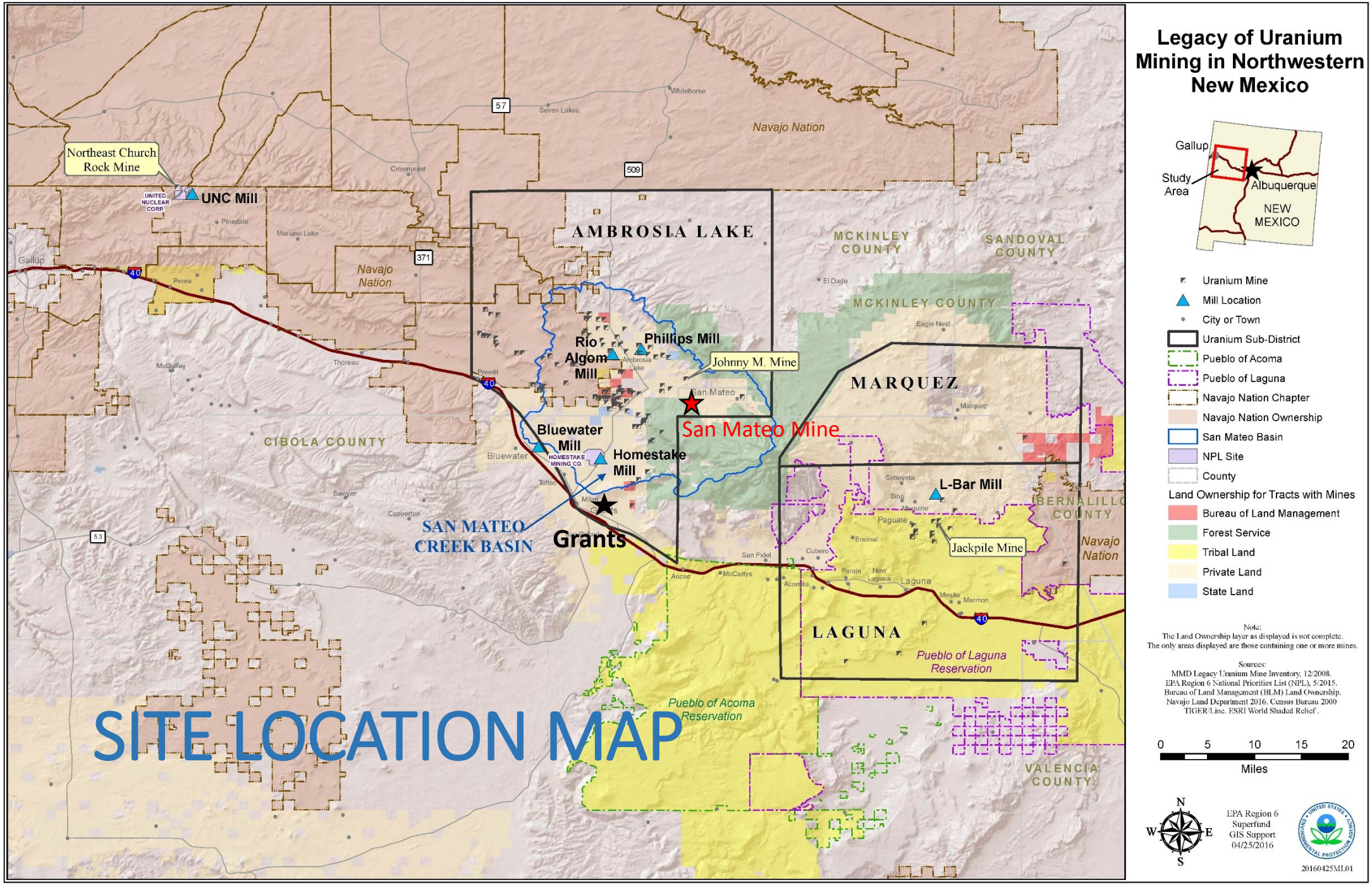
EPA GROUND WATER INVESTIGATION

San Mateo Creek Basin Uranium Legacy Site

January 12, 2017

9881541


Legacy of Uranium Mining in Northwestern New Mexico
Gallup
Study Area
Albuquerque
NEW MEXICO
Uranium Mine
Mill Location
City or Town
Uranium Sub-District
Pueblo of Acoma
Pueblo of Laguna
Navajo Nation Chapter
Navajo Nation Ownership
San Mateo Basin
NPL Site
County
Land Ownership for Tracts with Mines
Bureau of Land Management
Forest Service
Tribal Land
Private Land
State Land
Note:
The Land Ownership layer as displayed is not complete.
The only areas displayed are those containing one or more mines.
Sources:
MMD Legacy Uranium Mine Inventory. 12/2008.
EPA Region 6 National Priorities List (NPL), 5/2015.
Bureau of Land Management (BLM) Land Ownership.
Navajo Land Department 2016. Census Bureau 2000
TIGER/Line. ESRI World Shaded Relief.
0 5 10 15 20
Miles
N
W
E
S
EPA Region 6
Superfund
GIS Support
04/25/2016
20160425ML01
Northeast Church Rock Mine
UNITED NUCLEAR CORP.
UNC Mill
AMBROSIA LAKE
MCKINLEY COUNTY
SANDOVAL COUNTY
Navajo Nation
Rio Algom Mill
Phillips Mill
Johnny M. Mine
San Mateo Mine
MARQUEZ
Bluewater Mill
HOMESTAKE MINING CO.
Homestake Mill
CIBOLA COUNTY
SAN MATEO CREEK BASIN
Grants
L-Bar Mill
Jackpile Mine
BERNALILLO COUNTY
LAGUNA
Pueblo of Laguna Reservation
Pueblo of Acoma Reservation
VALENCIA COUNTY
SITE LOCATION MAP

San Mateo Creek
Basin
321 Square Miles
San Mateo
Mine
371
Milan
53
Grants
Paguate
Encinal
Seama
40
Laguna
Rio San Jose Basin
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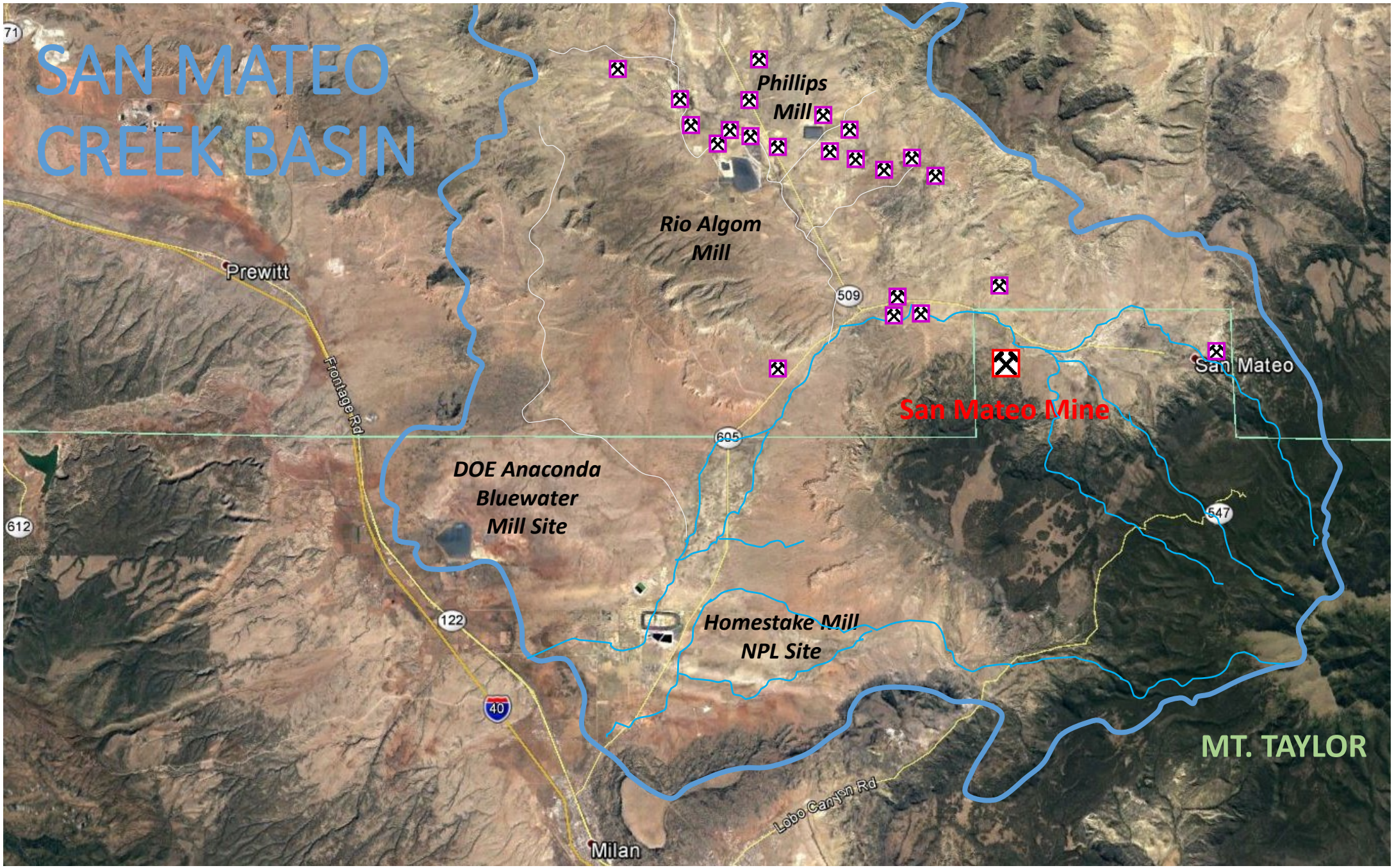
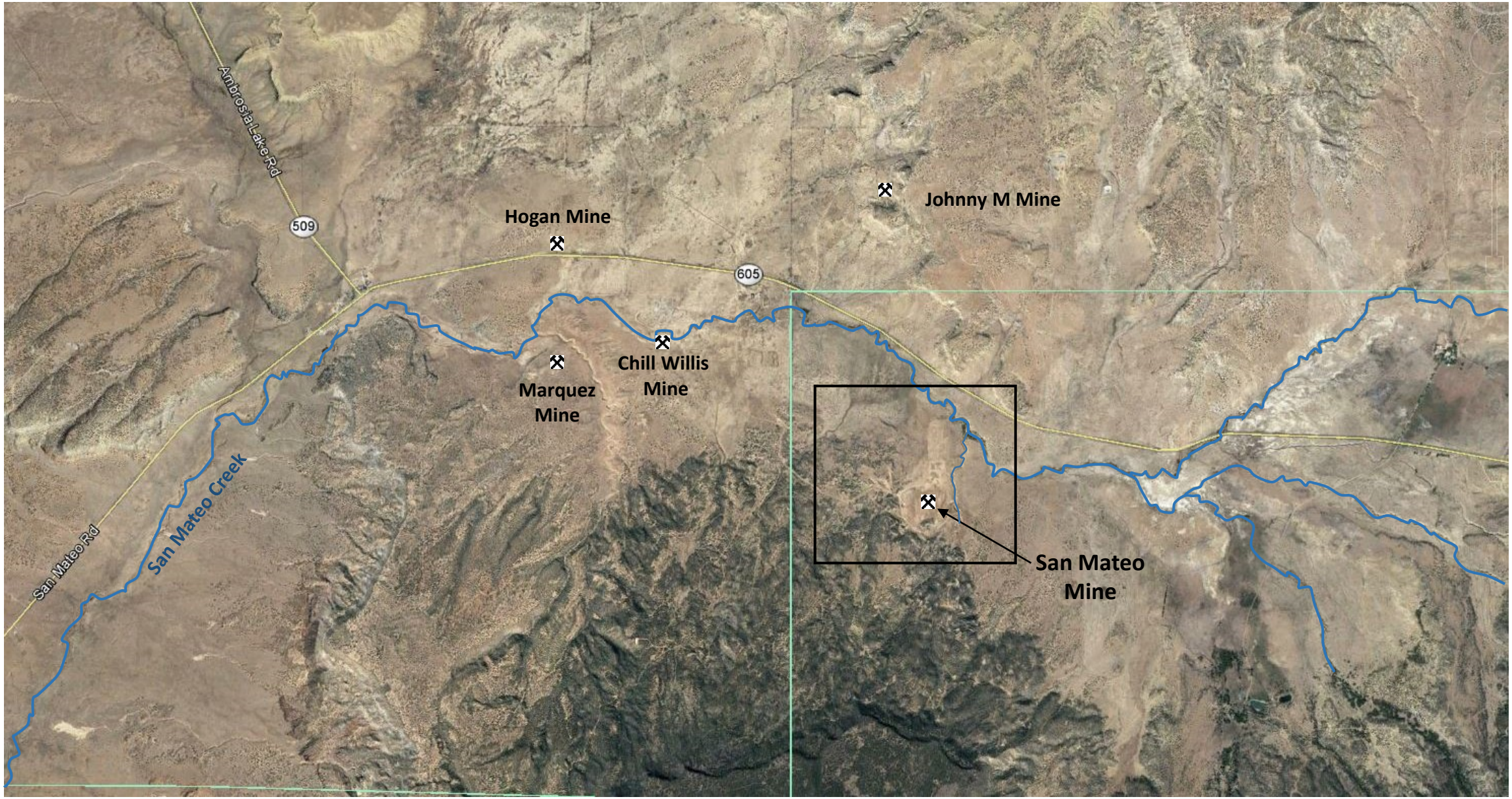

SAN MATEO CREEK BASIN
Phillips Mill
Rio Algom Mill
Prewitt
Frontage Rd
509
San Mateo
San Mateo Mine
605
DOE Anaconda Bluewater Mill Site
547
612
122
Homestake Mill NPL Site
40
MT. TAYLOR
Lobo Canyon Rd
Milan

UPPER SAN MATEO CREEK BASIN

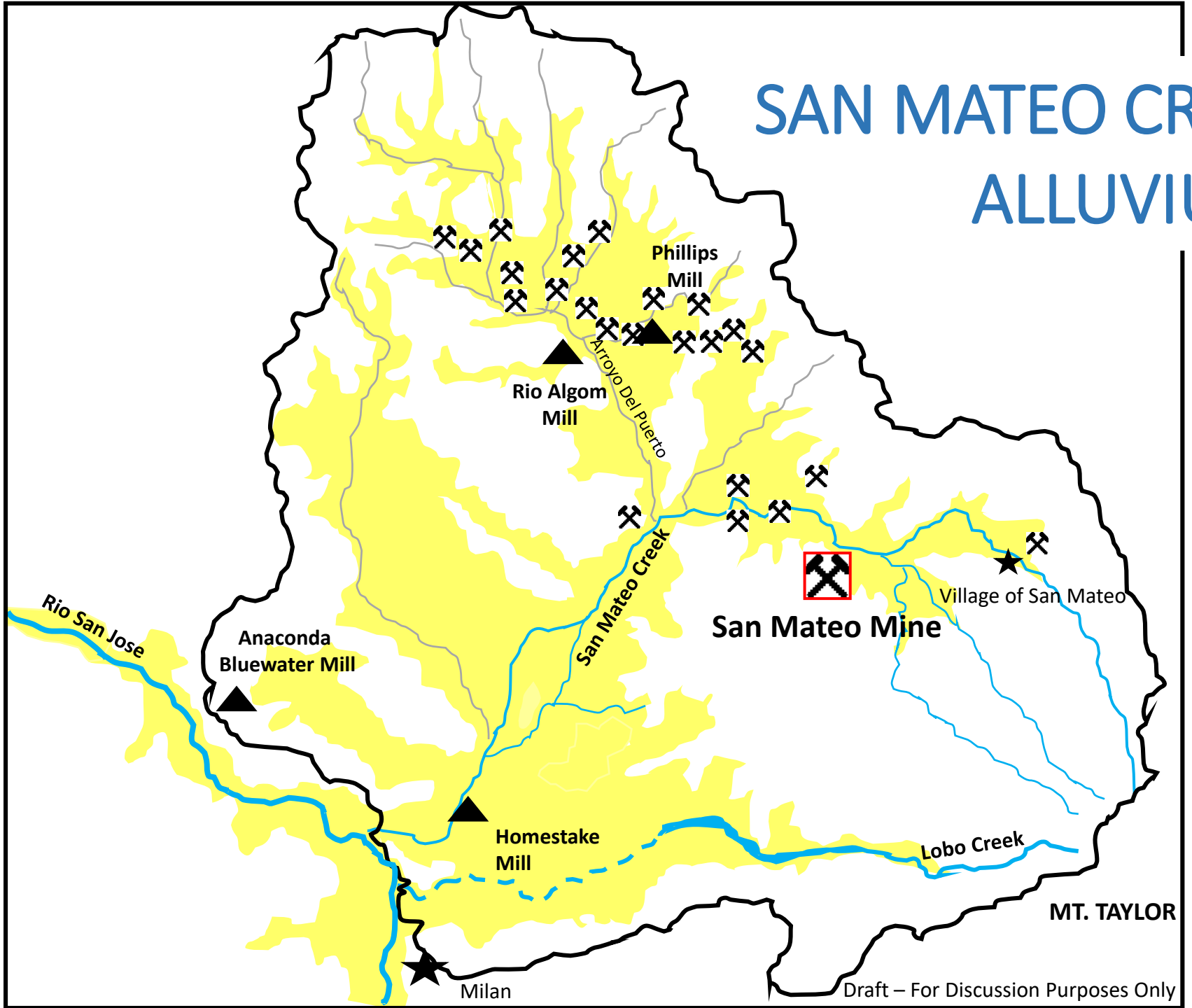


SAN MATEO MINE

ARROYO

Photo from USFS

SAN MATEO CREEK BASIN ALLUVIUM



Alluvium

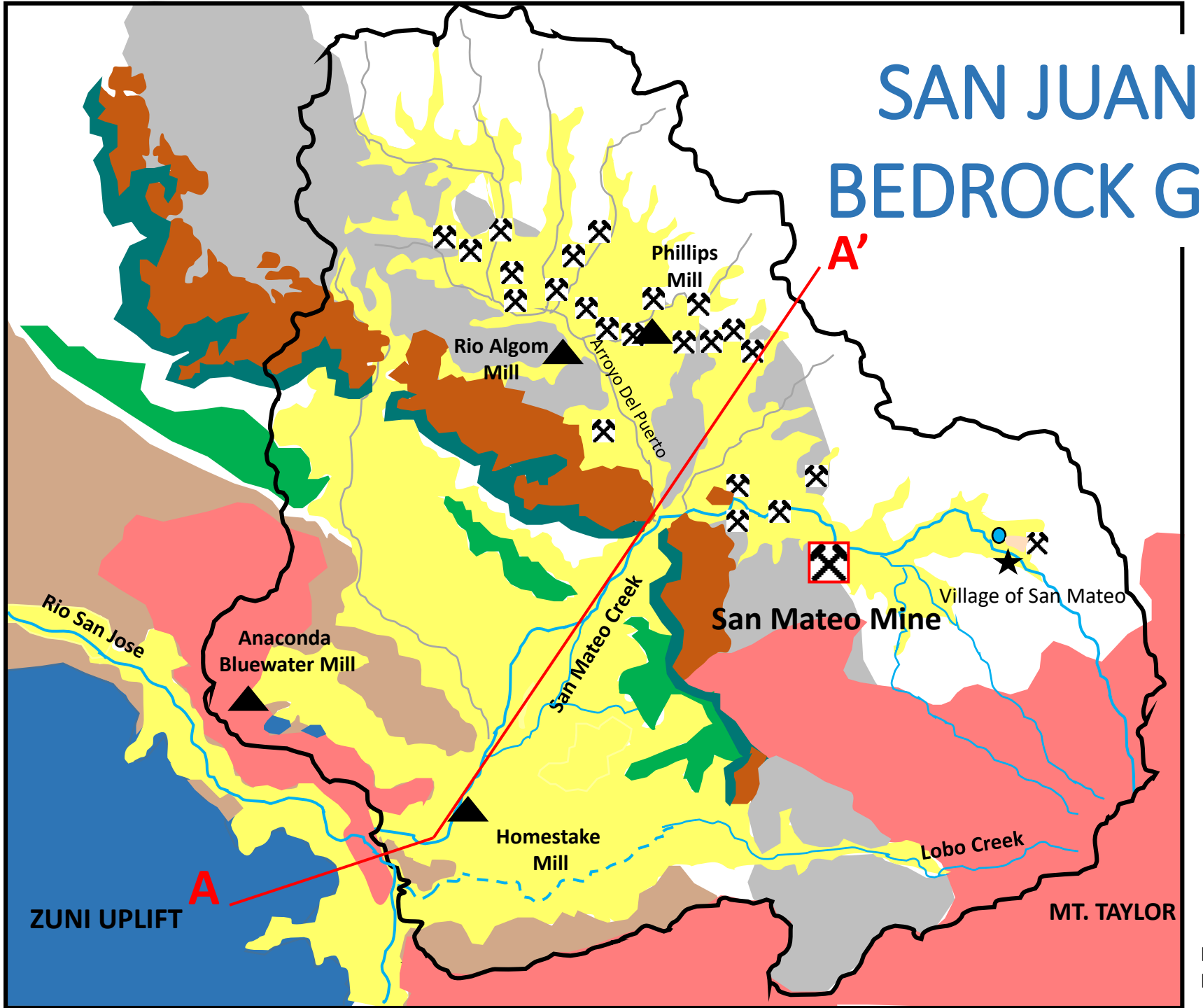
Wet Mine

ALLUVIUM:

Sediments Deposited in Basin from Erosional Processes;

Comprised of Sand, Silt, Clay and Gravel

SAN JUAN BASIN BEDROCK GEOLOGY



- Alluvium
- Mancos Shale
- Dakota Sandstone
- Morrison Fm
- Todilto Limestone
- Chinle Shale and Sandstone
- San Andres/Glorietta Limestone
- Volcanic
- Former Uranium Mill
- Wet Mine
- San Mateo Mine

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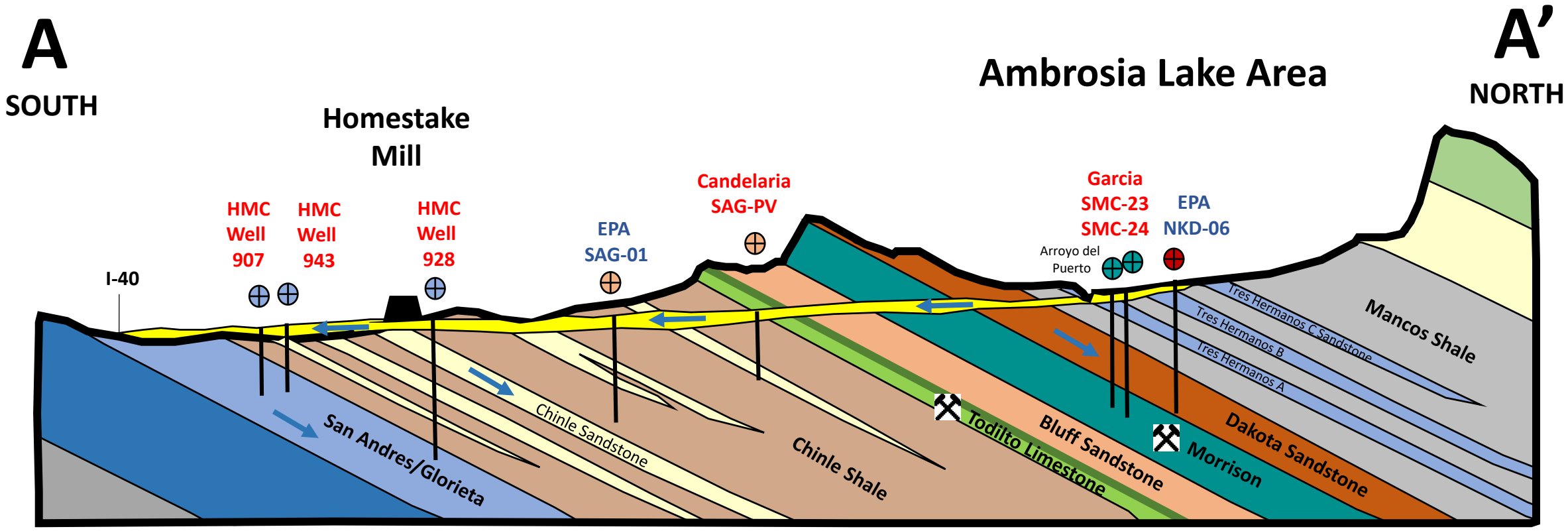
Based on USGS Geologic Map

CONCEPTUAL SITE GROUND WATER MODEL

Generalized Cross Section Through San Mateo Creek Basin



5 Miles

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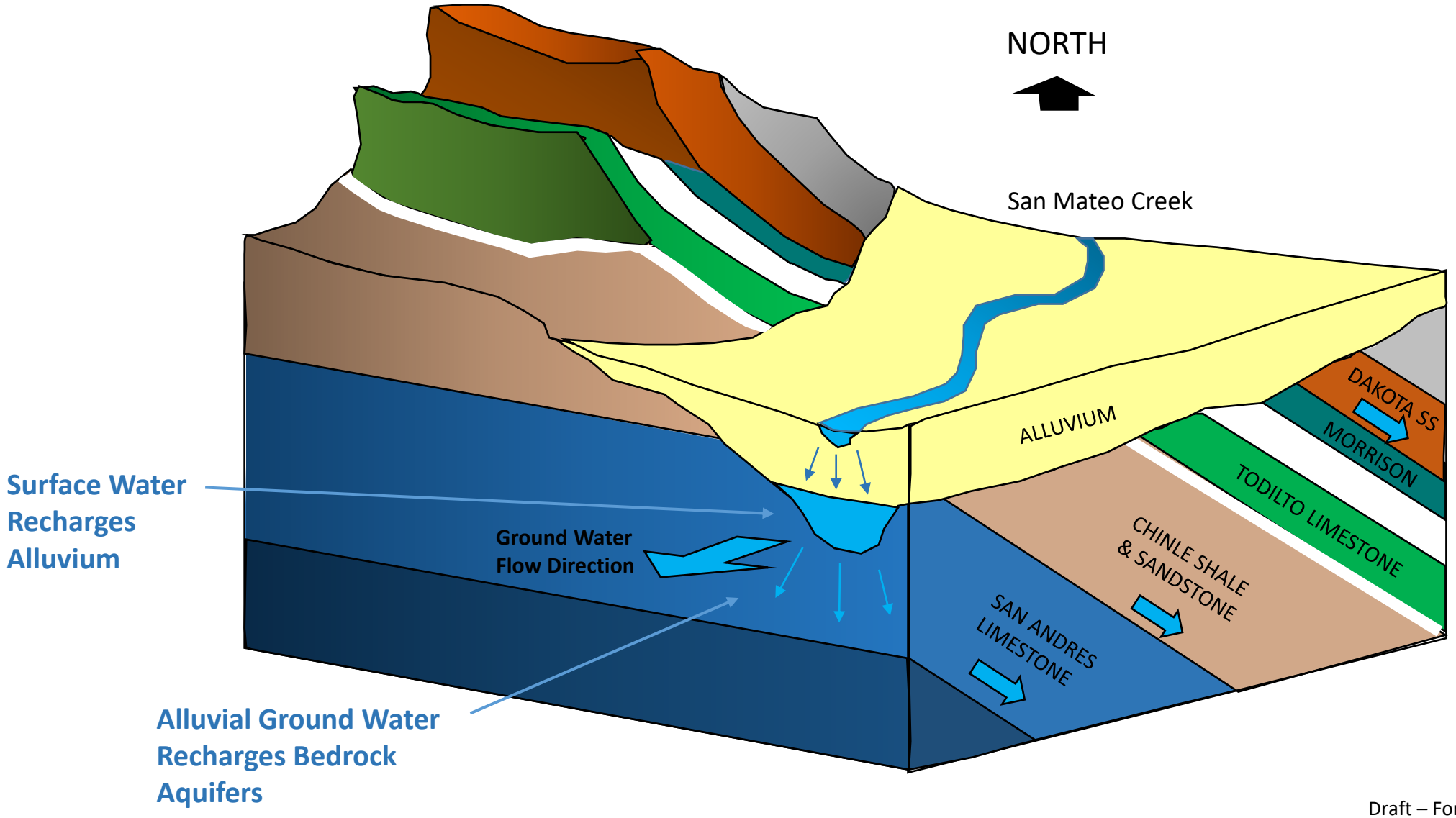
CONCEPTUAL SITE GROUND WATER MODEL



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MULTI-PHASED GROUND WATER INVESTIGATION

Phase 1

Alluvial Aquifer
2012 – 2016

Phase 2

Bedrock & Alluvial Aquifers
2015 – 2017

Phase 3

Develop Conceptual Site Model
2016 - 2018

PHASE 1 COMPLETED

EPA Phase 1 Ground Water Report

- Completed in August 2016
- Released to stakeholders in September 2016

Key components include:

- Summary of historical studies on uranium mining impacts
- Field investigation
- Findings and Conclusions

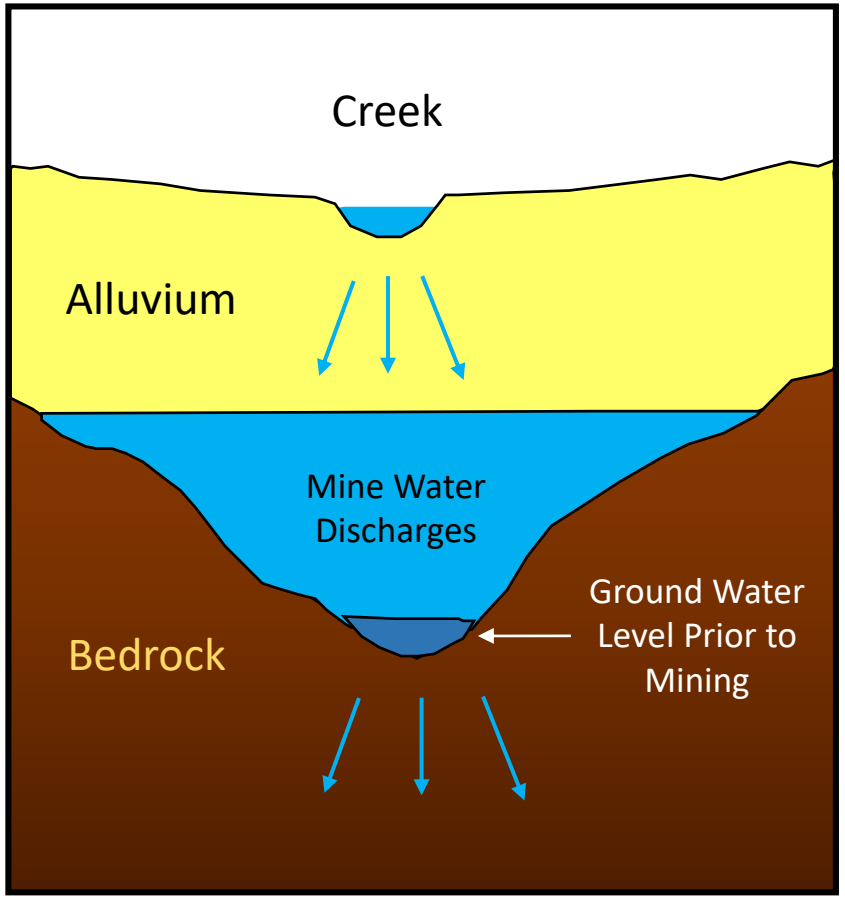
HISTORICAL STUDIES ON URANIUM MINING IMPACTS

- 1975 EPA study
  - Ground water contamination discovered
  - Sources – mine water discharge and tailing seepage
  - Perennial flows created in creeks/arroyos
- 1981 and 1986 New Mexico studies
  - Alluvial ground water exceeds standards
  - Mine water discharge rapidly infiltrates and saturates alluvium

1975 – Ambrosia Lake Area

IMPACT OF MINE WATER DISCHARGE OPERATIONS

- ***Dewatered underground workings***
- ***Discharged billions of gallons*** of mine water to creeks and arroyos
- ***Water infiltrated*** into ground
- ***Increased amount of ground water*** in alluvial sediments and bedrock
- ***Changed quality*** of ground water



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Not to Scale

SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

Comparison to Alluvial Background Water Quality

Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (mg/L)	1,690	520	125 – 300

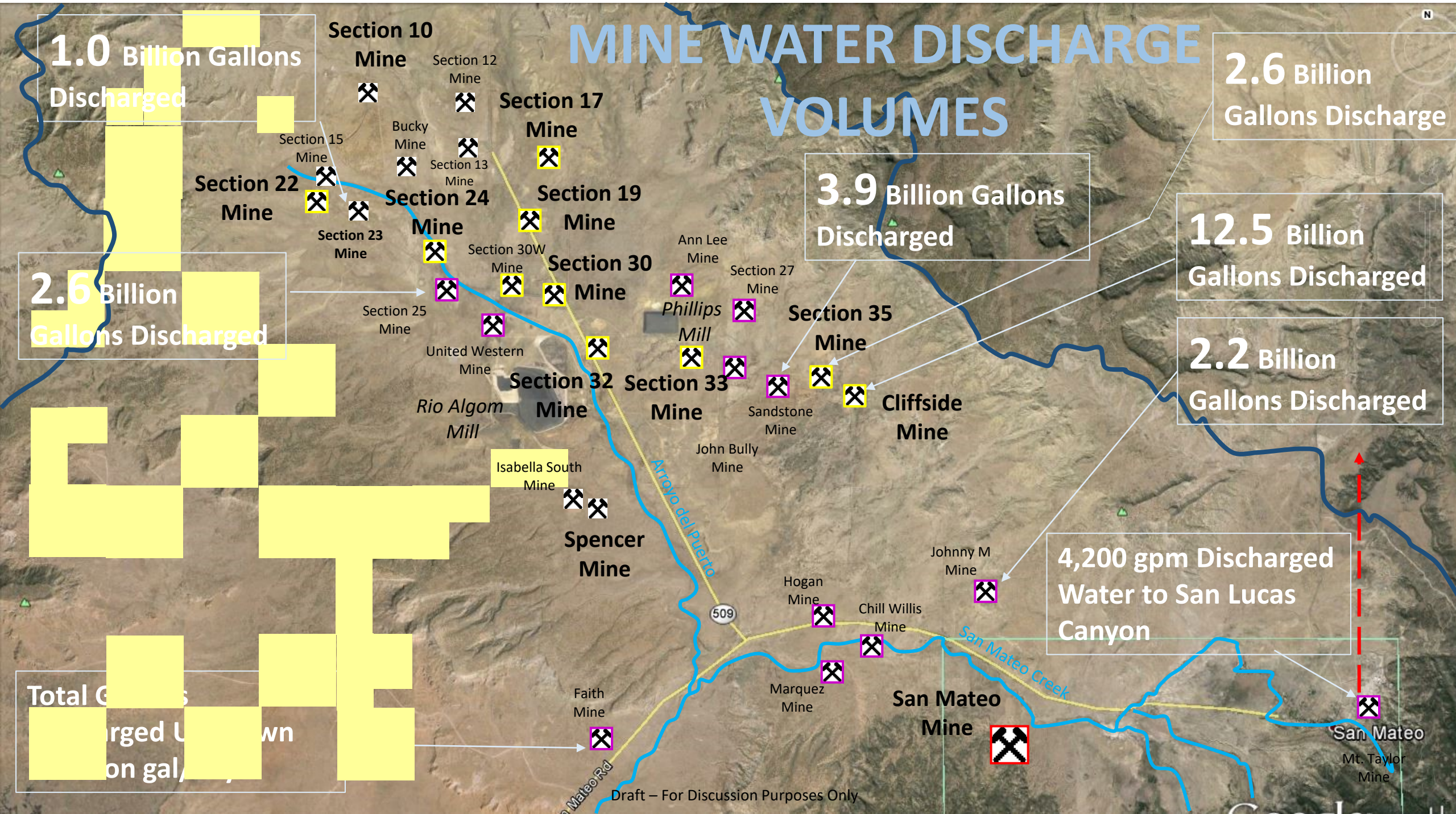
New Mexico 1981 and 1986 Reports

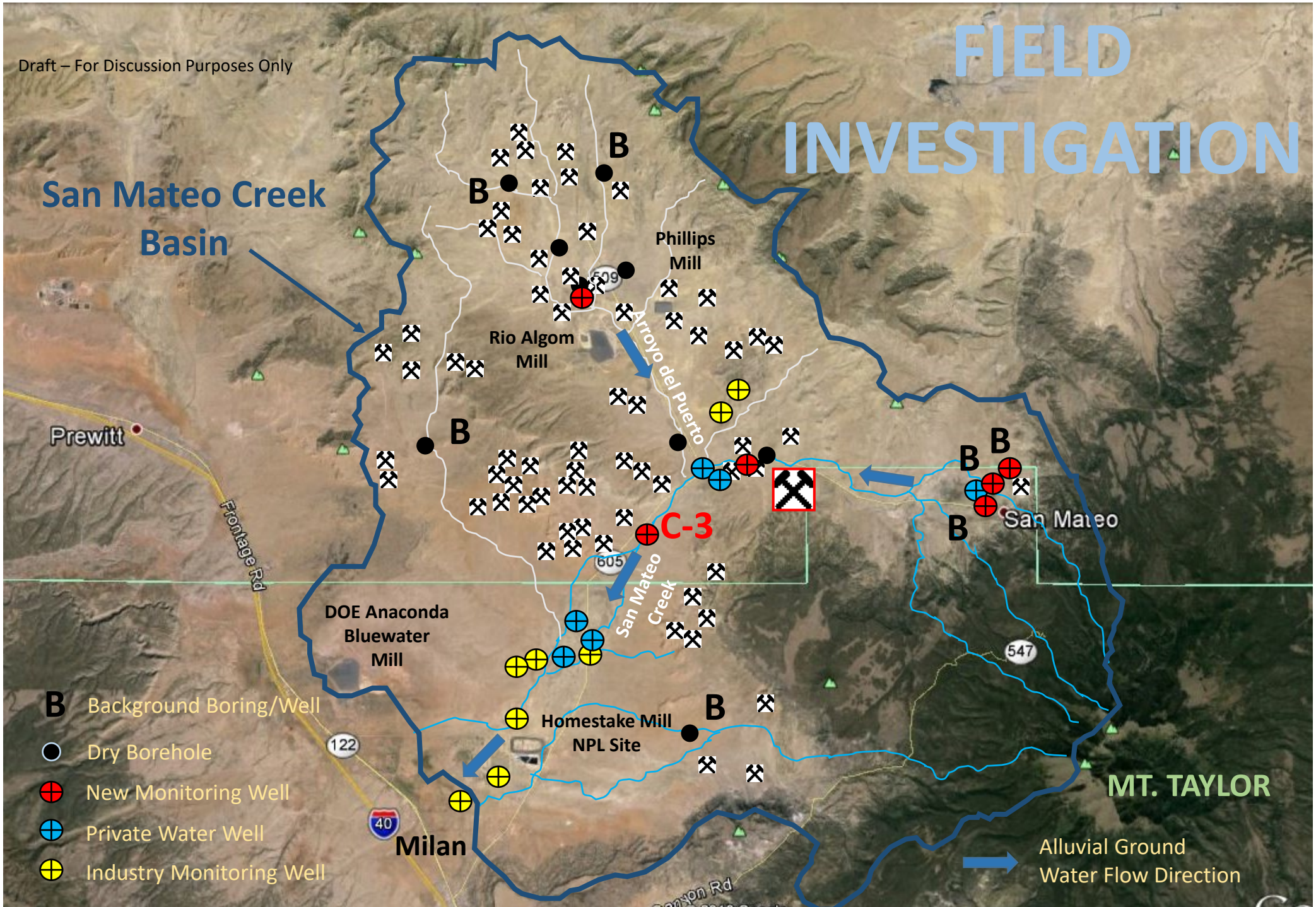
MINE WATER DISCHARGE

Artificially Created Surface Flows in Creeks and Arroyos

⚒ Wet Mine

MINE WATER DISCHARGE VOLUMES

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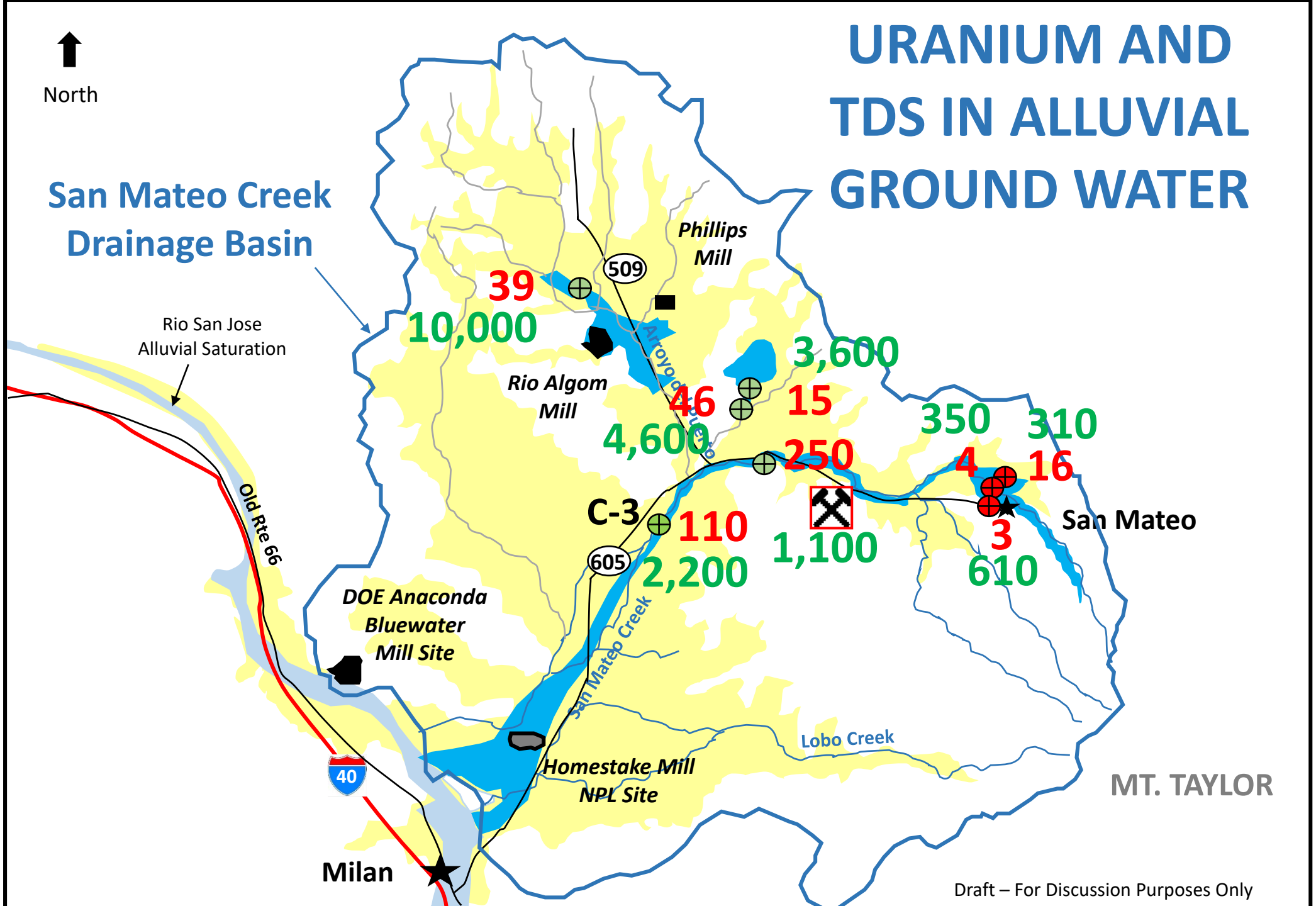
FIELD INVESTIGATION
San Mateo Creek Basin
Phillips Mill
Rio Algom Mill
Arroyo del Puerto
Prewitt
Frontage Rd
C-3
San Mateo Creek
San Mateo
DOE Anaconda Bluewater Mill
Homestake Mill NPL Site
Milan
MT. TAYLOR
Alluvial Ground Water Flow Direction
B Background Boring/Well
Dry Borehole
New Monitoring Well
Private Water Well
Industry Monitoring Well

SUMMARY OF CONCLUSIONS

Phase 1 Report

- Attempt to Characterize Alluvial Background had Mixed Results
  - Lack of Natural Saturation in Many Areas Investigated
- Alluvial Water Quality Varies Across Basin
  - Good quality upgradient of mines and mills
    - ✓ Meets standards
  - Poor quality downgradient of mines and mills
    - ✓ Exceeds standards
    - ✓ Similar to mine discharge water quality in some areas
- Mine Discharge Water Draining Through and Out of Alluvium

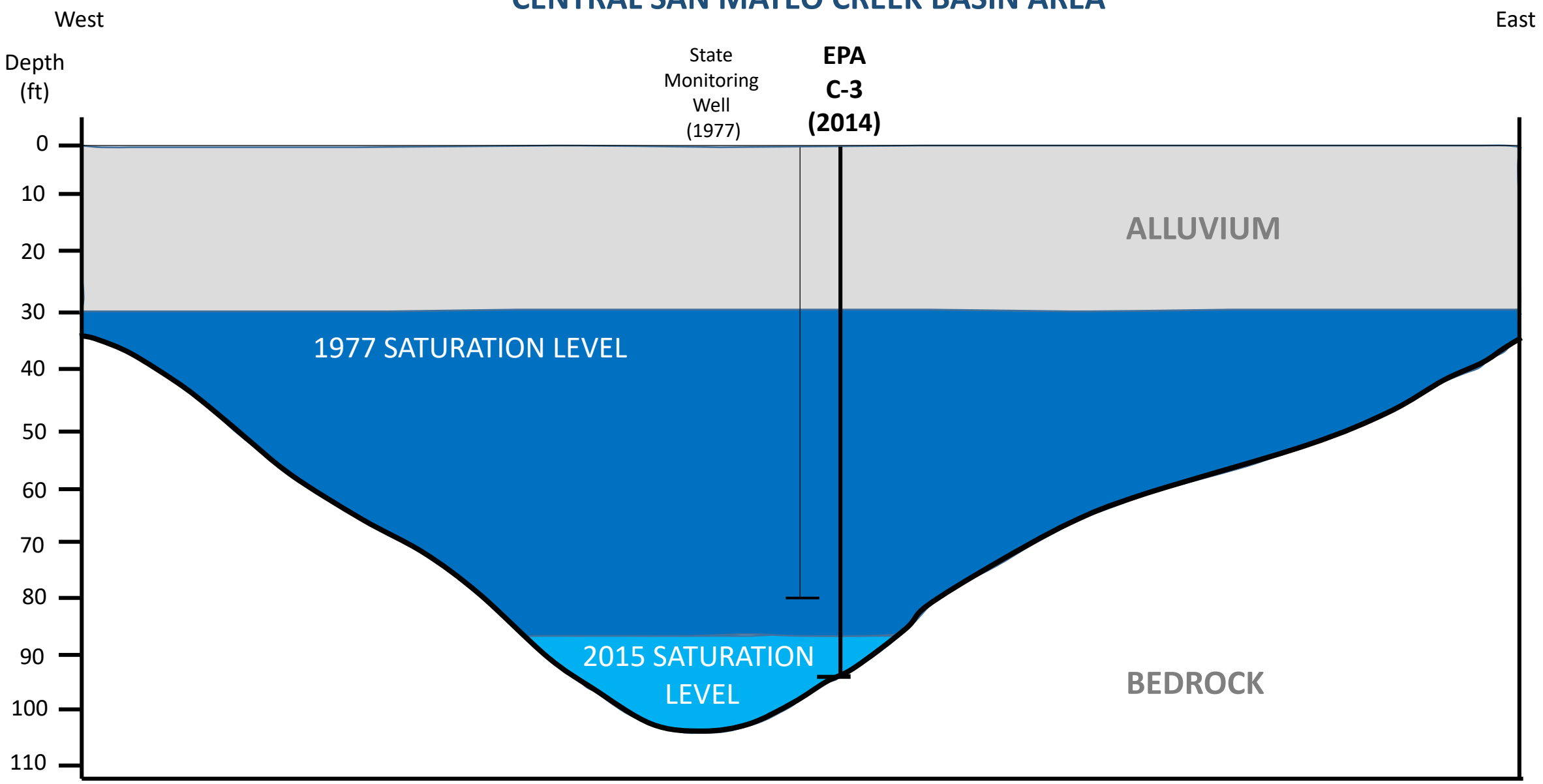

URANIUM AND TDS IN ALLUVIAL GROUND WATER
North
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
39
10,000
Rio Algom Mill
Arroyo del Puerto
46
4,600
3,600
15
250
350
4
310
16
3
610
San Mateo
C-3
110
2,200
605
1,100
DOE Anaconda Bluewater Mill Site
Old Rte 66
San Mateo Creek
Lobo Creek
Homestake Mill NPL Site
40
Milan
MT. TAYLOR
Draft – For Discussion Purposes Only
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
EPA Background Well
Well Downgradient to Legacy Mines
16 Uranium (ppb)
610 Total Dissolved Solids (ppm)

MASSIVE SATURATION AND DRAIN DOWN OF ALLUVIUM

- Caused by mine water discharges
- Water levels in central part of basin raised and dropped **OVER 50 FEET**
- Drain down not observed near Homestake

CROSS SECTION A-A'

CENTRAL SAN MATEO CREEK BASIN AREA



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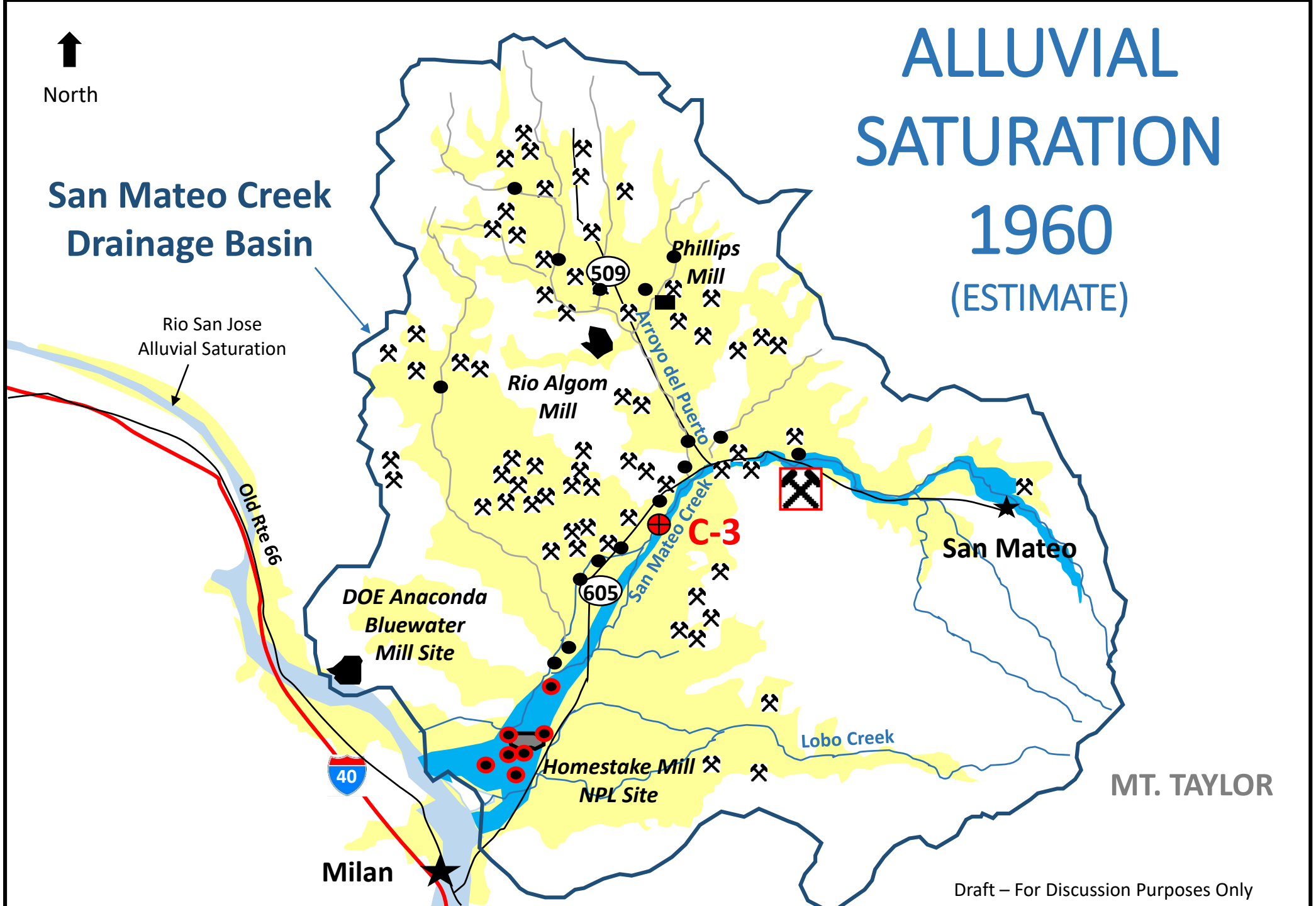
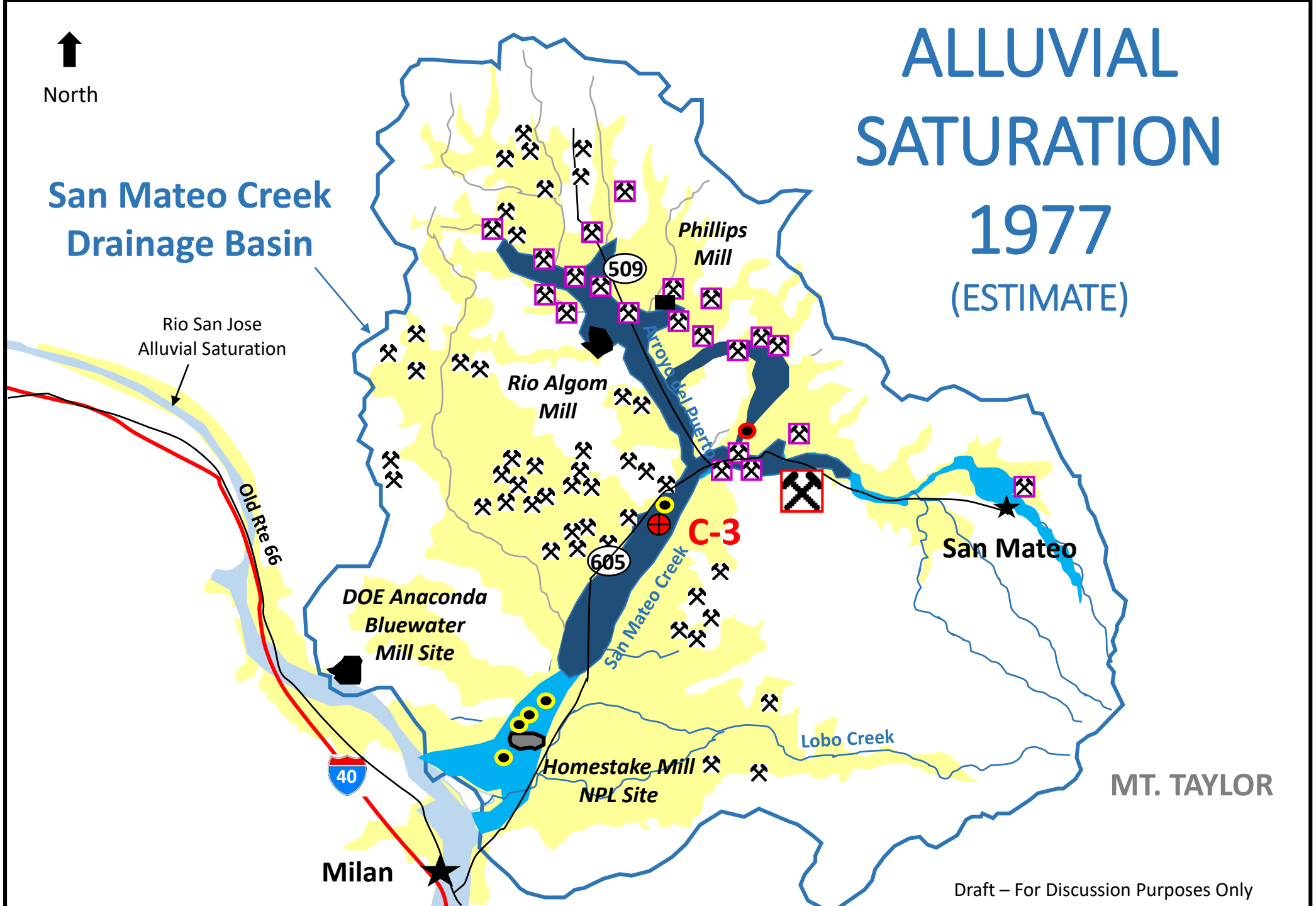

ALLUVIAL SATURATION 1960 (ESTIMATE)
North
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
Rio Algom Mill
Arroyo del Puerto
San Mateo Creek
C-3
San Mateo
605
DOE Anaconda Bluewater Mill Site
Old Rte 66
Lobo Creek
Homestake Mill NPL Site
40
Milan
MT. TAYLOR
Draft – For Discussion Purposes Only
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
EPA Monitoring Well - 2014
1960 or Older Well
Dry Borehole Drilled in 2014/2015


ALLUVIAL SATURATION 1977 (ESTIMATE)
North
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
Rio Algom Mill
Arroyo del Puerto
C-3
605
San Mateo Creek
San Mateo
DOE Anaconda Bluewater Mill Site
Old Rte 66
40
Homestake Mill NPL Site
Lobo Creek
Milan
MT. TAYLOR
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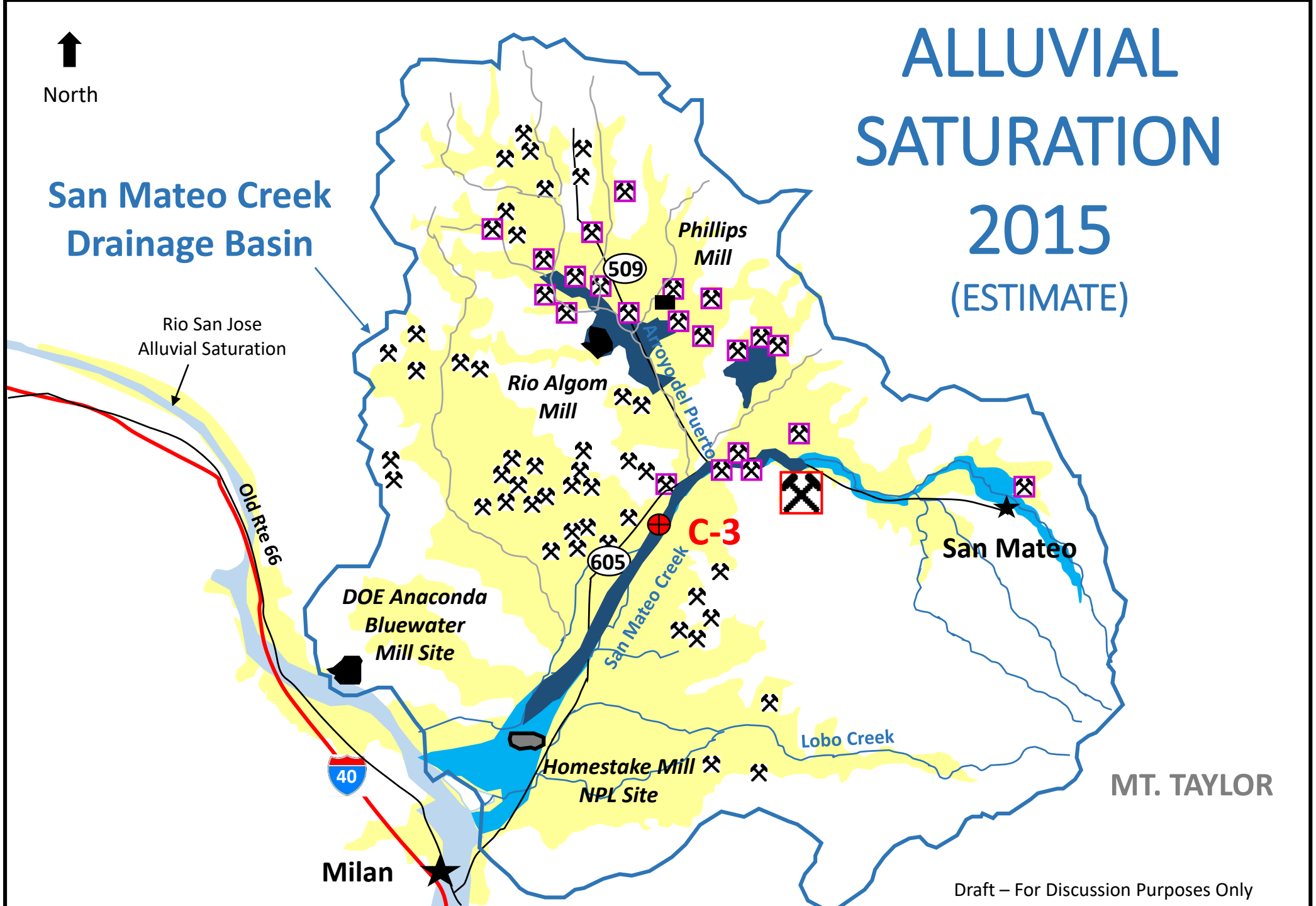
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
Mine Discharge Water
Wet Mine
1989 Private Well with Alluvial Saturation
1977 Well Data


ALLUVIAL SATURATION 2015
(ESTIMATE)
North
San Mateo Creek Drainage Basin
Rio San Jose Alluvial Saturation
Phillips Mill
509
Rio Algom Mill
Arroyo del Puerto
C-3
605
San Mateo Creek
San Mateo
DOE Anaconda Bluewater Mill Site
Old Rte 66
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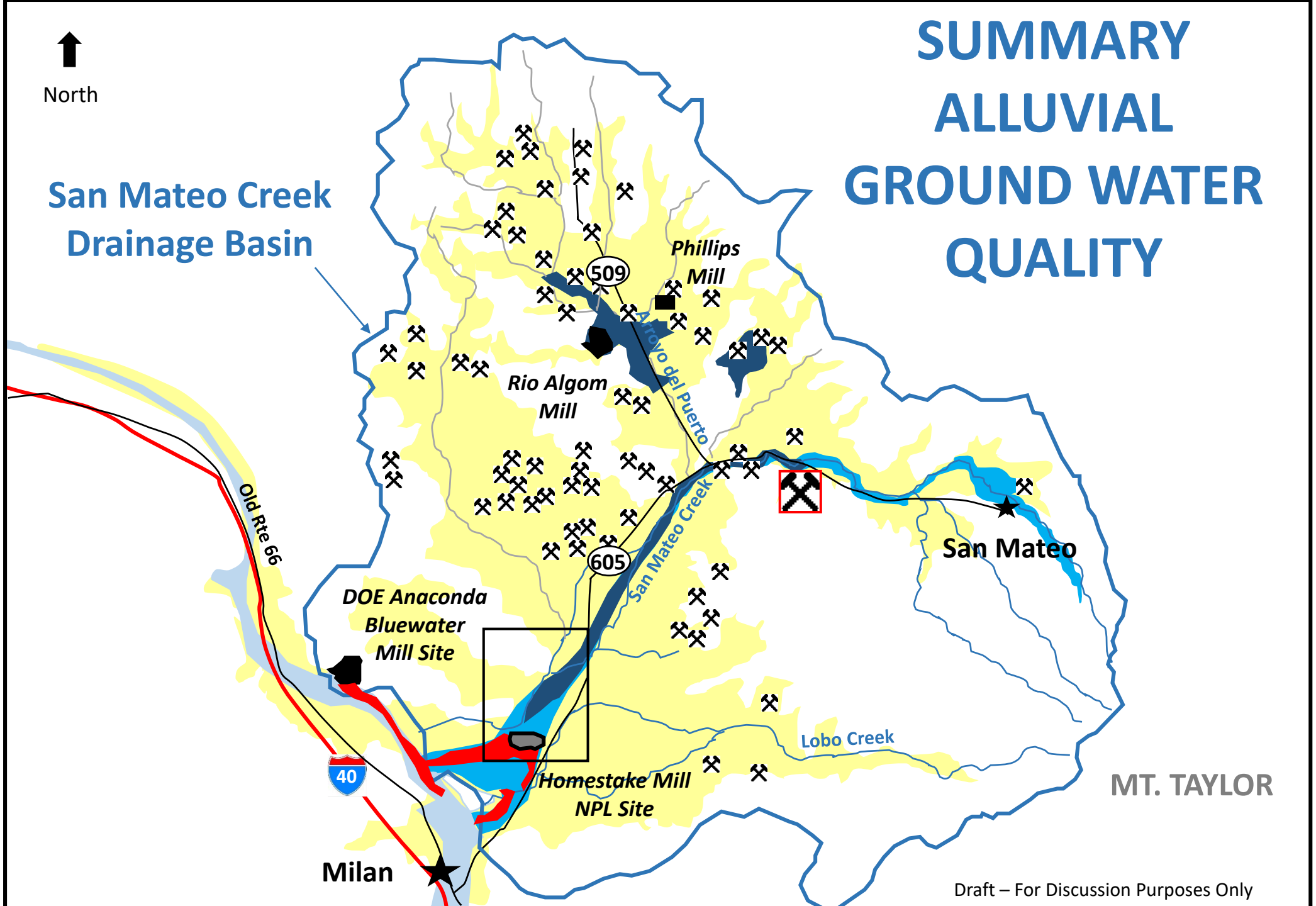
MT. TAYLOR
Draft – For Discussion Purposes Only
Alluvium
SMC Alluvial Ground Water
Rio San Jose Alluvial Ground Water
Mine Discharge Water
Wet Mine

SUMMARY ALLUVIAL GROUND WATER QUALITY



Alluvium

SMC Alluvial Ground Water

Rio San Jose Alluvial Ground Water

Poor Alluvial Water Quality (Exceeds Standards)

Poor Alluvial Water Quality Contaminated by Homestake NPL site and Bluewater DOE site (Exceeds Standards)

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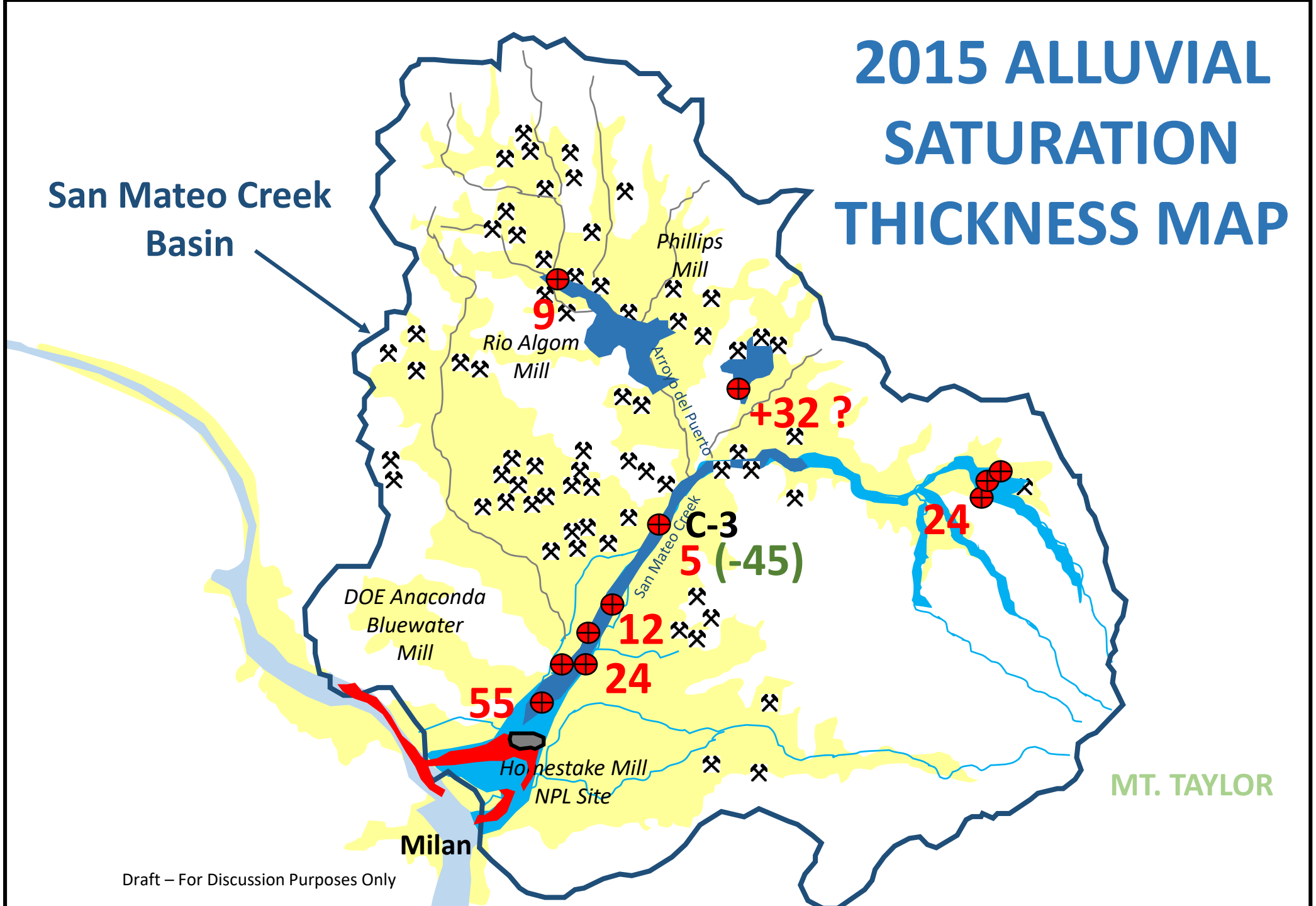
2015 ALLUVIAL SATURATION THICKNESS MAP



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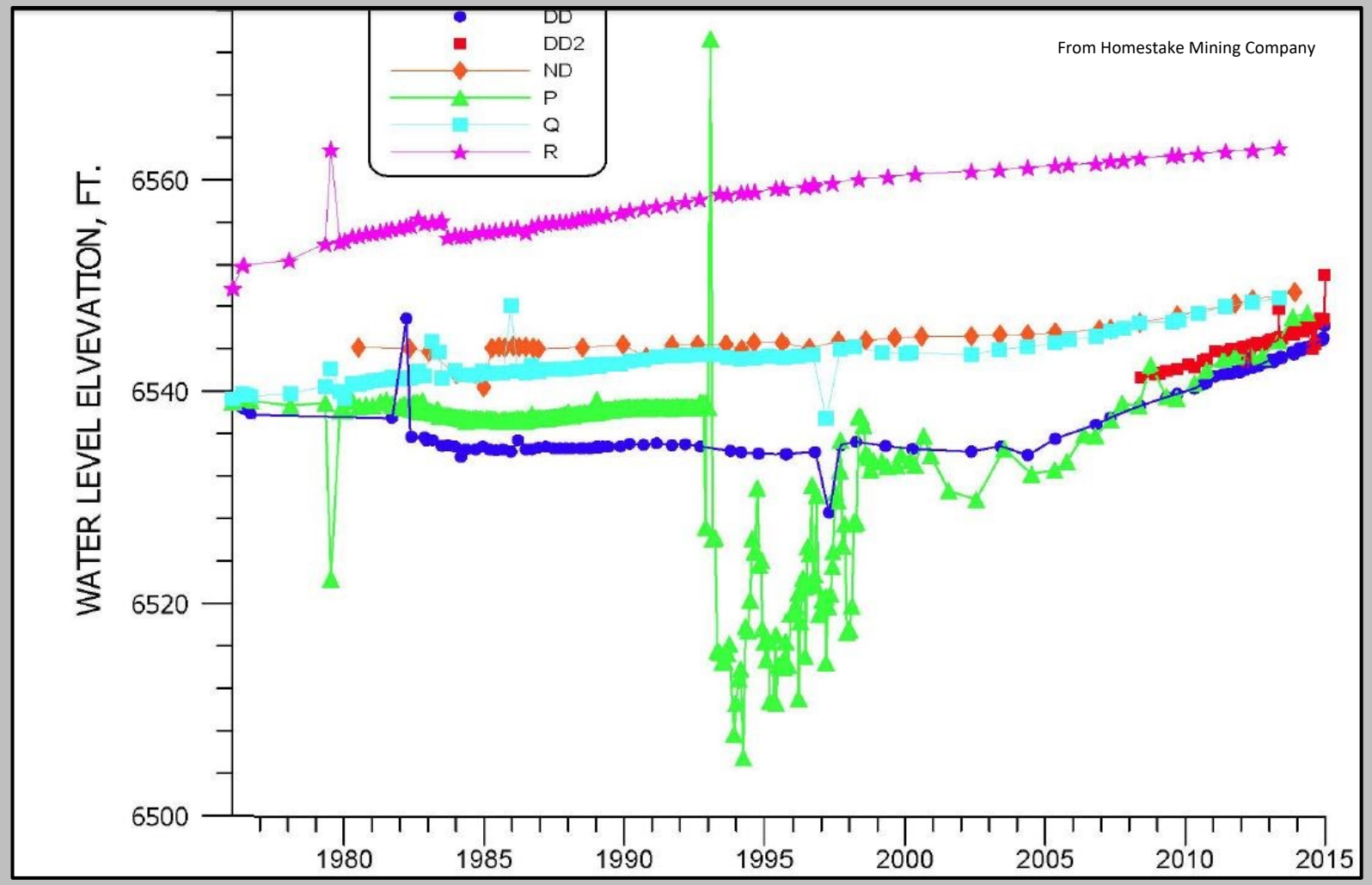
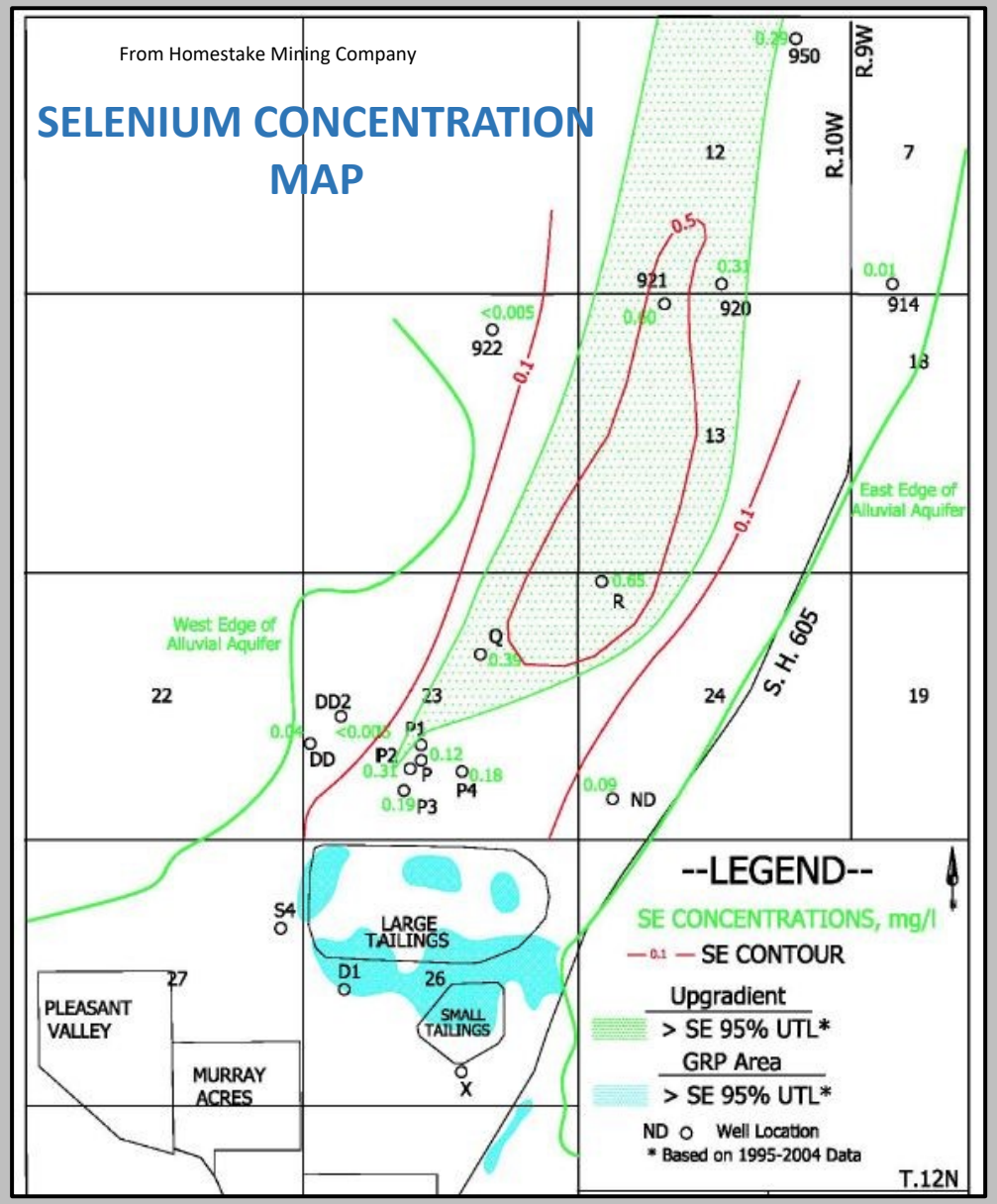
HISTORIC WATER LEVELS

HOMESTAKE NPL SITE



HOMESTAKE NPL SITE



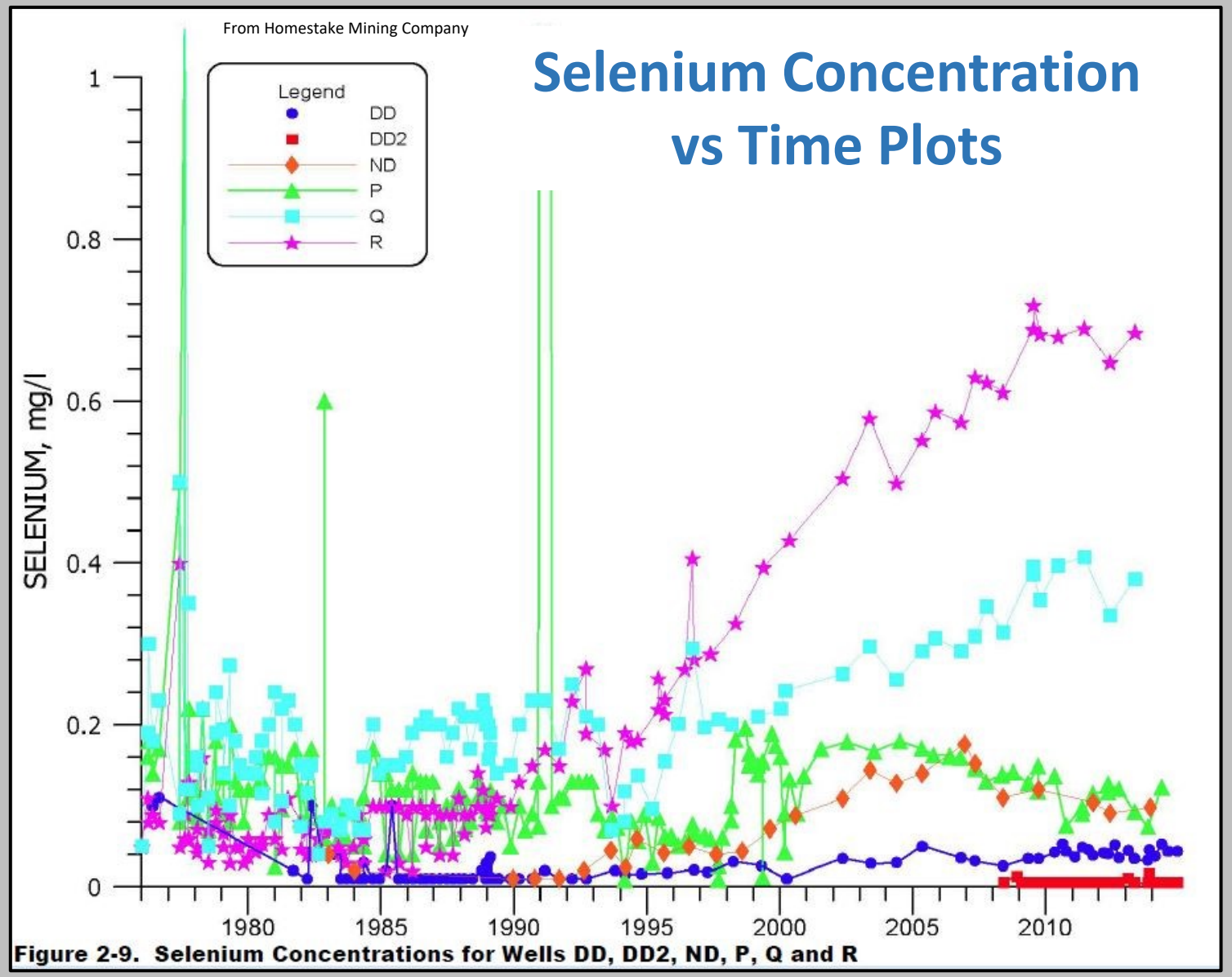


Figure 2-9. Selenium Concentrations for Wells DD, DD2, ND, P, Q and R

CONTAMINANT MASS LOADINGS FROM MINES

1		Section 35 Mine, Ambrosia Lake, NM									
2		Mass of Uranium, Molybdenum, & Selenium discharged from 1960 to 1976 before NPDES treatment required									
3											
4	LOWER MINE WATER DISCHARGE RATE										
5		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
6	URANIUM	1960-1976	850	1,440	1.22	5.25	(5.25 MG/L) X (1.22 MGD) X 8.34 lb/gal	53.59	19561.39	312982.19	156.49
7											
8	MOLYBDENUM	1960-1976	850	1,440	1.22	1.91	(1.91 MG/L) X (1.22 MGD) X 8.34 lb/gal	19.50	7116.62	113865.90	56.93
9											
10	SELENIUM	1960-1976	850	1,440	1.22	0.02	(0.02 MG/L) X (1.22 MGD) X 8.34 lb/gal	0.20	74.52	1192.31	0.60
11											
12											
13	HIGHER MINE WATER DISCHARGE RATE										
14		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
15	URANIUM	1960-1976	2,618	1,440	3.77	5.25	(5.25 MG/L) X (3.77 MGD) X 8.34 lb/gal	165.07	60249.07	963985.13	481.99
16											
17	MOLYBDENUM	1960-1976	2,618	1,440	3.77	1.91	(1.91 MG/L) X (3.77 MGD) X 8.34 lb/gal	60.05	21919.19	350706.97	175.35
18											
19	SELENIUM	1960-1976	2,618	1,440	3.77	0.02	(0.02 MG/L) X (3.77 MGD) X 8.34 lb/gal	0.63	229.52	3672.32	1.84

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