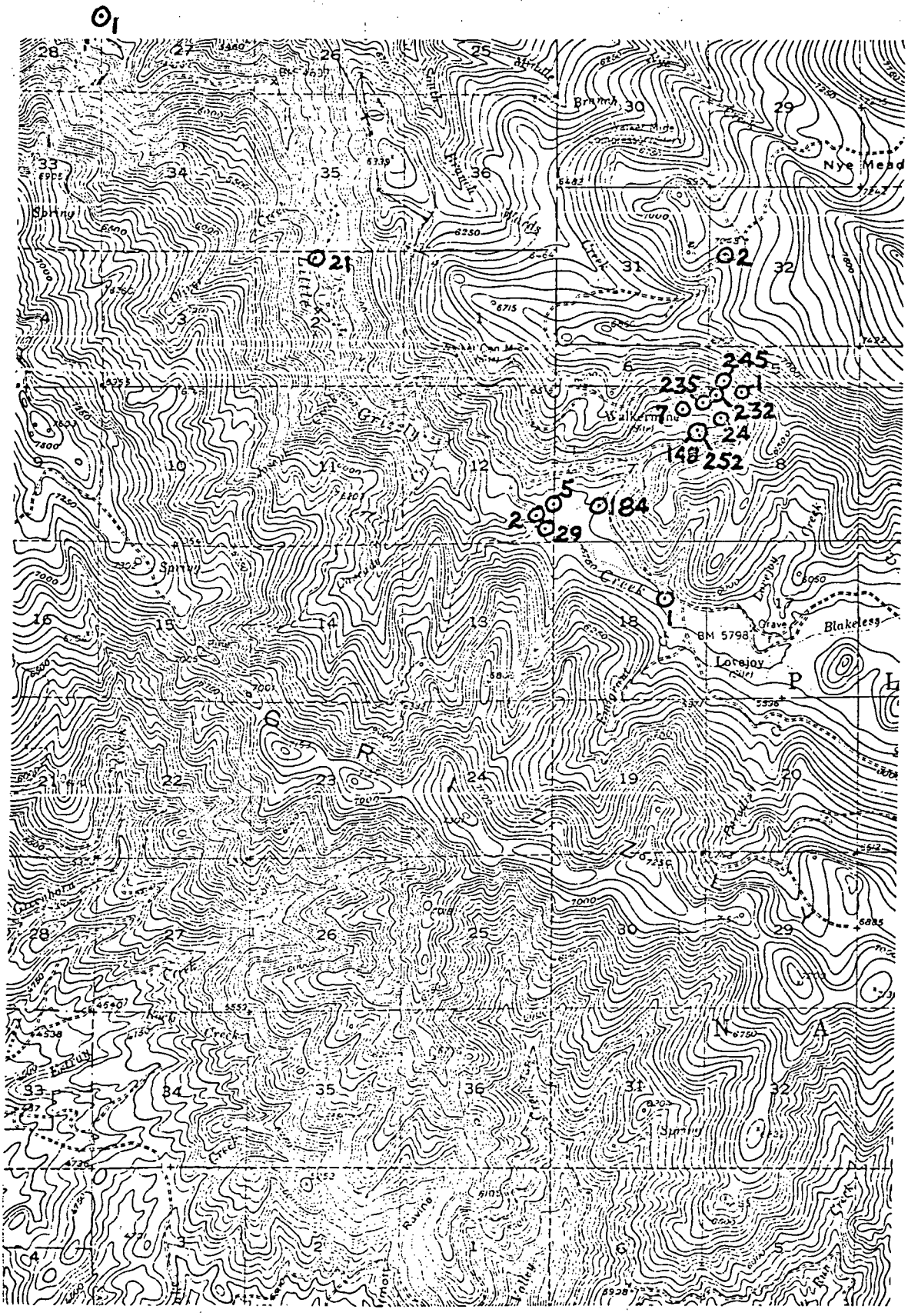
September 22, 1971



COPPER, ppb

concentrations in water

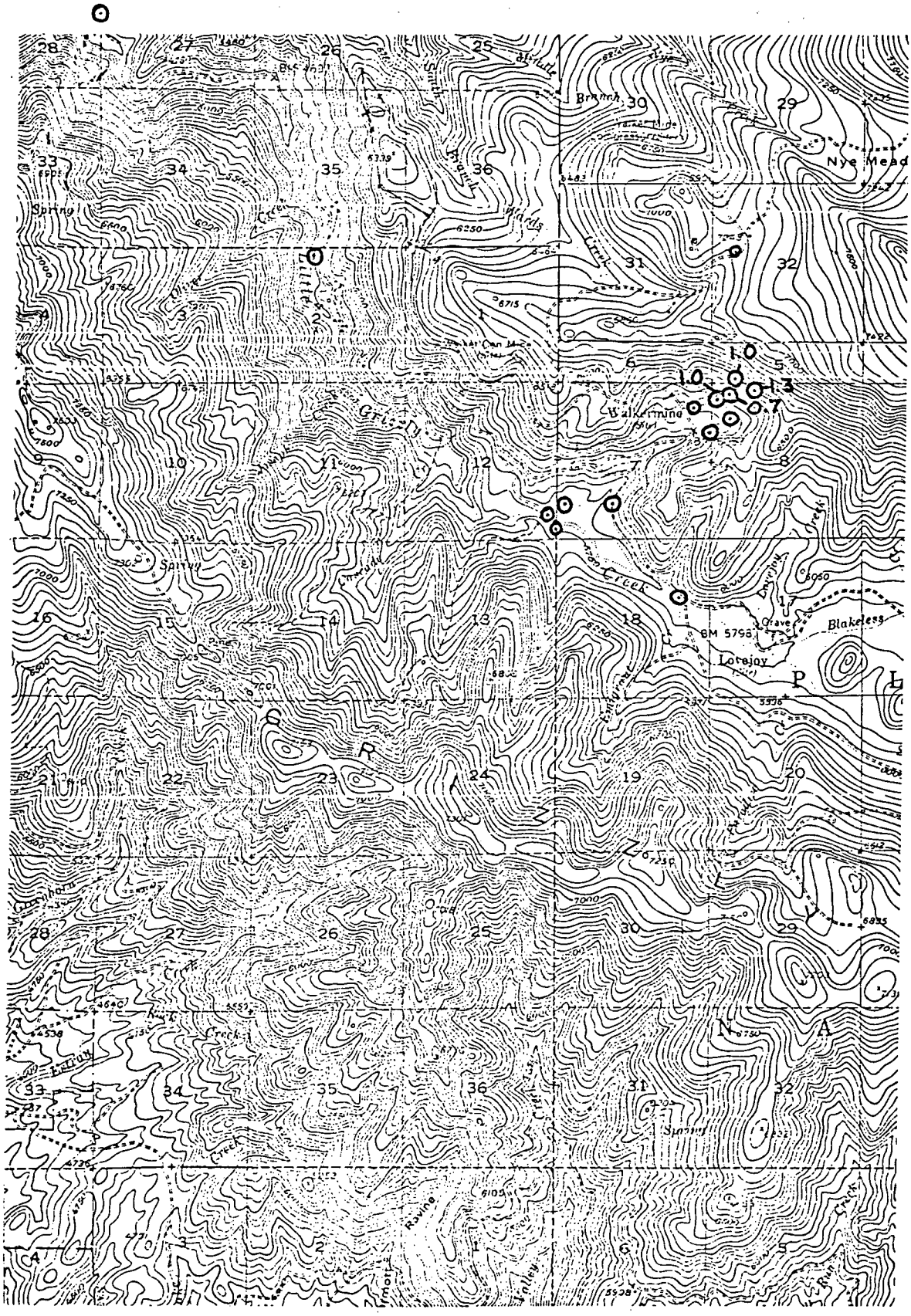
September 22, 1971



LEAD, ppb

concentrations in water

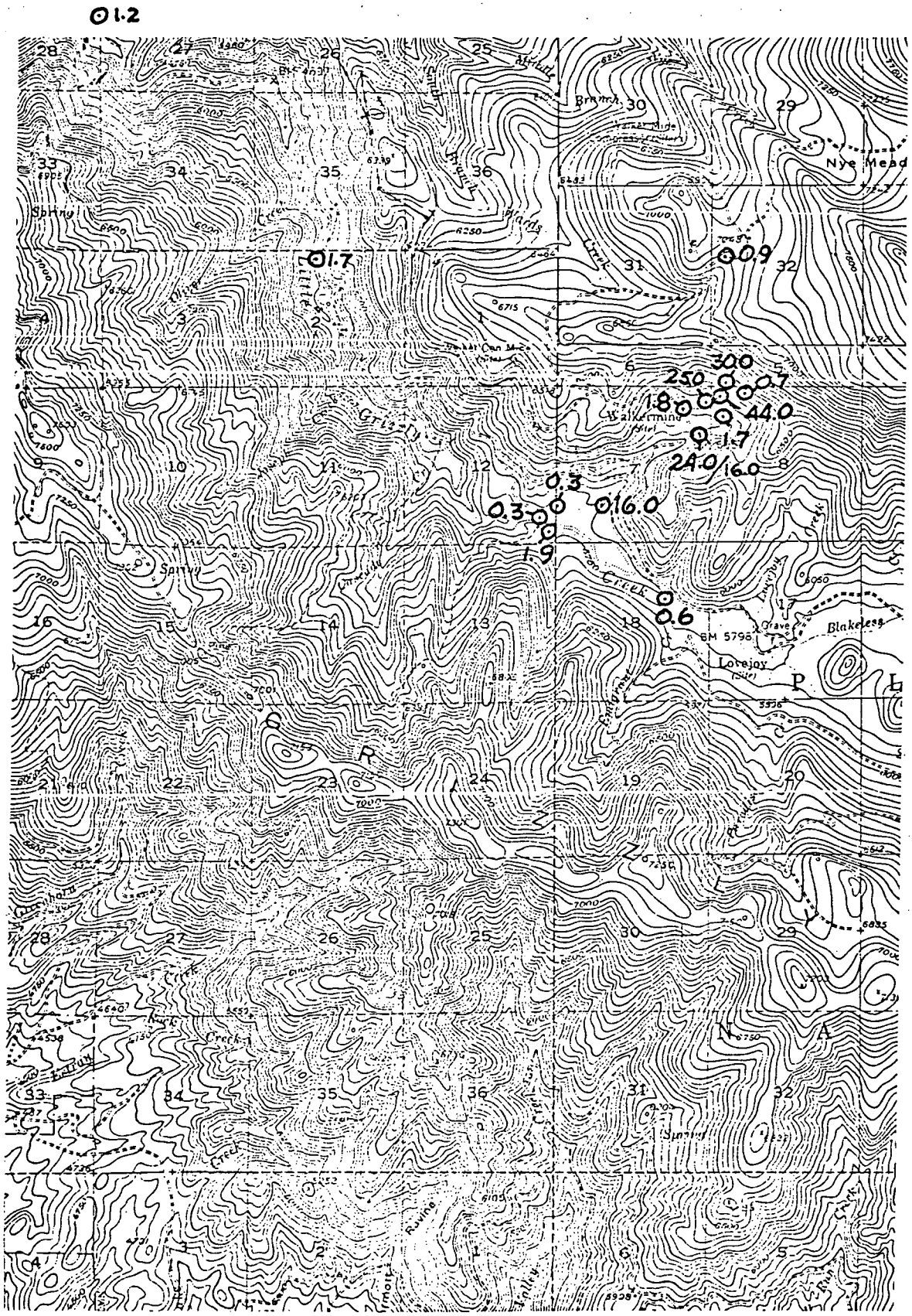
September 22, 1971



ZINC, ppb

concentrations in water

September 22, 1971



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74850

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

CARD - 3

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Board 5

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

LAB. 3

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

DATE TO LAB _____

DATE STARTED 7/3/72

DATE COMPLETED 7/5/72

CHEMIST SS

CHECKED L

W.O. 1080-6050

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #2 Little Grizzly Ck at Browns Cabin

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(som.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(som.)	ml A C Factor A(som.)	ml A C Factor A(som.)	ml	ml A C Factor A(som.)
as (P) mg/L	as (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
as ABS mg/L	O. & G. mg/L	Thio. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER Bk 0	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	X1 ml A 730 .5086 C 10.0 Factor 17.54 A(sam.) 224 .1101	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L 1.9	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC Bk 0
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	X1 ml A 276 .1397 C 0.5 Factor 3.579 A(sam.) .0257
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .09

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

D | T | LAB. NO. 74852

WATER ANALYSIS

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

CARD - 3

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Som) _____
Micromhos/cm

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP
SOURCE _____
LOCATION _____
POINT OF COLLECTION _____ PUMP TIME _____
SAMPLER _____ AGENCY Board 5

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

LAB. | 3

COLOR _____ ODOR _____ FOAM _____
Cl RESID. _____ TURB. _____ SECCHI _____ M

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST SS
CHECKED [illegible]
W.O. 1080-6050

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #4 Little Grizzly Ck. below Tailings & above Dollie Ck.

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml.	ml	ml	ml
	A C			
	Factor			
	A(sam.)			
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml	ml	ml	ml	ml
A C	A C	A C		A C
Factor	Factor	Factor		Factor
A(sam.)	A(sam.)	A(sam.)		A(sam.)
			S.S. mg/L	
as (P) mg/L	as (P) mg/L	as (P) mg/L	V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml	ml	Dil.
A C		Bot. No.
Factor		Orig.
A(sam.)		Orig. (c)
		Bot. No.
as ABS mg/L	O. & G. mg/L	Final
		Final (c)
		Diff.
		Seed
		Corr.
		mg/L
		% Dep.
		Thio. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON
ml	ml	ml	ml	ml
A C	A C	A C	A C 0.05	A C
Factor	Factor	Factor	Factor .3726	Factor
A(sam.)	A(sam.)	A(sam.)	A(sam.) .0054 − .0023 = .0031	A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L .00	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC
ml	ml	ml	ml
A C	A C	A C	A C 0.05
Factor	Factor	Factor	Factor
A(sam.)	A(sam.)	A(sam.)	A(sam.) .0077 − .0391 = .0314
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .00

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74,851

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16,25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$

CALCIUM _____ ml
1 ml = _____ mg Ca

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____

SODIUM _____ dil.
% T _____
Curve _____

POTASSIUM _____ dil.
% T _____

T.H. mg/L | Ca mg/L | Mg mg/L | Na mg/L | K mg/L

CARD - 2

ALKALINITY _____ ml
1 ml = _____ mg HCO_3

SULFATE _____ ml

CHLORIDE _____ ml
1 ml = _____ mg Cl

NITRATE _____ ml

HCO_3 mg/L | CO_3 mg/L | pH | SO_4 mg/L | Cl mg/L | NO_3 mg/L | 2

FLUORIDE _____ ml

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____

TURBIDITY

DIS. SOLIDS, 180 C

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____

F mg/L | B mg/L | Turb. | U | R | T.D.S. mg/L | T | Micromhos/cm

CARD - 3

SILICA _____ ml

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Board 5

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

SiO_2 mg/L

LAB. 3

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #3 Little Grizzly Ck. above mine at bridge to Grizzly Ridge

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST [illegible]
CHECKED _____
W.O. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
____ ml	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	____ ml	____ ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	____ ml A ____ C ____ Factor ____ A(sam.) ____
as (P) mg/L	as (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	Dil. ____ Bot. No. ____ Orig. ____ Orig. (c) ____ Bot. No. ____ Final ____ Final (c) ____ Diff. ____ Seed ____ Corr. ____ mg/L ____ % Dep. ____
as ABS mg/L	O. & G. mg/L	Thio. factor (0) ____ (F) ____ 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
____ ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	BK 2/5 .0022 x1 ____ ml A 20/21 .1364 C 0.05 Factor .2726 A(sam.) 20/21 .0090 − .0022 = .0068	.05/.1342 = .3726 ____ ml A ____ C ____ Factor ____ A(sam.) ____
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L .00	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC	
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	BK 66/68 .0304 x1 ____ ml A 790/786 .6716 C 0.05 Factor .0794 A(sam.) 107/108 .0471 − .0301 = .0170	.6716 − .0301 = .6415 .05/.6415 = .0794
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .00	

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

D | T | LAB. NO. 74863

WATER ANALYSIS

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER | 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$

CALCIUM _____ ml
1 ml = _____ mg Ca

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____

SODIUM _____ dil.
% T _____
Curve _____

POTASSIUM _____ dil.
% T _____

T.H. mg/L | Ca mg/L | Mg mg/L | Na mg/L | K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3

SULFATE _____ ml

CHLORIDE _____ ml
1 ml = _____ mg Cl

NITRATE _____ ml

HCO_3 mg/L | CO_3 mg/L | pH | SO_4 mg/L | Cl mg/L | NO_3 mg/L | 2

FLUORIDE _____ ml

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____

TURBIDITY

DIS. SOLIDS, 180 C

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____

F mg/L | B mg/L | Turb. | U | R | T.D.S. mg/L | T | Micromhos/cm

CARD - 3

SILICA _____ ml

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Board 5

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

SiO_2 mg/L

LAB. | 3

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #9 Dollie Ck below tailings pond

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST SS
CHECKED K
W.D. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
____ ml	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	____ ml	____ ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	____ ml A ____ C ____ Factor ____ A(sam.) ____
as (P) mg/L	as (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml	Dil. ____ Bot. No. ____ Orig. ____ Orig. (c) ____ Bot. No. ____ Final ____ Final (c) ____ Diff. ____ Seed ____ Corr. ____ mg/L ____ % Dep. ____
as ABS mg/L	O. & G. mg/L	Thio. factor (0) ____ (F) ____ 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
____ ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER BK O	IRON
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	x1 ____ ml A 730/730 .5686 C 10.0 Factor 17.59 A(sam.) 487/487 .2716	____ ml A ____ C ____ Factor ____ A(sam.) ____
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L 5.1	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC BK O
____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	____ ml A ____ C ____ Factor ____ A(sam.) ____	x1 ____ ml A 227/226 .1327 C 0.5 Factor 3.519 A(sam.) 136/136 .0635
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .23

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74862

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

CARD - 3

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

SILICA _____ ml
SiO_2 mg/L

LAB. | 3

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Board 5

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #8 Dollie Ck at lower bridge

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST SS.
CHECKED L
W.O. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(sam.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml	ml A C Factor A(sam.)
os (P) mg/L	as (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
os ABS mg/L	O. & G. mg/L	Thio. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER Bk 0	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	x1 ml A 770 .1666 C 10.0 Factor 17.57 A(sam.) 5/2 .3286	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L 6.0	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC Bk 0	
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	x1 ml A 279 .1397 C 0.5 Factor 3.577 A(sam.) 135 .0650	
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .23	

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

D | T | LAB. NO. 74,853

WATER ANALYSIS

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER | 1

TYPE OF ANALYSIS: 16,25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

CARD - 3

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP
SOURCE _____
LOCATION _____
POINT OF COLLECTION _____ PUMP TIME _____
SAMPLER _____ AGENCY Board 5

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

LAB. | 3

COLOR _____ ODOR _____ FOAM _____
Cl RESID. _____ TURB. _____ SECCHI _____ M

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST SB.
CHECKED
W.O. 1080-6050

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #5 Total flow below mine
50 gpm

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(sam.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml S.S. mg/L V.S.S. mg/L	ml A C Factor A(sam.)
as (P) mg/L	as (P) mg/L	as (P) mg/L		as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
as ABS mg/L	O. & G. mg/L	Thia. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER BK 0	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	x1 (1/5 dil) ml A .5686 C 10.0 Factor 17.59 A(sam.) .1765 3.10 x 5 = 15.5	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L 16.	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC BK 0
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	x1 ml A .1397 C 6.5 Factor 3.579 A(sam.) .1397
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .59

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74849

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

CARD - 3

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE
25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP
SOURCE _____
LOCATION _____
POINT OF COLLECTION _____ PUMP TIME _____
SAMPLER _____ AGENCY Board 5

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

LAB. | 3

COLOR _____ ODOR _____ FOAM _____
Cl RESID. _____ TURB. _____ SECCHI _____ M
ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #1 Adit
30 gpm

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST [illegible]
CHECKED [illegible]
W.O. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(sam.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml S.S. mg/L V.S.S. mg/L	ml A C Factor A(sam.)
as (P) mg/L	as (P) mg/L	as (P) mg/L		as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
as ABS mg/L	O. & G. mg/L	
CHEMICAL OXYGEN DEMAND ml		Thio. factor (0) (F) 5 day B.O.D. mg/L
C.O.D. mg/L		

ARSENIC	CADMIUM	CHROMIUM	COPPER Bk 0	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	X1 (1/5 dil) ml A 730/730 .5686 C 10.0 Factor 17.59 A(sam.) 300/300 .1271 5 X 3.29 = 16	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L 16.	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC Bk 0
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	X1 ml A 324/324 .1397 C Factor 3.579 A(sam.) 324/324 .1688
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .60

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74861

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER | 1

TYPE OF ANALYSIS: 16,25

W.A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L | 2

CARD - 3

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Boards

TH	CO_3
Ca	HCO_3
Mg	SO_4
Na	Cl
K	NO_3
meq/L sum	meq/L sum

LAB. | 3

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #7 Spring at spring house - (~~Ar Rise~~?)
15 gpm

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST GB
CHECKED K
W.O. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(sam.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml	ml A C Factor A(sam.)
as (P) mg/L	as (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
as ABS mg/L	O. & G. mg/L	Thio. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	3K 3/8 .0022 X1 ml A 3K/8 .1364 C 0.05 Factor .3926 A(sam.) 3/8 .0836-.0022 = .0012	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L .00	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	1K 66/69 .0201 X1 ml A 7/10 .6716 C 0.05 Factor .07791 A(sam.) 26/26 .0393-.0201 = .0092
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .00

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER ANALYSIS

D | T | LAB. NO. 74860

CARD - 1

BASIN | STATION NUMBER | T | YR 72 | MO 6 | DY 29 | TIME PST | CO | TEMP | U

FIELD EC | FIELD PH | DO | DISCHARGE (CFS) | GH (FT) | DEPTH (M) | SAMPLER 1

TYPE OF ANALYSIS: 16, 25

W. A. # 1080-6050

CARD - 2

HARDNESS _____ ml
1 ml = _____ mg $CaCO_3$
T.H. mg/L

CALCIUM _____ ml
1 ml = _____ mg Ca
Ca mg/L

MAGNESIUM
meq/L T.H. _____
meq/L Ca _____
meq/L Mg _____
Mg mg/L

SODIUM _____ dil.
% T _____
Curve _____
Na mg/L

POTASSIUM _____ dil.
% T _____
K mg/L

ALKALINITY _____ ml
1 ml = _____ mg HCO_3
HCO_3 mg/L | CO_3 mg/L | pH

SULFATE _____ ml
SO_4 mg/L

CHLORIDE _____ ml
1 ml = _____ mg Cl
Cl mg/L

NITRATE _____ ml
NO_3 mg/L 2

FLUORIDE _____ ml
F mg/L

BORON _____ ml
A _____ C _____
Factor _____
A (sam) _____
B mg/L

TURBIDITY
Turb. | U | R

DIS. SOLIDS, 180 C
T.D.S. mg/L | T

SPECIFIC CONDUCTANCE 25 C
R (Std) _____
R (Sam) _____
Micromhos/cm

CARD - 3

SILICA _____ ml
SiO_2 mg/L

WELL OWNER _____
NAME | ADDRESS | SEND ANAL.
CITY | ZIP

SOURCE _____

LOCATION _____

POINT OF COLLECTION _____ PUMP TIME _____

SAMPLER _____ AGENCY Board 5

_____ TH	_____ CO_3
_____ Ca	_____ HCO_3
_____ Mg	_____ SO_4
_____ Na	_____ Cl
_____ K	_____ NO_3
_____ meq/L sum	_____ meq/L sum

LAB. 3

COLOR _____ ODOR _____ FOAM _____

Cl RESID. _____ TURB. _____ SECCHI _____ M

ALGAE _____ WIND _____ COVER % OF _____ CLOUDS

REMARKS #6 Dollie CK above mine
5-7 gpm

DATE TO LAB _____
DATE STARTED 7/3/72
DATE COMPLETED 7/5/72
CHEMIST [illegible]
CHECKED [illegible]
W.O. 1080-6050

NITRATE	NITRITE	AMMONIA	ORGANIC NITROGEN	AMMONIA AND ORGANIC NITROGEN
ml	ml A C Factor A(sam.)	ml	ml	ml
as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L	as (N) mg/L

FILTERABLE ORTHOPHOSPHATE	FILTERABLE ACID HYDROLYZABLE PHOSPHATE	TOTAL PHOSPHORUS	SUSPENDED SOLIDS	PHENOLS
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml	ml A C Factor A(sam.)
os (P) mg/L	os (P) mg/L	as (P) mg/L	S.S. mg/L V.S.S. mg/L	as Phenol mg/L

METHYLENE BLUE ACTIVE SUBSTANCES	OIL AND GREASE	BIOCHEMICAL OXYGEN DEMAND
ml A C Factor A(sam.)	ml	Dil. Bot. No. Orig. Orig. (c) Bot. No. Final Final (c) Diff. Seed Corr. mg/L % Dep.
as ABS mg/L	O. & G. mg/L	Thio. factor (0) (F) 5 day B.O.D. mg/L

CHEMICAL OXYGEN DEMAND
ml
C.O.D. mg/L

ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	TK 3/5 .0022 x 1 ml A 291 .1364 C 0.05 Factor .37262 A(sam.) 10 .00762 = .0022 = .0024	ml A C Factor A(sam.)
As mg/L	Cd mg/L	Cr mg/L	Cu mg/L .00	Fe mg/L

LEAD	MANGANESE	SELENIUM	ZINC
ml A C Factor A(sam.)	ml A C Factor A(sam.)	ml A C Factor A(sam.)	TK 66/68 .0301 x 1 ml A 786 .6716 C 0.05 Factor .07791 A(sam.) 786 .6716 = .0301 = .1469
Pb mg/L	Mn mg/L	Se mg/L	Zn mg/L .01

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

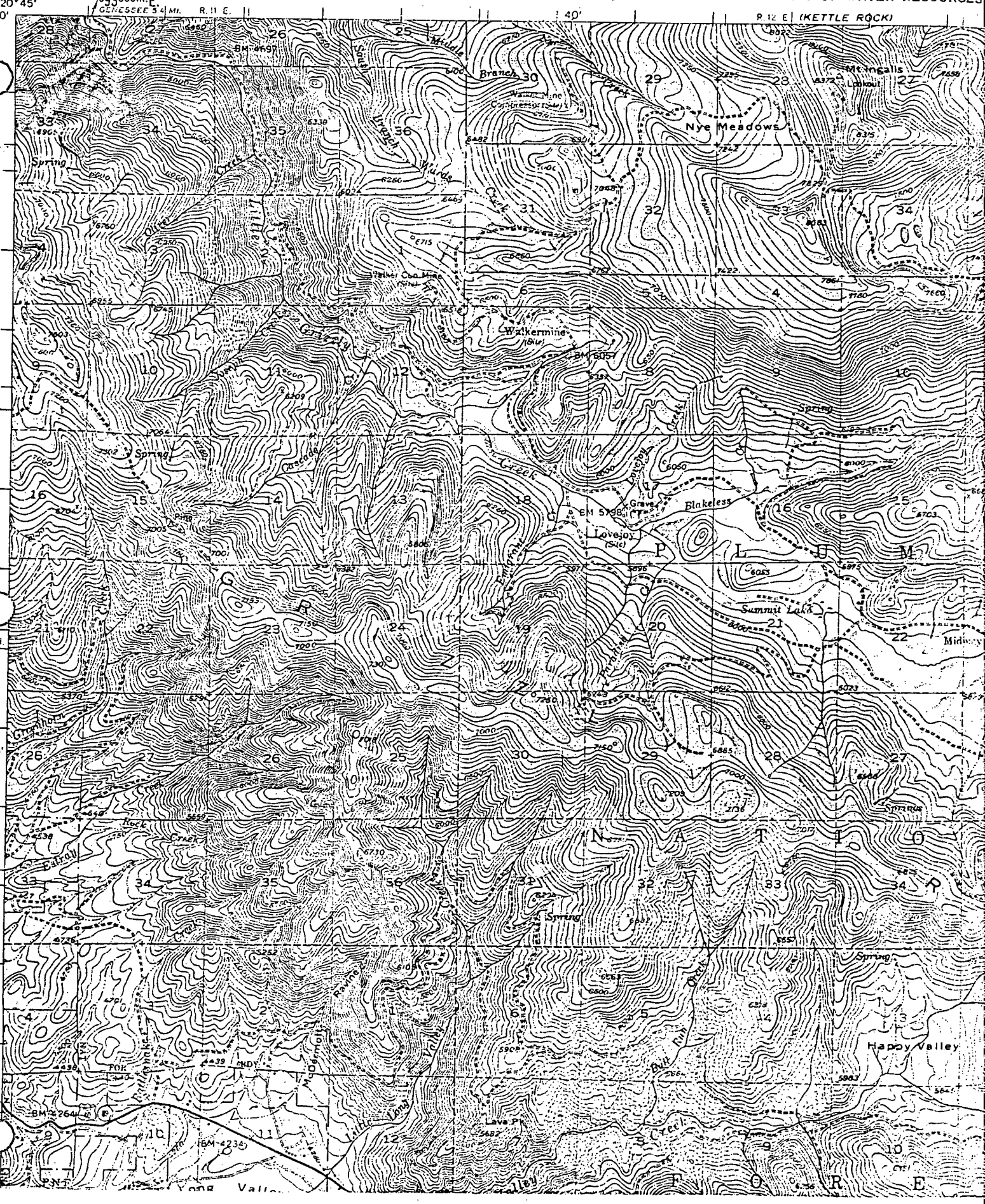


TABLE OF INVESTIGATIVE TASKS

	Contract Item Number	Task Priority Number	Block Number	Task	Explanation Appendix III, Page	Cost, Minimum $1,000.'s (estimated)	Manpower Man-Months (estimated)	Test Duration Months	Specialized Personnel*
Geology and Hydrology	1	14	II	Geologic Map, Surface	3	13	6	6	G
	1	17	III	Dewater Mine	7	50**	52**	12**	ME,H;M
	1	18	III	Open Mine Passageways	7	50**	52**	12**	ME;M
	1	19	III	Engineering Survey Mine Workings	7	13	6	3	ME;A
	1	20	III	Geology of Mine	11	25	10	5	G,A
	1	15	II	Regional Hydrologic Study	13	3	6	6	H
	1	16	II	Spring Gauges & Records (10)	13	15	8.5	6	H;A
Mine Water	2	6	I	Local Hydrologic Survey	18	9	6	3**	H
	2	22	III	Drill Hole Data, Core Logging	18	40	12	24	G
	2	21	III	Monitor Well Construction (100)	18	700	240	24	H;D
Sampling Program	3	7	I	Stream Gauges & Records (13)	25	20**	8.5**	12**	H;A
	3	4	I	Qualitative Tests (@$20. each)	25	10**	6**	12**	C;A
	3	5	I	Quantitative Tests (Cu,Zn;pH)	28	24.5	3	12	C,A;S
	3	11	II	Dump Samples	31	2	0.15	0.15	A
	3	12	II	Tailings Samples (10 sta.)	31	10	1	1	A
	3	8	I	Streambed Samples (15 sta.)	31	3	0.25	0.25	A
Toxicity Testing	4	1	I	Literature Search	34	2	3	2	FB
	4	2	I	Stream Habitat Survey	34	2	0.75	0.75	FB
	4	3	I	Dilution Tests ***(4)	35	8	6	3	FB
	4	9	I	Trout Toxicity Tests ***(6)	36	12	6	3	FB
	4	10	I	Insect Toxicity Tests ***(6)	37	12	6	3	FB
	4	24	III	Toxicity Control Methods Tests ***(6)	37	12	6	3	FB
	4	23	III	Soil Survey & Tests	39	6	6	6	SS
Land Ownership	5	25	III	Land Title Search, History	41	0.2	0.05		L
Toxicity Control Methods	6	13	II	Technical Awareness, Maintenance	51	20**	12**		WQT

*Specialized Personnel: A: Aid, field, geologic, etc; C: Chemist, Water; CE: Chemical Engineer; D: Driller; FB: Fisheries Biologist; G: Geologist; H: Hydrologist; L: Lawyer; M: Miner; ME: Mining Engineer; S: Statistician; SS: Soil Scientist; WQT: Water Quality Tech

**Preliminary or exploratory estimates only; subject to change. Tasks will require continued monitoring and maintenance until problem is solved

***Continuous flow bioassay @$2,000 each.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. 73-1

VIOLATION OF ABATEMENT ORDER

DISCHARGE OF TOXIC WASTES FROM THE WALKER MINE
TO DOLLIE CREEK AND LITTLE GRIZZLY CREEK, PLUMAS COUNTY
BY CALICOPIA CORPORATION AND ITS PRESIDENT, ROBERT R. BARRY

WHEREAS, the California Regional Water Quality Control Board, Central Valley Region finds:

1. The Executive Officer issued an order on 8 September 1971 directing Calicopia Corporation and its President Robert R. Barry to abate forthwith the pollution of Dollie and Little Grizzly Creeks, Plumas County.

2. Calicopia Corporation President Robert R. Barry responded to the order by letter dated 27 September 1971.

3. An inspection on 29 June 1972 by an engineer of the Board's staff found that the discharge of toxic mine wastes continues to pollute the waters of Dollie and Little Grizzly Creek and to cause a nuisance.

4. The California Department of Fish and Game reports that the waste discharge prevents the development of a fishery in Dollie Creek and in a significant reach of Little Gizzly Creek.

5. Calicopia Corporation and Robert R. Barry are intentionally or negligently discharging waste to Dollie Creek and Little Grizzly Creek in violation of the abatement order issued on 8 September 1971.

NOW, THEREFORE BE IT RESOLVED, that this Regional Board, in accordance with Section 13304 of the California Water Code, does hereby request the Attorney General for the State of California to take appropriate action under Section 13304 of the California Water Code, and

BE IT FURTHER RESOLVED, that the Executive Officer is authorized, and he is hereby directed to certify and submit copies of this Resolution to the Attorney General and such others as may have need therefore or as may request same.

I, JAMES A. ROBERTSON, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 28 July 1972.

Original signed by
[illegible]

Executive Officer

7/28/72 wbb/jw

R. W. Lassen, Regional Manager
Department of Fish & Game, Region II
1001 Jedsmith Drive
Sacramento, CA 95819

30 August 1974

Status Report - Walker Mine, Plumas County

As you know, we are currently in litigation with the Calicopia Corporation and its president, Robert R. Barry, regarding pollution from the Walker Mine. Following is a brief summary of events that have occurred during the past few months:

On 28 December 1973, Adolph Moskovitz, attorney for Calicopia Corporation, indicated to John Morris, Deputy Attorney General, that the Corporation would like to explore the possibility of reaching agreement on a stipulation for an injunction. Numerous meetings have occurred since then in an attempt to reach such an agreement.

Calicopia hired C. William McClung, mining consultant, to prepare a report regarding alternatives for solving the pollution problem. A copy of McClung's 10 July 1974 report is enclosed.

In order to review the proposals contained in Mr. McClung's report, Raymond Williamson, Deputy Attorney General, currently assigned to this case, contracted with Dr. Edward Schroeder, University of California at Davis. Dr. Schroeder visited the mine on 24 July 1974 with staff of the Regional Board and State Water Resources Control Board. A memorandum regarding this visit and the results of sampling is enclosed.

Dr. Schroeder's 16 August 1974 review of Mr. McClung's proposals is also enclosed.

As a result of Dr. Schroeder's review and meetings with Calicopia representatives, it was agreed that a system of dikes and ditches would be constructed around the glory holes and the Piute Shaft. This work will begin on or about 1 September 1974 and be completed on or before 15 October 1974 (see 27 August 1974 letter from Mr. Williamson to Mr. Moskovitz).

We are concerned that the Corporation has a need to open the mine shaft in order to allow inspection by persons interested in purchasing the mine. You

will note in Mr. Williamson's 27 August 1974 letter that we have indicated we would tolerate no further release of water from the shaft over that which is naturally flowing. Although we intend to devote as much staff as we possibly can to watch the progress of this construction, we would hope that your Warden could also keep an eye on the operation.

While we are making slow progress on this problem, we nevertheless are concerned that the solution may be too costly for the Corporation and we may yet end up in court. Mr. Williamson is concerned that we have no recent toxicity data and we have no data on the value of the fishery which has been adversely affected. Mr. Barry mentioned that he had a report prepared by Charles Hazel of Jones and Stokes regarding the value of the fishery. We have not seen this report.

We would greatly appreciate your help in obtaining the data Mr. Williamson needs. There is much data available on copper and zinc content of the discharge, Dollie Creek and Little Grizzly Creek down to Browns Cabin. There is little data below that point. We will be glad to make arrangements for any additional chemical analysis you feel is necessary and are willing to reimburse the Department for bioassay tests. The report on the value of the fishery that is being adversely affected is most important. Your very excellent report on the damage to the fishery by the City of Sacramento was the single most damaging piece of evidence we had.

Mr. Williamson feels that this work should be accomplished as soon as possible. May I please hear from you on this matter?

JAMES A. ROBERTSON
Executive Officer

WHC:ics

Enclosures

cc: Ray Williamson, Deputy Attorney General
Nancy Lea, Attorney, SWRCB

MEMORANDUM

TO: J. Lawrence Pearson
FROM: Larry F. Nash
SUBJECT: Walker Mine - Plumas County
WDR Order No. 75-119, NPDES No. CA0080110

On 17 October 1978, I inspected the subject non-operating copper mine to ascertain compliance with discharge requirements and to assess the current conditions at the mine site. At the time, I met Tex Tate and Jan Donato and three mine workers who are employed by the Continental Oil Company. Mr. Tate advised me that they were re-opening the tunnel in order to be able to better control the drainage from the mine and to evaluate possibilities of resuming mining activities. Cave-ins have blocked portions of the tunnel causing drainage water to back up until the water pressure eventually blows out the blockage. A major blowout this spring destroyed the pipes which had previously conveyed drainage to the tin tanks and eroded a large portion of the tailings below the adit. Mr. Tate believes that by eliminating the blockages and generally confining the drainage to the hard rock tunnel floors they will reduce the amount of water in contact with the ore body and improve the quality of the drainage water. Mr. Donato is operating a bulldozer in the flat area between the mine adit and Dollie Creek. He advised me that he is constructing a pond to provide containment and settling of the mine drainage. He said a one-acre pond should contain all the drainage during the summer and fall months and would provide sufficient removal of clay and silt during high flow periods to enable more effective treatment of overflow in a copper cementation tank system.

Drainage is currently discharged from the tunnel to the top of the tailings pile below the adit. The water quickly percolates into the rocks and resurfaces at the base of the tailings in the flat area. The drainage flows across the flat area in a deep trench before entering Dollie Creek. Dollie Creek supported abundant riparian vegetation and numerous beaver ponds immediately above the confluence with the Walker Mine drainage and was devoid of indications of plant and animal life downstream. I sampled the drainage above and below the tailings. Results of copper, Zinc, Cadmium, and pH analysis will be incorporated in the files when they are received from DWR Bryte Lab.

My inspection reveals that the mine remains "non-operating" although there is significant activity to re-open the mine tunnel and construct drainage control facilities. The involvement of the Continental Oil Company suggests that there is serious consideration of resuming mining activities at this site. Sufficient sampling was not conducted to determine compliance with all effluent and receiving water limitations contained in Order No. 75-119, however, previous inspection results, the lack of any treatment facilities, and the observed condition of Dollie Creek indicate that the discharge remains in violation of requirements. The discharge has also failed to comply with the monitoring and reporting required by Order No. 75-119.

LFN/sb 10/30/78

LARRY GARSIDE
NEVADA BUREAU OF MINES AND GEOLOGY
UNIVERSITY OF NEVADA
RENO, NEVADA 89557-0088

1978 PROGRESS REPORT ON THE WALKER MINE PROJECT

Steve Kilbreath
and
Art Leger

1978 PROGRESS REPORT

on the

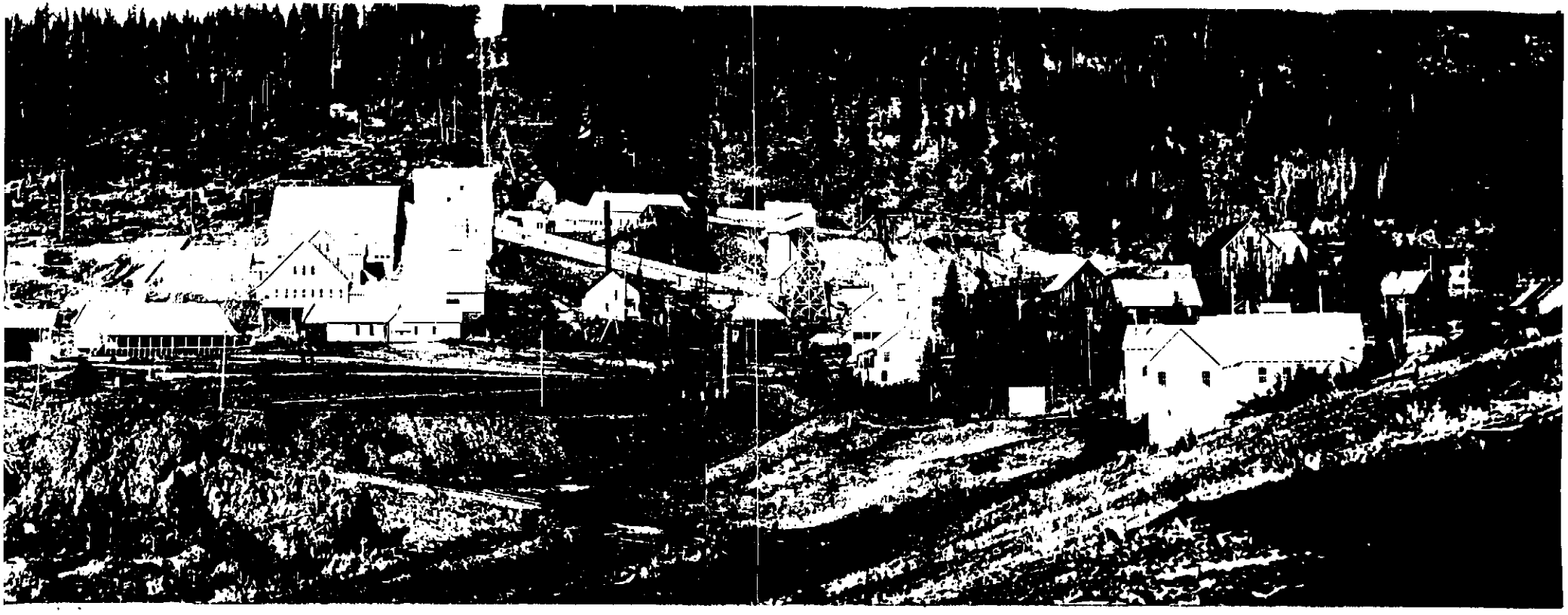
WALKER MINE PROJECT

by

Steve Kilbreath

and

Art Leger



Front piece - Walker Mine Town and Mill, Circa 1928

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1g	Cross Section along Line 12 South
1h	Cross Section along Line 16 South
1i	Cross Section along Line 20 South
1j	Cross Section along Line 26 South
1k	Cross Section along Line 28 South
1l	Cross Section along Line 40 South
1m	Cross Section along Line 48 South
1n	Cross Section along Line 56 South
2.	Alteration/Metamorphism Overlay to Accompany Geologic Map - Veining

PLATES (continued)

3. Alteration/Metamorphism Overlay to Accompany Geologic Map - Magnetite

4. Alteration/Metamorphism Overlay to Accompany Geologic Map - Biotite

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10. Alteration/Metamorphism Overlay to Accompany Geologic Map - Mafic:Felsic Ratio

11. Geochem Sample Location Map

12. Zinc Geochem Overlay to Accompany Geologic Map

13. Copper Geochem Overlay to Accompany Geologic Map

14. Thin Section Location Map - to overlay Plate 1

SUMMARY

The Walker Mine property in Plumas County, northeastern California, is a steeply dipping, tabular copper-silver-gold deposit localized within an exhalite unit and associated with a sequence of submarine felsic to intermediate pyroclastic rocks. The Walker Mine occupies the southern end of a N-NW striking zone of copper-gold-silver mineralization called the Plumas County Copper Belt.

The Walker Mine was the largest copper producer in Plumas County, yielding about 163 million pounds of copper from approximately five million tons of ore between 1916 and 1941. The Walker Mine ore zone consists of six orebodies aligned along 8000 feet of strike length and separated from each other by 100 to 1000 feet of apparently subeconomic mineralization. From south to north, the orebodies are South, Central, North, 712, Piute, and North Piute. About five million tons of potential mineralization remains in the Walker Mine between levels, in the partially mined North Piute orebody, and in the 712 Footwall orebody.

Norandex conducted exploration on the property from 1969 to 1971 and did extensive geochemical and geophysical surveys as well as drilling 11 diamond drill holes.

Amax acquired an option on the property in 1976. During the summers of 1976 and 1977, they conducted regional geologic reconnaissance, detailed mapping in the Walker-Lena-Con Gold areas, claim surveying, stream drainage and water quality sampling, whole rock geochemistry, and diamond drilling.

Conoco optioned the property by Letter Agreement from Amax on April 1, 1978, and at that time, option payments were re-negotiated with

the owner, Mr. Robert Barry. The Amax terms require Conoco to spend $170,000 by January 31, 1980 to acquire a 51% interest in the property. Conoco has exceeded the $170,000 earning requirement, however, Amax is not required to reimburse Conoco for Amax's share (49%) of the expenditures beyond the earning requirement until 1980.

Active field work done by Conoco in the summer of 1978 consisted of detailed mapping in the Walker Mine Area, a soil geochemical survey, claim surveying, and stream drainage and water quality sampling. In addition to the above work, all of the Amax and Noranda drill holes were re-logged and the assay data for these holes was obtained and evaluated.

The geologic mapping established a stratigraphic sequence of volcanic and chemical sedimentary or deposits as follows:

(1) Footwall-andesitic lithic tuff with minor included felsic pyroclastic zones, and dacitic porphyry dikes and sills.

(2) Exhalite (ore) zones - two major exhalite horizons consisting of chert, chert-magnetite breccia with barite and dispersed sulphides.

(3) Hangingwall - intermediate to felsic agglomerate containing sub-angular to subround fragments of felsic volcanic material and barite in a fine-to-medium grained siliceous matrix; andesite tuff similar to footwall rocks; felsic lithic tuff; and intrusive dacite porphyry.

The massive form of portions of the ore, the close association of the mineralization with the exhalite zones, and the proximity to felsic and intermediate volcanic rocks suggests a volcanogenic origin for the Walker Mine copper-silver-gold mineralization.

Geochemical surveys conducted by Conoco over the Walker Miner area included:

(1) water quality monitoring to assist in evaluating potential environmental problems attributable to toxic acid mine discharge and

(2) a soil survey on a 200 foot x 200 foot grid, the results of which indicated two prominent copper anomalies coinciding with the two mapped exhalite zones.

Surveying of claims was done in the summer of 1978 to re-establish corners as required by California law.

RECOMMENDATIONS FOR 1979

In the Walker Mine area, the chances of discovering viable copper-silver-gold ± lead-zinc mineralization appears excellent in the following areas:

(1) along a northern extension of the Walker Mine horizon beneath post mineral volcanic cover;

(2) along the recently mapped footwall exhalative zones;

(3) downdip extensions from known orebodies;

(4) in the Northern Walker Area, two miles north of the Piute decline.

It is recommended that ground magnetics and induced polarization be run over the Northern Walker Area to trace the exhalative horizon. Induced polarization should be run over the footwall exhalative horizon by the 712 and Piute Orebodies to test for sulphide content and continuity. A mise-a-la-masse survey should be run over the North Piute area to test for continuity of the exhalative in this area.

The soil samples collected in 1978 should be re-run for Au, Tl and a full emission spectrographic analysis conducted to see if there are any geochemical trends developing that might lead to ore under the young volcanic cover. In addition to the surface geochemistry, the underground workings should be mapped and samples collected to determine if metal zoning exists.

When targets are developed, core drilling of approximately 4000 feet is recommended. This drilling should be divided between three separate targets, the Northern Walker Area, the back exhalative horizon by the 712-Piute Orebodies, and the back exhalative horizon by the Central-North Orebodies. Two to three holes of 400 to 500 foot depth should be drilled in each target area.

INTRODUCTION

LOCATION

The Walker Mine property is approximately 80 miles by road northwest of Reno, Nevada, in east-central Plumas County, California (Figure 1). Access to the property is by a forest service road that leaves State Highway 70 at Portola and heads northwest towards recreation areas at Lake Davis, then onward to the mine and beyond. The 25-mile distance from Portola to the mine is about half paved. The other half, which is dirt and gravel, is impassable by wheeled vehicles during the winter months.

Elevations range from 5,500 to 7,200 feet above sea level. Topography is moderate. Mt. Ingalls, a prominent topographic feature, is two miles east of the Walker Mine.

PROPERTY STATUS

The Walker Mine property consists of 34 patented lode claims, 358 unpatented federal lode claims, several patented mill sites, and a townsite. Total acreage is approximately 7,966 acres. The property was optioned by Letter Agreement from Amax April 1, 1978, and at which time, option payments, etc., were re-negotiated with the owners, Calicopia Corporation and R. R. Barry (see land reports).

ENVIRONMENTAL STUDIES

The Walker Mine property and tailings deposit have an unfortunate history as a significant contributor of pollution to Grizzly Creek. Toxic waters from the mine and tailings are documented by state and federal agencies as being a serious environmental problem.

In May 1978, Dawn Kaback, an environmental geochemist from Conoco's

INDEX MAP - WALKER MINE

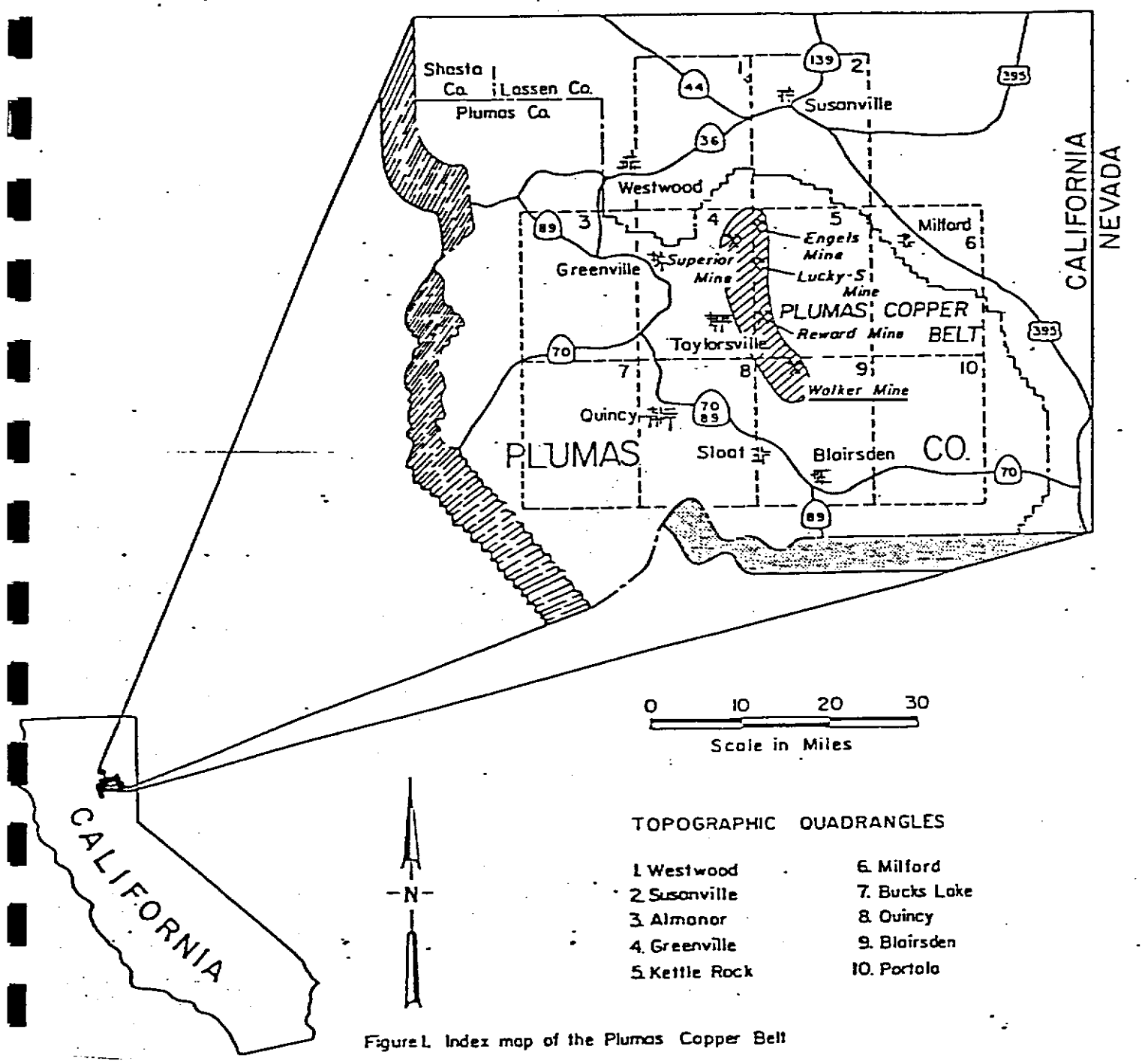


Figure 1. Index map of the Plumas Copper Belt

Ponca City office, visited the Walker Mine property to review and expand the water quality monitoring program. Her comments are recorded in a memo titled "Walker Mine Environmental Monitoring" dated June 7, 1978.

PRIOR WORK

The Walker Mine was one of the largest copper producers in Plumas County, yielding 163 million pounds of copper. The mine was operated almost continuously from 1916 to 1941 by the International Smelting Company, a subsidiary of the Anaconda Mining Company. During this time, the mine produced a total of 5,045,800 tons of ore averaging 1.55% Cu, 0.80 oz. Ag and 0.04 oz. Au (Reith, 1972).

Norandex conducted an exploration program on the property from 1969 to 1971 consisting of geologic mapping, geochemical and geophysical surveys as well as drilling 11 diamond drill holes.

Amax Exploration Inc. acquired the property in 1976 and conducted exploration activities during the summers of 1976 and 1977. Their work consisted of regional geologic reconnaissance, detailed geologic mapping, claim surveying, stream drainage and water quality sampling, whole rock geochemistry and diamond drilling (Hursh, 1977).

CONOCO EXPLORATION PROGRAM - 1978

INTRODUCTION

The Conoco exploration program at the Walker Mine started in late 1977 and continued to the present time. In December 1977, Ron Long and Ray Threlkeld visited the area and recommended acquiring the property.

Active field work began in June 1978 and consisted of re-establishing

Norandex's survey grid, surveying control lines between Norandex's lines, and soil sampling at 200 foot intervals along the grid lines (Figure 2). Approximately 900 soil samples were collected and analyzed for Cu, Pb, and Zn. Geologic mapping began in August and was concentrated on the Main Walker Area (Plate 1). The mapping was at a scale of 1" = 200' and consisted of detailed observations of the mineralized zone and surrounding area. In order to ascertain rock type, alteration, mineralization, and degree of metamorphism, 275 samples were collected for thin section examination. In addition, both Norandex and Amax drill holes were re-logged and samples taken for petrographic investigation. No regional mapping was completed during the 1978 program.

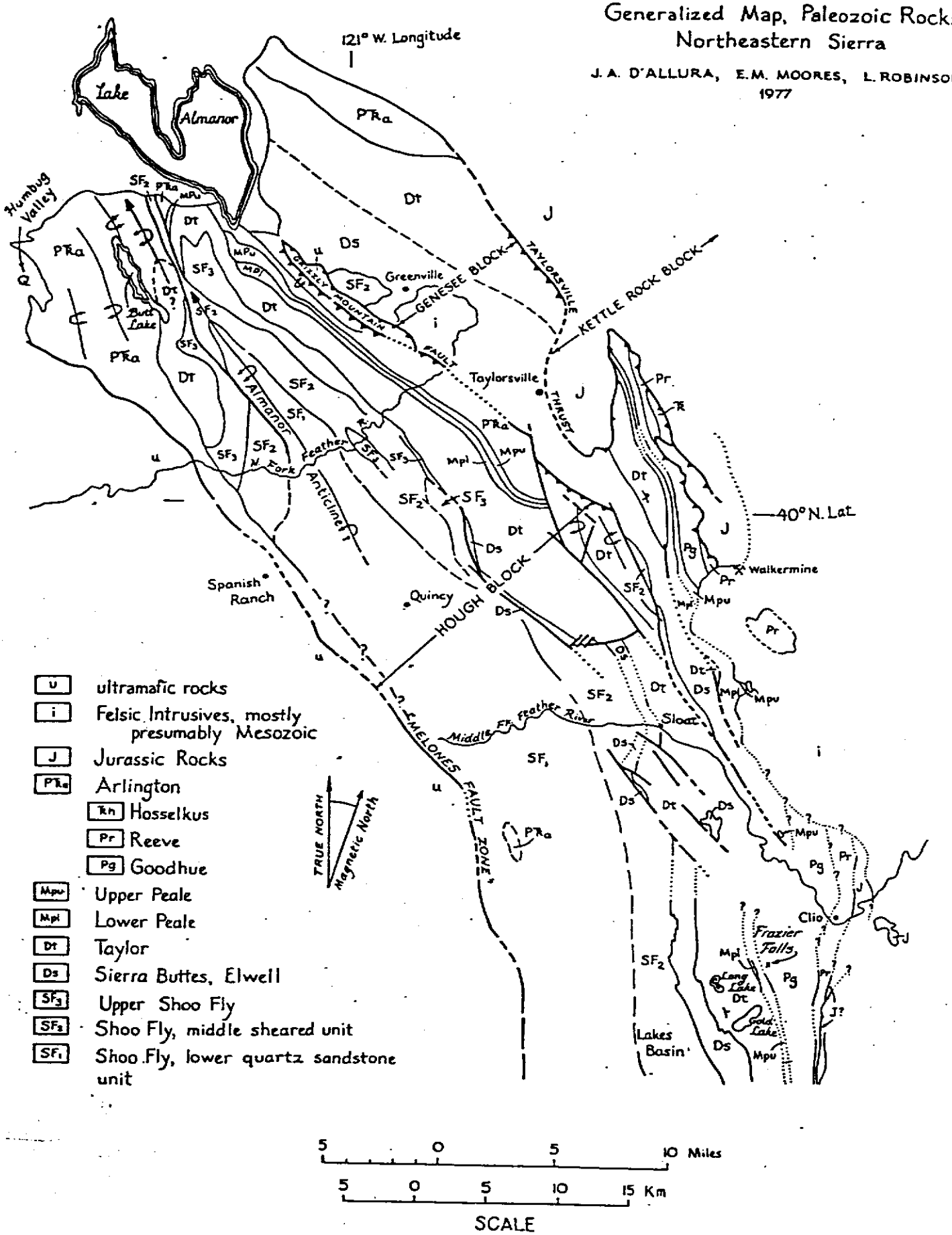
REGIONAL GEOLOGIC SETTING

The Walker Mine is located on the eastern margin of a complex series of northwest striking marine volcanic and sedimentary rocks that range from pre-late Devonian to Jurassic in age (Figure 2). Two Paleozoic and one Mesozoic volcanic assemblages are present in this sequence (D'Allura and others, 1977). The oldest of the volcanic assemblages is represented by the Upper Shoo Fly (SF), Sierra Buttes and Elwell (Ds), Taylor (Dt) and Lower Peale (Mpe) Formations (see Figure 2). This older volcanic assemblage was deposited on the Lower (SF) and Middle (SF 2) Shoo Fly basement rocks. Separating the old Paleozoic volcanic assemblage from the young Paleozoic assemblage is a period of volcanic quiescence represented by cherts and epiclastic sediments of the Upper Peale (Mpu) Formation. The young Paleozoic volcanic assemblage is represented by the Goodhue (Pg) and Reeve (Pr) Formations. Overlying these volcanic rocks are sediments and limestones of the Arlington Formation (Pra). The Arlington is overlain by a series of Jurassic

Figure 2

Generalized Map, Paleozoic Rocks
Northeastern Sierra

J. A. D'ALLURA, E.M. MOORES, L. ROBINSON
1977



volcanic and sedimentary rocks. The Jurassic rocks are represented by the submarine andesites of the Kettle Formation and the epiclastic sediments of the Trail Formation. It is believed that the Walker Mine is contained within the andesites of the Kettle Formation. This northwest striking band of Jurassic rocks is the host for the Plumas Copper Belt.

The Paleozoic-Mesozoic rocks of the northern Sierra Nevada can be divided into three distinct structural blocks (see Figure 2), the Hough Block, Genesee Block, and the Kettle Rock Block (McMath, 1966, D'Allura and others, 1977). All three of the structural blocks are bounded by northwest striking faults. The Hough Block is thrust over the Genesee Block on the Grizzly Mountain Fault and the Genesee Block is in turn thrust over the Kettle Rock Block on the Taylorsville Thrust. The Walker Mine is in the Jurassic rocks in the Kettle Rock Block which forms the lower plate of the Taylorsville Thrust.

PROJECT GEOLOGY

The Walker Mine is a volcanogenic sulphide system that occurs in a thick sequence of intermediate to felsic submarine volcanic rocks that are thought to be a part of the Jurassic Kettle Formation. The structural footwall of the ore zone is a thick accumulation of andesitic to dacitic crystal lithic tuffs. Scattered through these tuffs are irregular zones and lenses of coarse fragmental tuff of the same composition. Locally within these intermediate tuffs thin zones of more felsic tuff occurs. East of the above tuffs are two sub-parallel exhalative horizons that are separated by 100-300 feet of altered, intermediate pyroclastics. The exhalatives consist of 6 to 150 foot-thick zones of chert and chert magnetite breccia. The easternmost of these exhalatives is the main Walker Mine Ore Zone. Immediately

east of the exhalative is a zone of felsic breccia that is thought to be a vent breccia. East of the vent breccia is another zone of intermediate pyroclastics similar to those in the footwall. Within these rocks is a zone of felsic tuffs that are similar to those in the footwall. Intruding all of the above rocks is dacite porphyry which occurs as a large sill-like mass east of the above rocks and as small dikes and sills throughout both the hanging and footwall volcanic sequence. Intruding all of the Jurassic rocks described above is a large body of Sierran granodiorite. Unconformably overlying all of the rocks in the Walker Mine area are intercalated flows of laharic breccia and basalt to dacite flows.

Within the main Walker Mine area the only stratigraphic marker is the exhalite horizons. It is assumed that the rocks are right side up and the stratigraphic top of the section is to the east. In the following sections the rocks will be discussed from footwall to hanging wall, which should be from oldest to the youngest.

Footwall Sequence

The footwall sequence of rocks consists of three dominant types, intermediate pyroclastics, sericitic pyroclastics and dacite porphyry intrusive. The intermediate pyroclastic rocks are the most abundant rock type and contain scattered lenses of the sericitic pyroclastics in addition to dikes and sills of dacite porphyry.

The intermediate pyroclastics (ip, Platel) are a series of sub-aqueous lithic tuffs with scattered zones of tuff breccia all of which are andesitic to dacite in composition. These lithic tuffs are light gray to dark gray in color (weather reddish brown), contain a well developed foliation, and are moderately to strongly magnetic. Locally the abundance (up to 70%) and size

(up to 20 cm) of the fragments increase to the point where fragments are more abundant than matrix and the rock grades into tuff breccia. Close examination indicates the foliation consists of aligned elongate mafic clots set in a very fine grained matrix of quartz and sericite. Randomly scattered through the matrix are small (4 mm) grains of pink garnet and radiating clusters (1 - 2 mm) of andalusite.

In thin section, these rocks are seen to consist of aligned phenocrysts of plagioclase and hornblende that range from 0.5 to 5 mm in size. The phenocrysts range in shape from euhedral to angular broken portions of originally euhedral crystals. The total number of phenocrysts ranges from 5 to 60 percent of the rock with roughly equal proportions of plagioclase and hornblende, although locally one or the other may be dominant. These phenocrysts are no longer primary hornblende and plagioclase, they are the metamorphic equivalent of the alteration products of these minerals. The plagioclase is pseudomorphed by two assemblages, one consists entirely of sericite and the other is an equal mixture of sericite and quartz. The hornblende phenocrysts are pseudomorphed predominantly by a biotite + magnetite assemblage but assemblages of biotite, biotite + magnetite + cordierite, biotite + quartz, magnetite + quartz, magnetite + quartz + sericite, magnetite + sericite, garnet + magnetite + biotite, and garnet + sericite + magnetite + biotite exist. These various pseudomorphing assemblages are thought to represent variations in alteration prior to metamorphism but this is not very well understood at this time. The lithic fragments, when present, consist of an intergrown mass of biotite and magnetite with minor amounts of schorl. The schorl occurs in the fragments or in the matrix as a halo around the fragments. The matrix of the intermediate pyroclastics consists dominantly

of quartz, sericite and biotite with lesser amounts of magnetite, garnet, andalusite, schorl, cordierite and green spinel (gahnite/hercynite). The quartz grains intersect at triple points, this is indicative of thermal recrystallization. Sericite and biotite occur randomly through the matrix interstitial to the quartz and seem to show an antithetic relationship to each other. Small disseminated grains of magnetite are scattered throughout the rocks.

The sericitic pyroclastics (sp, Plate 1) occur as pods and lenses contained within the intermediate pyroclastics discussed above. There are two main areas where these rocks crop out, Transverse Ridge and West Ridge (see Plate 1). The sericitic pyroclastics are buff to light gray in color, (weather reddish brown) and are generally fine grained with abundant relict feldspar phenocrysts. Scattered through the rocks are a minor amount ($\pm$5%) of hornblende phenocrysts. In general these rocks are well foliated with all the phenocrysts aligned. In thin section sericite (60 - 70%) and quartz (20 - 30%) are dominant minerals with magnetite, biotite, chlorite, schorl, garnet and andalusite comprising the remainder of the rocks. About 30 - 40% of the rock is made up of broken to euhedral plagioclase crystals 1 - 3 mm in length that are pseudomorphed by massive sericite. About 1 - 5% of the rock is made up of hornblende crystals that are pseudomorphed by sericite and magnetite with minor biotite and chlorite. Occasionally a recrystallized quartz phenocryst may be present. The matrix is very fine grained (.03 - .1 mm) and consists predominantly of recrystallized quartz and sericite in equal proportions. Scattered through the matrix are grains of magnetite and schorl and porphyroblastic garnet and andalusite.

In general, the sericitic pyroclastics contain a better developed foliation

and are more sericitic than the intermediate pyroclastics. This is probably due to the fact that the sericitic pyroclastics are somewhat more felsic than the intermediate pyroclastics and are probably dacitic to rhyodacitic in composition.

Exhalative Horizons

Surface mapping indicates two exhalative zones west of the North and Central shafts and south of the Piute decline (Figure 1). Rocks in these zones are expressed by 10 to 200 foot wide zones of chert and chert magnetite breccia with barite and dispersed sulphides. The strike of the two units varies from N 20° - 30° W to N 20° E. The dip, as indicated from drill holes and surface exposures, is about 70° E in the south, flattening to 35° - 40° E in the north. The easternmost horizon is the main Walker Mine ore zone and indications from both drill and underground intersections are that it is continuous but pinches down in two dimensions to very narrow widths. The back interval, or footwall zone, just recognized, appears thin (10 - 30 feet) but is anomalous in copper and gold. The two exhalative horizons are separated by highly altered intermediate pyroclastic rocks that will be discussed in the alteration section of this report.

Within the main Walker Mine ore zone a crude zonation of the exhalative may be present, as seen in the Piute Orebody (the only Orebody examined underground to date). Along the footwall of the exhalative is a thin zone (2 - 15 feet) of chert-magnetite breccia. This zone is marked by angular fragments of chert that are cemented by magnetite and minor pyrite, pyrrhotite and chalcopyrite. Overlying the chert-magnetite breccia is a massive zone of chert that ranges in thickness from 10 to 200 feet. Interpersed through the chert are pods and bands of magnetite, barite, pyrite, pyrrhotite and chalcopyrite.

Locally the sulphide minerals may form thin (1 - 2 foot-thick) pods of massive sulphide ore in a banded chert-magnetite host. Occasionally the massive chert becomes fragmental with chert fragments cemented by barite. Within the exhalative, magnetite is the most abundant mineral (5 - 30%) present, and barite (5 - 10%) exceeds pyrite which exceeds pyrrhotite which exceeds chalcopyrite. Other sulphide minerals reported to be present are tetrahedrite and cubanite (Hursh, 1977). Within 30 - 50 feet of the surface, the exhalative exhibits supergene enrichment with chalcocite as veins and coatings on pyrite and chalcopyrite grains. Barite may also zone across the exhalative horizon, it appears to be more abundant (10 - 15%) in the exhalative next to the hangingwall contact in the large glory hole at Line 4/S x 300 E.

Hangingwall Sequence

The hangingwall sequence of rocks consists predominantly of intermediate pyroclastics similar to those in the footwall with interbedded zones of felsic fragmental, arkosic wacke and sericitic pyroclastics (see Plate 1).

Immediately east of the exhalative horizon along lines 10, 12, 14 and 16, south and from 100 to 300 W is a lense of arkosic wacke (S, Plate 1). The arkosic wacke obtains a maximum thickness of 30 - 40 feet and laterally pinches out over a distance of about 500 feet. The arkosic wacke is a crudely layered rock with thin alternating biotite rich bands that are distinct from sericite rich bands. Abundant angular quartz grains and plagioclase grains that are pseudomorphed by sericite are present throughout. Small lithic fragments and scattered amphibole clasts comprise the remainder of the coarse fraction of the rock. The coarse material is set in a fine grained matrix of dominantly quartz and sericite with lessor amounts of

magnetite, garnet, chlorite, apatite and tourmaline. Porphyroblastic andalusite is abundant throughout these rocks and locally comprises as much as 25 percent of the rock.

Occurring west of the baseline (21/S - 29/S x 300W) on the crest of Transverse Ridge is a zone of felsic fragmental (ff, Plate 1). This fragmental unit attains a maximum thickness of about 150 feet along line 26/S and pinches out 500 feet north and 300 feet south of this point. Within this thickest portion, the average fragment size is 10 cm with fragments to 30 cm. Both north and south, the average fragment size decreases to 5 cm with fragments to 15 cm. The fragments are a fine grained, foliated, sericite rich volcanic that is thought to be rhyolitic in composition. Barite as veins and clasts occurs throughout the fragmental unit. The felsic fragmental unit is believed to represent a period of explosive rhyolitic volcanism which accompanied mineralization.

East of the above, a large lense-like mass of sericitic pyroclastics (sp, Plate 1) crops out. These sericitic pyroclastics are identical to those described in the footwall section and are probably dacitic to rhyodacitic in composition. This lense-like mass reaches a maximum thickness of 300 feet along line 22/S.

The arkosic wacke, felsic fragmental and sericitic pyroclastics are interbedded in intermediate pyroclastics identical to those in the footwall. These rocks contain abundant plagioclase and hornblende crystals and lithic fragments and probably represent renewed andesitic volcanism from the same source as that of the footwall rocks.

Intrusive Rocks

Intruding both the hangingwall and footwall sequences are a series of

dikes and sills of dacite porphyry (dp, Plate 1). The main intrusive mass is a large sill-like body occurring east of the baseline between lines 10/S and 52/S that is roughly parallel to the foliation of the volcanics that it intrudes. This sill has a few dikes that project away from the main mass into the volcanics. Scattered through the footwall rocks along West Ridge are a series of small dikes of dacite porphyry. In the field the dacite porphyry is medium to dark gray in color, contains abundant millimeter sized phenocrysts of white albite and clots and fracture coatings of epidote. About 40% of the rock consists of albitized plagioclase phenocrysts and glomeroporphyritic clusters of albite phenocrysts up to 5 mm across. An additional 20% consists of microlitic fine grained albite in the matrix. Primary phenocrystic hornblende or pyroxene constitutes 5 to 10% of the rock and is pseudomorphed by epidote, chlorite, biotite and actinolite. The feldspar and mafic phenocrysts are set in a very fine grained matrix of actinolite, biotite and magnetite. The dacite porphyry has undergone the same degree of thermal metamorphism as the pyroclastic rocks it intrudes and is believed to be part of the same period of volcanism that formed these pyroclastic rocks.

Intruding all of the above rocks is a large body of augite-hornblende-biotite quartz diorite that is part of the Sierran Batholithic Complex. The intrusive rocks occur south of the main Walker Mine area (Plate 1) where they intrude the South Orebody and are covered by Tertiary volcanic rocks. It is believed that the batholithic rocks are the causitive agent for the strong thermal metamorphism in the Walker area.

Tertiary Volcanic Rocks

The pre-Tertiary volcanic rocks that host the Walker Mine Mineralization

are exposed in a semicircular window in Tertiary volcanic rocks (Tv, Plate 1). The Tertiary volcanics were not differentiated during field mapping but two separate units were noted. The first of these is a sequence of andesitic laharic breccia with intercalated flows of basalt, andesite and dacite. This unit forms the majority of the volcanic cover in the Walker area. The second unit is an olivine basalt flow with well developed columnar jointing that crops out on the south side of Dollie Creek by the old Walker Townsite. McMath (1952) believes that these two units are the Bonta Formation of Miocene age and the Warner Basalt of Piocene age respectively.

Structure of the Main Walker Area

The structure present in the Main Walker Mine Area consists of foliation in the pyroclastic rocks, shearing, and minor faulting. The foliation consistantly strikes from N 20° W to N 40° W and dips from 60° to 80° E. The foliation consists of aligned and stretched phenocrysts and mafic fragments in the pyroclastics. Two small faults are present by the Central Orebody. The first of these is a N 50° E striking structure that offsets the main exhalative 100 feet in an apparent left lateral sense. The second fault is a N 20° W striking structure that may down drop the Tertiary volcanic rocks against the pre-Tertiary volcanics. A third fault, N 60° W, may be present between the 712 and Piute Orebodies. This fault would account for the linear stream drainage in the area and also the change of dip between the 712 (65° E) and the Piute (35 - 45° E) Orebodies. Along Transverse Ridge and by the North Orebody (Plate 2) is an abundance of small shear zones with a bleached sericitic halo around them. These shear zones can be grouped into two main groupings, N 20° - 40° W with a steep NE dip and N 20° - 40° E with steep NW or SE dips. These shears are thought to represent fractures

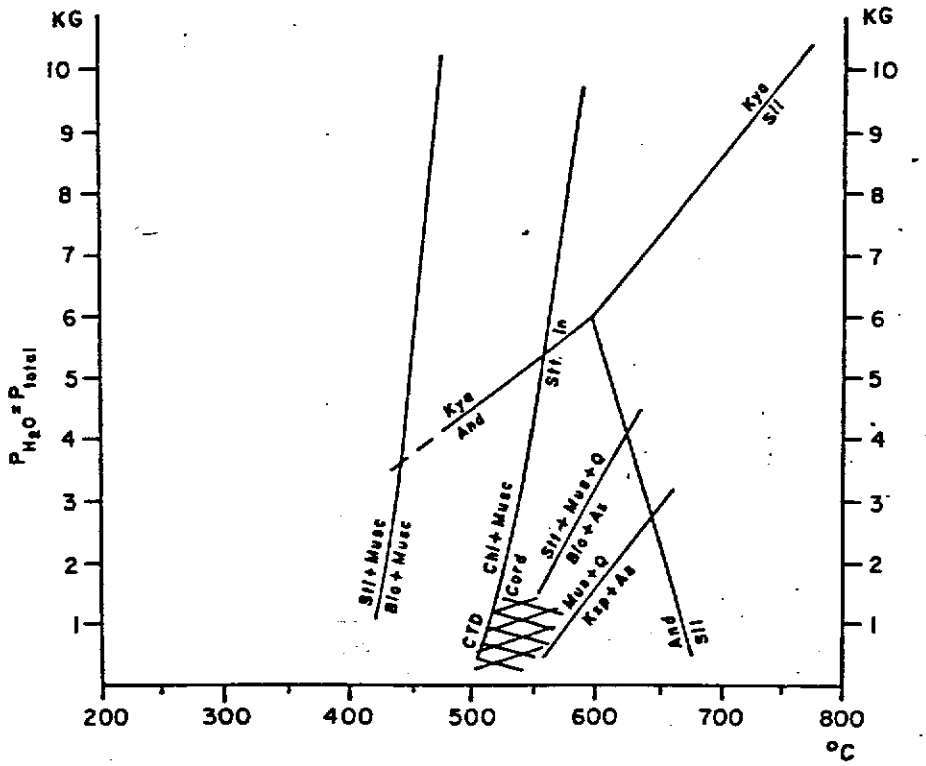
that fluids moved through at the time of ore deposition.

Metamorphism

The Jurassic rocks in the Walker Mine area (Plate 1) have all undergone a medium grade thermal metamorphism that is probably related to the emplacement of the Sierran Batholith. This metamorphic event is marked by a temperature range of 500° - 550° and a pressure range of 1 - 2 kilobars (Figure 3). These P-T conditions give rise to two different metamorphic assemblages that are controlled by pre-metamorphic lithology.

The pyroclastic rocks (ip, sp, ff, Plate 1) and the arkosic wacke (s, Plate 1) give rise to a typical pelitic metamorphic assemblage. These rocks belong to the cordierite - almandine zone of the lower amphibolite facies (Figure 4). This is shown by the presence of a cordierite, almandine, andalusite, biotite and muscovite assemblage. These minerals generally occur as a blastoporphyritic assemblage that mimicks the relict pre-metamorphic volcanic textures. In general, the metamorphic minerals pseudomorph the relict volcanic minerals, feldspar and hornblende. Garnet, cordierite and andalusite are the only porphyoblastic minerals present. The andalusite is of particular interest because it shows "bow tie" radiating clusters indicative of low confining pressures during crystallization. Whenever quartz is present, it is always recrystallized into polygonal mosaics that intersect at triple points.

The dacite porphyry dikes show a similar metamorphic grade but a totally different metamorphic assemblage. These rocks belong to the albite/oligoclase-hornblende-biotite zone of the Amphibolite Facies (Figure 5). The dacite porphyry consists predominantly of albite, hornblende, clinozoisite and biotite with lesser amounts of sphene, quartz, sericite, magnetite and



Stl— Stilphomelane
Musc— Muscovite/Sericite
Bio— Biotite
Kya— Kyanite
And— Andalusite
Stt— Staurolite
CTD—Chloritoid

Chl— Chlorite
Cord— Cordierite
Q— Quartz
As— Alumnosilicate
Ksp— K feldspar
Sil— Sillimanite

Figure 3 Metamorphic reactions in pelitic rocks. Cross hatched area shows approximate P-T relationships of the metamorphism present at Walker Mine. After Winkler, 1976.

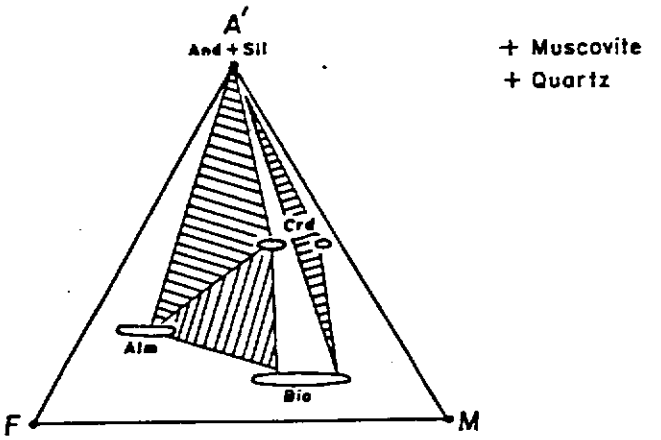


Figure 4 Mineral associations in the Cordierite — Almandine zone of the Medium Amphibolite Facies. After Winkler, 1976.

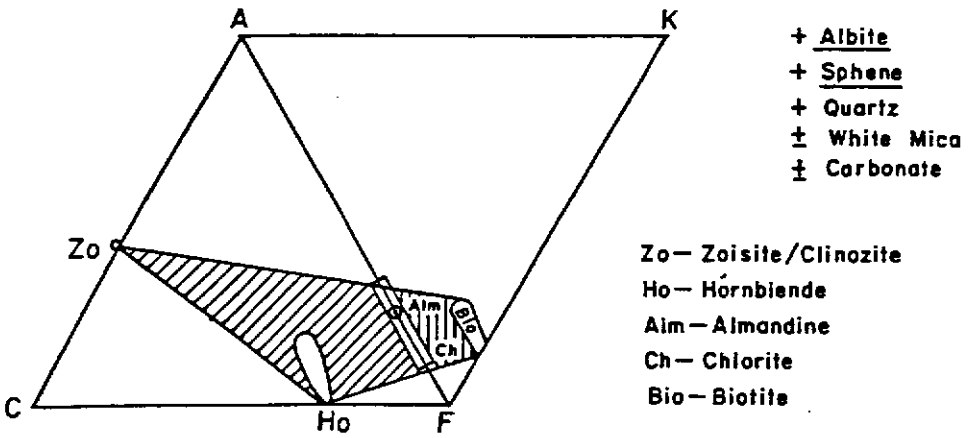


Figure 5. The albite/oligoclase-hornblende-biotite zone of the low grade, high temperature part of the Amphibolite Facies. After Winkler, 1976.

and carbonate. Blastoporphyritic textures where the original volcanic textures are mimicked by the metamorphic, minerals are abundant throughout. The plagioclase has been converted to albite, clinozoisite and carbonate and the amphibole/pyroxene phenocrysts are metamorphosed to hornblende, biotite, clinozoisite, sphene and magnetite. The matrix of these rocks is a fine grained mixture of hornblende, biotite, clinozoisite, quartz, magnetite and sericite.

Alteration

The host rocks for the Walker Mine mineralization show a well developed zonation of metamorphic minerals that directly reflects the original alteration mineralogy. The zonation was determined by examination of 275 thin sections and plotting and contouring of the percentage of constituent minerals present. Thin sections from the dacite porphyry were not used in the alteration zonation study because they are believed to postdate mineralization. The original alteration mineralogy was masked by the amphibolite grade metamorphism, but it can be determined by working backward through the metamorphic reactions.

Magnetite is ubiquitous throughout the hangingwall, footwall and exhalative horizons in the Walker area. Several areas (Plate 3) where the magnetite content exceeds 10 percent are present and appear to be related to alteration. These areas are along West Ridge, Transverse Ridge, by the Central Orebody and by the 712 Orebody. The magnetite is thought to represent an area of Fe metasomatism.

Biotite (Plate 4) has roughly the same general zonation pattern as magnetite. The biotite follows the exhalative horizons very well and is

concentrated in both hangingwall and footwall as well as between the horizons. Biotite occurs along West Ridge in increased quantity and as a zone trending roughly N 60° - 80° W that starts at the Central Orebody and heads for the western end of Transverse Ridge. The biotite probably formed by the addition of K^{+} to chlorite through K^{+} metasomatism.

Cordierite (Plate 5) follows biotite and magnetite and occurs along West and Transverse Ridges in addition to the Central and North Orebody areas. Due to x-ray diffraction and whole rock chemistry in the Transverse Ridge area, it is thought that the cordierite is an iron rich variety. In order to form cordierite, iron and aluminum in the presence of excess quartz is needed. The formation of cordierite can be expressed by the following reaction: 4 Quartz + 1 Kaolinite + 1 Chlorite $\rightarrow$ 2 Cordierite.

Garnet (Plate 6) closely mimicks magnetite, biotite and cordierite in its zonal pattern. It is believed that the garnet is almandine in composition and therefore, needs excess iron and aluminum to form. A distinct N 30° - 40° E striking zone of garnet occurs along the northeast portion of West Ridge and closely follows similar zones of cordierite, biotite and magnetite. Garnet forms a broad (700 - 1100 feet) zone that occurs in both hangingwall and footwall rocks along the exhalative horizons from the Central to the Piute Orebodies.

Andalusite (Plate 7) occurs along Transverse Ridge, West Ridge, the exhalative horizons and as a N 70° - 80° W striking zone from the Central Orebody towards Transverse Ridge. Andalusite probably formed from a two step process in which plagioclase was altered to kaolinite, the latter then metamorphosed to andalusite by the following reactions:

4 plagioclase + 24 $H_2O \rightarrow$ 3 kaolinite + 8 quartz + 12 H_2O + 4 NA^{+} + 4 Ca^{++} and 1 kaolinite $\rightarrow$ 1 andalusite + 1 quartz

These reactions start with a plagioclase of about An 50 which is that of a typical andesitic volcanic.

Sericite (Plate 8) shows an antithetic relationship to all of the above minerals. The sericite occurs as a halo around Transverse Ridge and the exhalative horizons. Sericite forms from the alteration of plagioclase by the following reaction:

$$2 \text{ plagioclase} + 2K^{+} + 4\ H_2O \rightarrow 1 \text{ sericite} + 4 \text{ quartz} + 2\ Na^{+} + 2Ca^{++} + 2\ H_2O$$

The sericite is stable through the metamorphism with only recrystallization to a coarser grain size.

Quartz (Plate 9) seems to follow sericite to some extent and also shows an antithetic relationship to cordierite, biotite, andalusite, garnet and magnetite. The zones of the highest quartz concentration occur as a halo around Transverse Ridge and to the west of the exhalite horizons. The reason for quartz and sericite going together is explained by the alteration of plagioclase to sericite releasing quartz as shown by the reaction described above.

The Mafic:Felsic Ratio (Plate 10)is a method of summing up the various metamorphic products of the original alteration mineralogy. This was done by taking the total percent mafic minerals and dividing by the total percent felsic minerals and then multiplying by 100 to obtain a whole number. In areas where the Mafic:Felsic ratio is greater than 100, at least 50 percent or more of the rock is mafic components and in areas where it is less than 25, then 20 percent or less of the rock is mafic minerals. The areas along Transverse and West Ridges and along the exhalite horizons and the N 70° - 80° W zone by the Central Orebody contain a marked increase of mafic minerals.

The sericitized shear zones (Plate 2) discussed under the "Structure" section show a close relationship to the altered zones discussed above. There is an abundance of these shears on Transverse and West Ridges and along the exhalite horizon by the North Orebody.

All of the zonal patterns of the metamorphic equivalents of the alteration products can be related to the deposition of the Walker Mine volcanogenic mineralization. A central pipe-like zone along Transverse Ridge represents peripheral alteration above a feeder zone. The metamorphic equivalent of the central "pipe" alteration is magnetite, biotite, cordierite, garnet and andalusite. This assemblage represents the presence of high iron, aluminum and possibly potassium. The andesitic pyroclastics were kaolinized and chloritized prior to metamorphism. The potassium needed to form biotite during metamorphism may have come from the primary hornblende or as a metasomatic product during alteration. This type of alteration also occurs along the exhalative horizons north and south of Transverse Ridge. In the area of West Ridge and west of the Central Orebody, are lenticular areas of alteration identical to those along Transverse Ridge. These areas were probably fault or fracture zones through which mineralizing solutions passed and may have actually been vents for mineralization. The zone by the Central Orebody was probably a feeder for the South and Central Orebodies and the altered zone along West Ridge represents a feeder for the North Piute area. These orebodies are proximal to their feeder source but distal to Transverse Ridge which was probably the main vent area for the pyroclastics. The North and 712 Orebodies were probably formed on the side of this main vent and are proximal orebodies with respect to Transverse Ridge.

Surrounding the Fe-Al-K alteration zones are areas where sericitization was prominant. The sericitized zones have a low mafic content and may actually represent areas where iron and magnesium was leached.

The apparent lack of a classic magnesium chlorite "pipe" can be explained by the lithology of the wall rocks. The fluids that passed upward through the vent were probably enriched in magnesium but found no receptive rocks to alter. The wall rocks were all andesitic-dacitic in composition and relatively high in MgO and were probably in equilibrium with the fluids in respect to MgO, so no Mg alteration developed.

There are no Na or Ca bearing minerals present in any thin sections examined from the Walker Mine property. This suggests that there was strong alkali leaching accompanying the alteration and mineralization.

Soil Geochemistry

Approximately 900 soil samples were collected over a grid on a 200 foot by 200 foot pattern and analyzed for Cu, Pb, and Zn. All soil samples were collected from the "B" horizon and where soil samples could not be taken, rock chip samples were collected.

No anomalous lead was detected in any of the soil samples. A nearly continuous band of high zinc values occurs in a semi-circular band around the main Walker Mine Zone (Plate 12) that correlates with the first outcrops of the overlying Tertiary volcanic rocks. There appears to be a zinc anomaly over the exhalative horizons by the Central and North Orebodies. This anomaly is not continuous through to the 712 and Piute area. There are some scattered anomalies in the West Ridge area that are not well understood at this time. These anomalies may be related to the presence

of a zinc bearing spinel or to zinc incorporated into the lattice of magnetite.

Four prominent copper anomalies are present with values ranging from 710 ppm to 0.69%. All four of these anomalies correspond to outcropping exhalative horizons (Plate 13).

Mine Clean-Up

In August, 1978, Mr. Tex Tate of Ponderosa Mining and Development, was hired to re-open and clean-up the Walker Mine. This operation consisted of re-timbering the adit and mucking through a caved-in area. After many delays, the main haulage level was finally opened in late November. At this time, Mr. Tate took his equipment and left for the winter.

Mr. Jan Donato, a Portola contractor, has been doing general mine clean-up since fall of 1978. This work consisted of construction of a settling pond, building a storage shed over the portal, reconditioning the flume system and a minor amount of underground work. The underground work consisted of re-timbering areas where timbers have broken since Mr. Tate finished his work and re-building portions of the flume inside the mine. The flume system is set up to handle a very large flow of water and hopefully will help control the heavy spring run-off.

Environmental Program

The Walker Mine has the unfortunate problem of having an acid mine discharge that exceeds the California pollution standards for Cu, Zn, Fe and Al. A sampling program was established to monitor the pollution in the mine effluent and its effect on Dollie, Little Grizzly and Indian Creeks.

Water samples were collected monthly from May through November. The

sample sites ranged from above the mine influence on Dollie and Little Grizzly Creeks to 20 miles downstream from the mine on Indian Creek. A more detailed sampling program involving stream sediment sampling, filtration of water samples in the field, and experimentation designed to remove Cu and Zn from the mine water were conducted in June by Dawn Kaback, an environmental geochemist from Ponco City. For more detailed information about the environmental program, the writer refers you to an interoffice communication from Dawn Kaback to Gordon Pine dated September 18, 1978 entitle "Environmental Program at Walker Mine".

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STATE WATER RESOURCES CONTROL BOARD

INTERNAL MEMO

In Reply Refer To: 415/JMP

TO: Stan Phillippe

Central Valley Regional Board

FROM: Jim Parsons

DIVISION OF PLANNING AND RESEARCH

DATE: MAR 28 1979

SIGNATURE: Jim

SUBJECT: Draft Report, "Evaluation of Water Pollution Sources and Development of Conceptual Pollution Abatement Plans, Walker Mine, Plumas County, California," prepared by D'Appolonia Consulting Engineers, Incorporated

I have reviewed the subject draft report relative to the adequacy of the description of the geohydrologic conditions of the site, the water pollution problem, and the proposed pollution abatement proposals.

Comments:

1. I find this draft report contains a good description of Walker Mine water pollution problem and some well thought out imaginative methods to reduce the problem to manageable levels.

2. Page 2-13, Site Geology, and Figure 3, Site Geologic Map:

   A reader's understanding of this section would be greatly enhanced by the inclusion of one or more geologic cross-sections. The list of formations in the text does not match those listed in the map legend with alluvium and tailings, glacial moraine, and Cascade gravels being omitted from the text. The site geologic map needs to be corrected to eliminate a number of carelessly drafted, squared off geologic contacts as well as several omitted contacts.

3. Page 2-14, Section 2.4.1, Surface Water Quantity and Table 1, "Hydrologic Characteristics of Watersheds in the Vicinity of Walker Mine":

   Although it is true that the Walker Mine lies within the Sacramento River Basin, it would be helpful if this were narrowed down by also noting that the mine is within the watershed of the North Fork of the Feather River. The flow data in Table 1 appears to have greater precision than the methods used for their determination would justify.

SWRCB 326 (3-75)

36192-063 8-78 5M OSP

Surname	Parsons 3/28/79						

4. Page 2-16 and Table 4, "Water Discharge Requirements Walker Mine Portal":

   The reference to drinking water standards seems irrelevant. The main beneficial use of downstream waters is its value as a fishery. The copper and zinc concentration limits for this use is much more restrictive than the drinking water standards.

5. Pages 2-17 and 2-18, Section 2.5.1, Mine Water Quantity:

   The frequent reference to the aquifer characteristics of the several formations is potentially misleading. These "aquifers" are fractured rock with only secondary permeability through the fractures. The main concern ought to be the capability of the formation to transmit water to the mine. Other aquifer properties such as porosity, density, etc., are irrelevant.

6. Page 3-1, Section 3.1, Identification of Pollution Sources:

   The reference in the second paragraph to the mine water having a low level of suspended solids should be supplemented by a discussion of the probable high suspended solid levels to be expected in the mine outflow during the developer's proposed mine cleanup operations.

7. Page 4-13:

   The proposal to dewater the mine and use the lower levels for impoundment of water during the winter months has several potential consequences that are not adequately discussed:

   a. Dewatering of the mine would cause dewatering of many fractures in the mine area. Water levels could be depressed quite some distance away from the mine. Thus, a substantially larger quantity of water would require treatment.

   b. A considerable volume of mineralized sulfite-rich rock would be exposed to annual wet-dry cycles. This would significantly increase the quantity of sulfates and heavy metals in the waters to be treated.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 80-058

NPDES NO. CA0080110

FACILITY I.D. NO. 5A322014001

MONITORING AND REPORTING PROGRAM
FOR
WALKER MINE
ROBERT R. BARRY
AND
CALICOPIA CORPORATION
PLUMAS COUNTY

MONITORING STATIONS

Discharge and Receiving Water Stations are shown on the schematic map, "Attachment A" and are described as follows:

#1 - Discharge Station at Walker Mine Portal.

#2 - Receiving Water Station, Dollie Creek 100 feet upstream from confluence with drainage discharge.

#3 - Receiving Water Station, Dollie Creek downstream from drainage discharge and above tailings pond.

#4 - Receiving Water Station, Little Grizzly Creek above tailings pond.

#7 - Receiving Water Station, Dollie Creek below tailings pond dam and upstream from confluence with Little Grizzly Creek.

#8 - Receiving Water Station, Little Grizzly Creek downstream from confluence with Dollie Creek.

MONITORING PROGRAM

WATER QUALITY PARAMETER	UNITS	SAMPLING METHOD	SAMPLING STATION	SAMPLING FREQUENCY
Temperature	^{o}C	Field Meas.	1, 2, 3, 4, 7, 8	Monthly
pH	pH Units	Field Meas.	1, 2, 3, 4, 7, 8	Monthly
Specific Conductance	umhos/cm @ $25^{o}C$	Field Meas.	1, 2, 3, 4, 7, 8	Monthly
Eh(1)	mV	Field Meas.	1	Monthly
Alkalinity	mg/l $CaCO_3$	Grab - 24 hrs.	1, 2, 3, 4	Monthly
Acidity	mg/l $CaCO_3$	Grab - 24 hrs.	1, 2, 3, 4	Monthly
Aluminum	mg/l	Grab	1, 2, 3	Monthly

MONITORING AND REPORTING PROGRAM
WALKER MINE-CALICOPIA CORPORATION
PLUMAS COUNTY

WATER QUALITY PARAMETER	UNITS	SAMPLING METHOD	SAMPLING STATION	SAMPLING FREQUENCY
Copper	mg/l	Grab	1, 2, 3, 4, 7, 8	Monthly
Iron	mg/l	Grab	1, 2, 3,	Monthly
Manganese	mg/l	Grab	1	Monthly
Zinc	mg/l	Grab	1, 2, 3	Monthly
Settleable Solids	ml/l	Grab	1	Monthly
Flow	cfs	Field Meas.(2)	1, 2, 3, 4	footnote (2)

(1)Oxidation-Reduction Potential

(2)Methods, Locations, and Frequency for stream flow measurements are dependent upon accessibility and availability of stream sections where gauging and measurement are feasible. Discharge Flow Measurement will require installation of a weir or other equipment with a recording devise. A report describing proposed flow monitoring methods must be submitted to the Executive Officer no later than 15 days fromt he effective date of this order.

REPORTING

In reporting the monitoring data, the discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner to illustrate clearly the compliance with waste discharge requirements.

Quarterly monitoring reports shall be submitted to the Regional Board by the 15th day of the following months: April, July, October, and January.

If the discharger monitors any pollutant at the locations designated herein more frequently than is required by this Order, he shall include the results of such monitoring in the calculation and reporting of the values required in the discharge Monitoring Report Form. Such increased frequency shall be indicated on the discharge Monitoring Report Form.

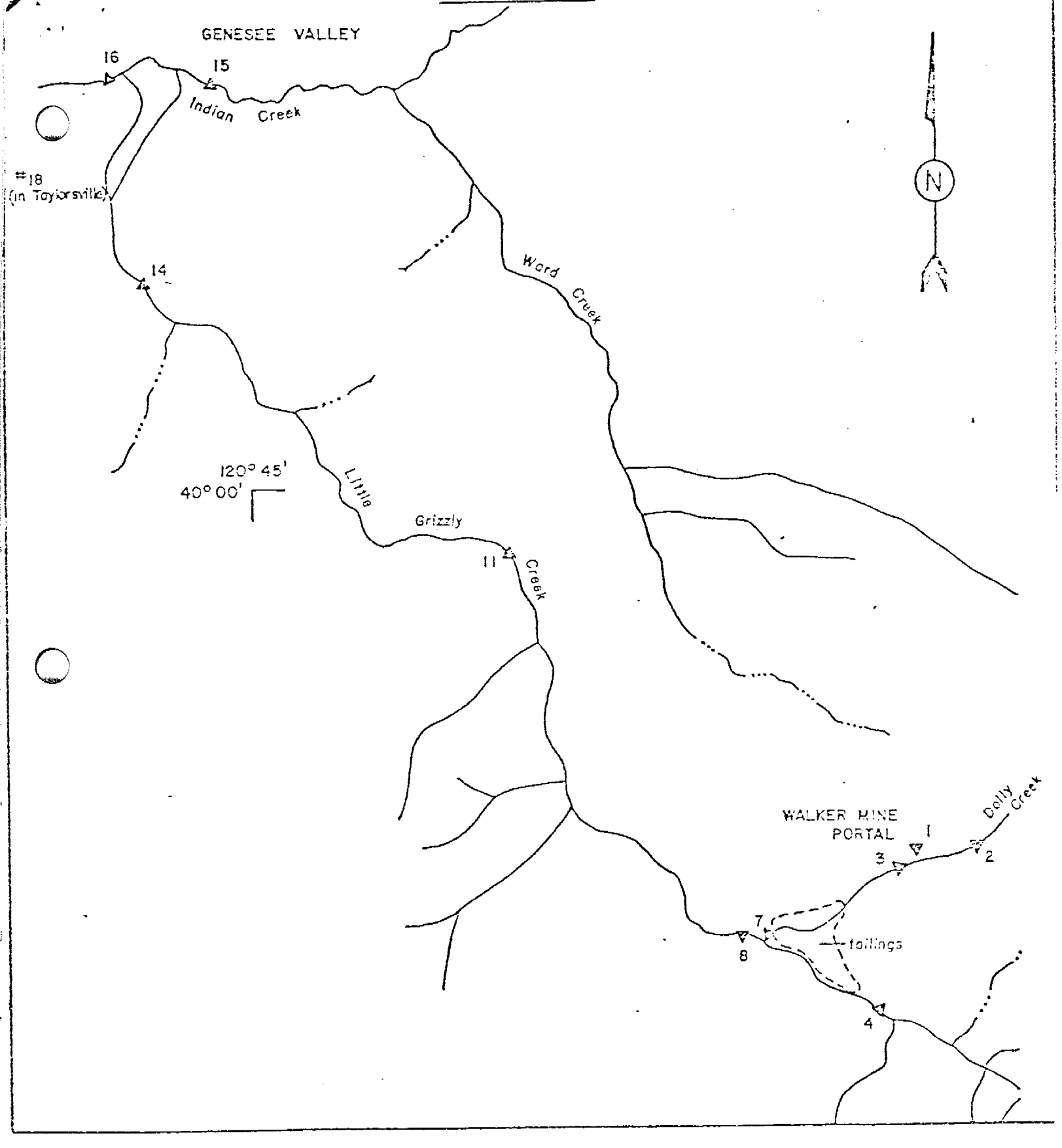
The discharger shall implement the above monitoring program no later than 30 days from the effective date of this Order.

Ordered by Original signed by James A. Robertson
JAMES A. ROBERTSON, Executive Officer

30 May 1980
(Date)

LFN/ap 5/1/80

ATTACHMENT "A"



Water Sample Location Sites

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 80-070

CLEANUP AND ABATEMENT ORDER
FOR
WALKER MINE, ROBERT R. BARRY AND CALICOPIA CORPORATION
PLUMAS COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board), finds:

1. The Board, on 23 May 1975, adopted Order No. 75-119, NPDES No. CA0080110, prescribing requirements covering the discharge of drainage from the Walker Mine, owned by Robert R. Barry and Calicopia Corporation (hereafter discharger).

2. Order No. 75-119 expired on 1 March 1980 without a new Report of Waste Discharge from the discharger, and the requirements were reissued on 30 May 1980 with the adoption of Order No. 80-058 by the Board.

3. The waste discharge requirements contained in Order No. 75-119 (and subsequently in Order No. 80-058) provide, in part, as follows:

"A. Effluent Limitations

"2. The discharge shall not have a pH less than 6.5 nor more than 8.5.

"B. Receiving Water Limitations

"1. The discharge shall not cause concentrations of constituents in Dollie Creek to exceed the following limits:

Constituent	Units	30-Day Average	Daily Maximum
Copper	mg/l	0.02	0.05
Zinc	mg/l	0.10	0.20
Aluminum	mg/l	0.20	0.40
Iron	mg/l	0.20	0.40

"2. The discharge shall not cause esthetically undesirable discoloration of Little Grizzly Creek.

"3. The discharge shall not cause bottom deposits in Little Grizzly Creek.

"4. The discharge shall not cause floating or suspended materials in Little Grizzly Creek.

"5. The discharge shall not cause concentrations of any materials in Little Grizzly Creek which is deleterious to human, animal, aquatic, or plant life.

"6. The discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Board or the State Water Resources Control Board as required by the Federal Water Pollution Control Act and regulations adopted thereunder. If more stringent applicable water quality standards are approved pursuant to Section 303 of the Federal Water Pollution Control Act, or amendments thereto, the Board will revise and modify this Order in accordance with such more stringent standards.

"C. Provisions

"5. The discharger shall comply with the "General Monitoring and Reporting Provisions" and Monitoring and Reporting Program No. 75-119 as specified by the Executive Officer.

"6. This Order expires on 1 March 1980 and the mine owners must file a Report of Waste Discharge in accordance with Title 23, California Administrative Code, not later than 180 days in advance of such date as application for issuance of new waste discharge requirements."

4. Information in the Board's files, including investigations by Board staff and the Department of Fish and Game, and reports by engineering and mining consultants, demonstrates that the discharger has violated and continues to violate the requirements listed above and that the discharge has created a condition of pollution resulting in the depletion of trout and other aquatic life in Dollie and Little Grizzly Creeks extending 5 to 10 miles downstream from the discharge location.

5. The Board has contracted with D'Appolonia Consulting Engineers, Inc., to assess the water quality problem at Walker Mine and to identify and evaluate alternative pollution abatement methods. The resulting December 1979 D'Appolonia Report recommends a two-phased approach:

   a. Reduction of inflow to the mine by diversion of surface runoff,

   b. Treatment of remaining outflow from mine adit.

6. By letter dated 23 April 1980, to Robert R. Barry, the Board requested that the discharger implement the first phase of the recommended abatement approach during the summer of 1980 with a time schedule for design and construction to be submitted by 26 May 1980. Mr. Barry notified Board staff by telephone on 8 May 1980 that he would not be able to comply with the request.

7. On 30 May 1980, in Lakeport, California, after due notice to the discharger and other affected persons, the Board conducted a public hearing at which evidence was received concerning the discharge.

8. Issuance of this Order is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000, et seq.) in accordance with Section 15108, Chapter 3, Title 14, California Administrative Code.

IT IS HEREBY ORDERED THAT: Robert R. Barry and Calicopia Corporation cleanup and abate pollution in Dollie and Little Grizzly Creek by:

1. Complying with the following schedule:

	Task	Completion Date	Report Date
a.	Submit project report and financial plan to substantially reduce concentrations of metals in receiving waters.	15 Jun 1980	30 Jun 1980
b.	Comply with Monitoring and Reporting Program No. 80-058.	30 Jun 1980	---
c.	Complete work identified in Task a.	31 Oct 1980	15 Nov 1980
d.	Begin design of project to reduce receiving water metal concentrations and acidity to protect fish and aquatic life.	1 Sep 1981	15 Sep 1981
e.	Begin construction of project in Task d.	1 Jul 1982	15 Jul 1982
f.	Complete construction of project in Task d.	1 Nov 1982	15 Nov 1982

2. Maintaining and operating abatement projects as necessary to protect receiving waters.

I, JAMES A. ROBERTSON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 30 May 1980.

J A Robertson

JAMES A. ROBERTSON, Executive Officer

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 80-058

NPDES NO. CA0030110

WASTE DISCHARGE REQUIREMENTS
FOR
WALKER MINE
ROBERT R. BARRY
AND
CALICOPIA CORPORATION
PLUMAS COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereinafter Board), finds that:

1. The Walker Mine, owned by the Calicopia Corporation and Robert R. Barry, (hereinafter discharger), is a non-operating copper mine located in east central Plumas County, about twenty miles (32 km) east of Quincy; T24N, R4E, MDB&M.

2. Mining operations ceased in 1941 but acid mine drainage continues to discharge to Dollie Creek near its confluence with Little Grizzly Creek, which is tributary to Indian Creek, thence the East Branch North Fork Feather River, waters of the United States.

Available data indicates the water quality of the discharge to be as follows:

Constituent	Median Value	Range	Units	
Flow	0.2	0.0 - 0.5	cfs	
pH	4.8	4.4 - 6.6	-	
Copper	11.0	0.23 - 69	mg/l	.05
Zinc	0.78	0.09 - 3.2	mg/l	.2
Aluminum	4.8	0.9 - 12	mg/l	.4
Iron	0.8	0.01 - 1.4	mg/l	.4

4. The Board on 25 July 1975 adopted a Water Quality Control Plan for the Sacramento River Basin (5A). The Basin Plan contains water quality objectives for all inland waters.

5. The beneficial uses of the Feather River and its tributaries are: municipal, industrial, and agricultural supply; recreation; esthetic enjoyment; navigation; ground water recharge, freshwater replenishment; hydroelectric power generation; and preservation and enhancement of fish, wildlife and other aquatic resources. The aquatic resources of much of Little Grizzly Creek have been eliminated by the discharge from Walker Mine.

6. Effluent limitation, and toxic and pretreatment effluent standards established pursuant to Sections 208b, 301, 302, 304, and 307 of the Federal Water Pollution Control Act and amendments thereto are applicable to the discharge.

7. The discharge was governed by waste discharge requirements adopted by the Board on 23 May 1975 in Order No. 75-119, which expired 1 March 1980.

8. The action to adopt an NPDES permit is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000, et seq.), in accordance with Section 13389 of the California Water Code.

9. The Board has notified the discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

10. The Board in a public meeting heard and considered all comments pertaining to the discharge.

11. This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Federal Water Pollution Control Act, or amendments thereto, and shall take effect ten days from the date of hearing provided the Regional Administrator EPA has no objections.

IT IS HEREBY ORDERED, the Calicopia Corporation and Robert R. Barry, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder and the provisions of the Federal Water Pollution Control Act and regulations and guidelines adopted thereunder, shall comply with the following:

A. Effluent Limitations:

1. The discharge shall not have a pH less than 6.5 nor greater than 8.5.

2. The discharge shall not contain more than 0.2 ml/l settleable solids.

B. Sludge and Solid Waste Disposal:

1. Sludge and/or solid wastes generated by treatment facilities or during mining exploration shall only be disposed at sites which have been approved by the Executive Officer.

C. Receiving Water Limitations:

1. The discharge shall not cause concentrations of constituents in the receiving waters to exceed the following limits:

Constituent	Units	30 Day Average	Daily Maximum
Copper	mg/l	0.02	0.05
Zinc	mg/l	0.10	0.20
Aluminum	mg/l	0.20	0.40
Iron	mg/l	0.20	0.40

2. The discharge shall not cause visible oil, grease, scum, foam, or floating or suspended material in the receiving waters or watercourses.

3. The discharge shall not cause concentrations of any materials in the receiving waters which are deleterious to human, animal, aquatic, or plant life.

4. The discharge shall not cause esthetically undesirable discoloration of the receiving waters.

5. The discharge shall not cause fungus, slimes, or other objectionable growths in the receiving waters.

6. The discharge shall not cause bottom deposits in the receiving waters.

7. The discharge shall not increase the turbidity of the receiving waters by more than 20% over background levels.

8. The discharge shall not alter the normal ambient pH of the receiving water more than 0.5 units.

9. The discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Board or the State Water Resources Control Board as required by the Federal Water Pollution Control Act and regulations adopted thereunder. If more stringent applicable water quality standards are approved pursuant to Section 303 of the Federal Water Pollution Control Act, or amendments thereto, the Board will revise and modify this Order in accordance with such more stringent standards.

D. Provisions:

1. Neither the discharge nor its treatment shall create a nuisance as defined in Section 13050 of the California Water Code.

2. The requirements prescribed by this Order renew and continue the requirements prescribed by Order No. 75-119, which expired on 1 March 1980.

3. The discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements (NPDES)" dated 21 September 1979 which are a part of this Order.

4. The discharger shall comply with the attached Monitoring and Reporting Program No. 80-058 as ordered by the Executive Officer.

5. This Order expires on 1 May 1985 and the discharger must file a Report of Waste Discharge in accordance with Title 23, California Administrative Code, not later than 180 days in advance of such date as application for issuance of new waste discharge requirements. If mining operations are to be resumed, a Report of Waste Discharge must be filed at least 180 days prior to such operations.

6. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the discharger, the discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be forwarded to this office.

I, JAMES A. ROBERTSON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 30 May 1980.

JAMES A. ROBERTSON, Executive Officer

State of California

The Resources Agency of California

Memorandum

To : Mr. Robert C. Mukai
Deputy Attorney General
Department of Justice
555 Capitol Mall, Suite 350
Sacramento, CA 95814

Date: 2 July 1980

From : **California Regional Water Quality Control Board**
Central Valley Region
3201 S Street, Sacramento, California 95816
Phone: 445:0270

Subject: WALKER MINE, ROBERT R. BARRY AND CALICOPIA CORPORATION, PLUMAS COUNTY

In accordance with our discussion yesterday, I have enclosed a copy of the 26 June 1980 letter from Conoco, Inc., describing the conditions under which Conoco will grant us access to the Walker Mine portal for flow monitoring purposes.

I have also enclosed a chronology of recent correspondence, with copies of letters and orders, demonstrating that the mine owners have failed to perform requested monitoring and abatement tasks and that they are aware of our intent to expend public funds for necessary pollution abatement with subsequent recovery of such funds through property liens.

Since we anticipate possible construction of diversion ditches on the Walker Mine property in late July or early August, we will need to initiate appropriate procedures to obtain legal access and authority to construct such facilities.

Please phone me at 2-1590 if you need additional information.

Larry F. Nash

LARRY F. NASH
Area Engineer
Sacramento Watershed

LFN/gs

cc: Ms. Sheila Vassey, Legal & Technical Services Div., SWRCB

Enclosures

APPROVED

WST