ATTACHMENT OP-4

Plant Drainage Plan

DRAINAGE REPORT

To Accompany Development Plan
For The
Lost Creek ISR Facility

Prepared for:

Ur-Energy
Your Uranium Powerhouse

August 2009

Professional Engineer (Civil)
DARRIN A. TROMBLE
PE-9486
DATE
12/18/09
WYOMING

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Drainage Report for the Lost Creek ISR Facility

This report details the existing and proposed drainage patterns in and around the proposed facilities to be constructed at the Lost Creek mine site. These facilities will include the Process Plant, Drill Shop, and the intersection of the mine access road with the Wamsutter-Crooks Gap Road, Sweetwater County Road 23. The site is located approximately 34 miles north of Wamsutter, Wyoming and approximately 25 miles south of Jeffery City, Wyoming in the area known as the Great Divide Basin.

Existing Topography and Soil Conditions

The topography around the Lost Creek ISR Facility is relatively flat, with gently rolling slopes and small drainages. Existing vegetation around the entire area is native rangeland grasses and sagebrush. In a report by Inberg-Miller Engineers which was provided to us by UR Energy, the bore logs show primarily sandy clay on the surface. Beneath the surface layer is dense sandstone. Cursory geologic reviews indicate the Battle Spring Formation occurs at or near the surface in much of the eastern portion on the Great Divide Basin. The Battle Spring Formation is composed of sandstone, with lesser amounts of clay and mudstone. The Battle Spring Formation has good water-bearing properties, which indicates that its runoff potential would be minimal. Inspection of topographic maps in the subject area indicates minimal topographic relief, with the majority of streams draining to playas.

Process Plant

The proposed Process Plant is located in Section 18, T25N, R92W. The existing topography around the plant generally flows to the south with very gentle slopes. The plant site is located just east of a small swale, with two proposed holding ponds located just east of the process plant in the bottom of the swale. The drainage area of the watershed above the plant site is approximately 350 acres. This drainage area was split into three basins: one basin that will drain to the north and west sides of the process plant, one basin that will drain to the north and east of the process plant between the process plant and holding ponds, and one basin that will drain into a diversion ditch around the east side of the holding ponds. The delineated drainage basins have been included on Sheet 1 of 7 of the Drainage Plan exhibits.

The existing drainage patterns will remain basically unchanged after construction of the process plant and holding ponds. The process plant itself will be constructed on a flat and level pad, with the surrounding parking and access areas sloping away from the building in all directions. The shop will be constructed on a flat and level pad to the north of the process plant. Drainage ditches will be constructed around the parking and access area to intercept and redirect runoff from the adjacent lands around and away from the building. The majority of runoff intercepted by the process plant will be coming form the northwest. Once intercepted by the ditches around the building, these flows will be diverted to the south until they have moved beyond the plant. Runoff in the swale upstream of the holding ponds will be diverted to flow around the holding ponds to the east, then return to the original flow path directly south of the holding ponds.

All drainage basin calculations used the curve number 70, minimum infiltration rate of 0.15 in/hr, adjusted minimum infiltration rate of 2.2”, 25 yr SCS Type II 24 hr-general storm. All ditch and culvert channel slopes are 0.005 ft/ft. Tables 1 and 2 show calculated values and geometric parameters for the drainage basins, ditches, and one culvert around the process plant, shop, and holding ponds:

Table 1 Process Plant Area Drainage Basins

BASIN	MI^2	MI	FT	CFS	AC-FT
	DRAINAGE AREA	WATERCOURSE LENGTH	ELEV. DIFF.	PEAK DISCHARGE	RUNOFF VOLUME
PROCESS PLANT	0.0500	0.42	40	7.57	0.33
BETWEEN PLANT & PONDS	0.0070	0.21	15	1.93	0.07
POND AREA	0.4900	1.16	80	39.83	3.23

Table 2 Process Plant Area Ditches and Culvert Size

DESCRIPTION	FT:FT	FT:FT	FT	FT	IN
	LEFT SLOPE	RIGHT SLOPE	BOTTOM WIDTH	MIN. DEPTH	DIAMETER
NORTH & WEST PROCESS PLANT DITCH	5:1	3:1	5	2.0	
EMERGENCY ACCESS RD CULVERT					24
DITCH BETWEEN PLANT AND PONDS	3:1	4:1	0	1.5	
DIVERSION DITCH	3:1	3:1	10	3.0	

The emergency access road will intersect with the access road approximately 300’ south of the gate, and will require a 24” corrugated metal pipe (CMP) culvert to pass the stormwater runoff from the north and west process plant ditch and the land area encompassed by the two roads. This intersection and culvert are not shown on the drainage plan sheets.

Drill Shop

The proposed drill shop is also located in Section 18, approximately 2000’ south of the Process Plant. The drill shop will be constructed on top of a gently sloping ridge, just east of the swale where the holding ponds are located. There is no significant watershed above the drill shop, as surface runoff will tend to travel off either side of the ridge to the east and west. No significant change in drainage patterns is anticipated once construction of the drill shop and adjacent staging area has been completed. The topsoil will be stripped around the drill shop and staging area, and gravel will be placed in the staging area yard. A small foundation pad for the drill shop will be constructed. It will be elevated above the surrounding area by a minimum of one foot, with 3:1 or flatter fill slopes on all sides.

The drainage area for the drill shop culvert is approximately 0.0006 mi^2 with an elevation difference of 10’ and a watercourse length of 0.1 mi. This basin creates a peak discharge of 0.15 cfs that will be transmitted through a culvert beneath the approach. Using open channel flow hydraulics and an estimated slope of 0.0045 ft/ft, a 12” CMP culvert will have adequate capacity to convey runoff from the 25-yr event.

Wamsutter Road Intersection with Lost Creek ISR Facility Access Road

A proposed access road to the Lost Creek ISR facility will be constructed from County Road 23, also known as the Wamsutter-Crooks Gap Road. A separate road design for this access road has been prepared. This report only pertains to the drainage around the intersection approach of these two roads. The access road intersection will be located in Section 16, T25N R93W. The existing Wamsutter-Crooks Gap Road runs basically north-south, with the proposed access road running east-west. Surface runoff in the area around this intersection flows generally from east to west, and is intercepted by the Wamsutter-Crooks Gap Road. The grade of the Wamsutter-Crooks Gap Road flows towards the north, although there is a small swale located just south of the proposed intersection.

Existing drainage patterns will remain unchanged after construction of the access road approach. Construction of this road will only change the location where runoff from this basin is intercepted by the Wamsutter-Crooks Gap Road. The only increase in runoff may occur from the difference in impervious soils between existing soils and the proposed roadway surface. Pre developed runoff estimates for the basin have been estimated at 2.47 cfs and 0.07 ac-ft; while post development increases are only estimated to be an additional 0.225 cfs and 0.013 ac-ft. The drainage area for the intersection is approximately 0.005 mi^2 with an elevation difference of 7' and a watercourse length of 0.1 mi. An 18" CMP culvert will be placed under the approach, and will convey the calculated 2.47 cfs runoff from the north side of the existing fence line under the approach where it will flow north in the borrow ditch along the Wamsutter-Crooks Gap Road, as it does currently.

No changes will occur to the drainage patterns or the drainage areas south of the access road approach after construction of the access road. Runoff south of the existing fence line will be intercepted by the borrow ditch and will flow south to the existing swale where it will collect on the east side of Wamsutter road. It should be noted that there was not an existing culvert visible under the Wamsutter-Crooks Gap Road to convey this runoff to the west side of the road, where it could continue flowing west in the existing drainage channel.

ATTACHMENT A

HYDRAULIC CALCULATIONS

Trihydo-98

UR Energy Drill Shop Culvert Basin
SCS Type II, 24-Hour General Storm
25-Year Return Period

Basin Characteristics	
Drainage Area (A)	0.0006 square miles
Stream Length of Longest Watercours	0.100 miles
Elevation Difference of Watercourse	10.000 feet
Runoff Curve Number (CN)	70.000
Minimum Infiltration Loss (iph) inches/hour	0.150
Precipitation for Specified Storm	
Adjusted Precipitation for Selected	2.200 inches
Resultant Hydrograph Values	
Peak Discharge	0.20 cfs
Runoff Volume	0.00 acre-feet
Time to Peak Discharge	12.00 hours
Time of Concentration	0.01 hours

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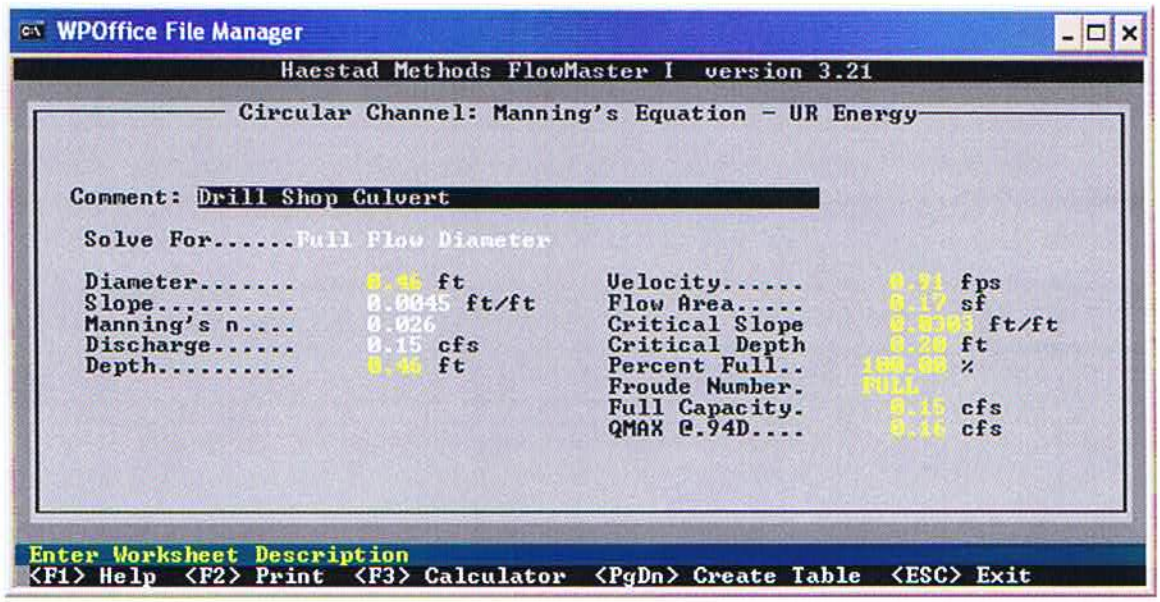

A 12" CMP culvert will suffice since 75% of the Peak Discharge can be passed by a CMP culvert less than 6" in diameter on a very flat slope. The 12" diameter culvert has 4 times to area to pass the flow.

Trihydo-98

UR Energy Process Plant
SCS Type II, 24-Hour General Storm
25-Year Return Period

Basin Characteristics	
Drainage Area (A)	0.050 square miles
Stream Length of Longest Watercours	0.420 miles
Elevation Difference of Watercourse	40.000 feet
Runoff Curve Number (CN)	70.000
Minimum Infiltration Loss (iph) inches/hour	0.150
Precipitation for Specified Storm	
Adjusted Precipitation for Selected	2.200 inches
Resultant Hydrograph Values	
Peak Discharge	7.57 cfs
Runoff Volume	0.33 acre-feet
Time to Peak Discharge	12.22 hours
Time of Concentration	0.32 hours

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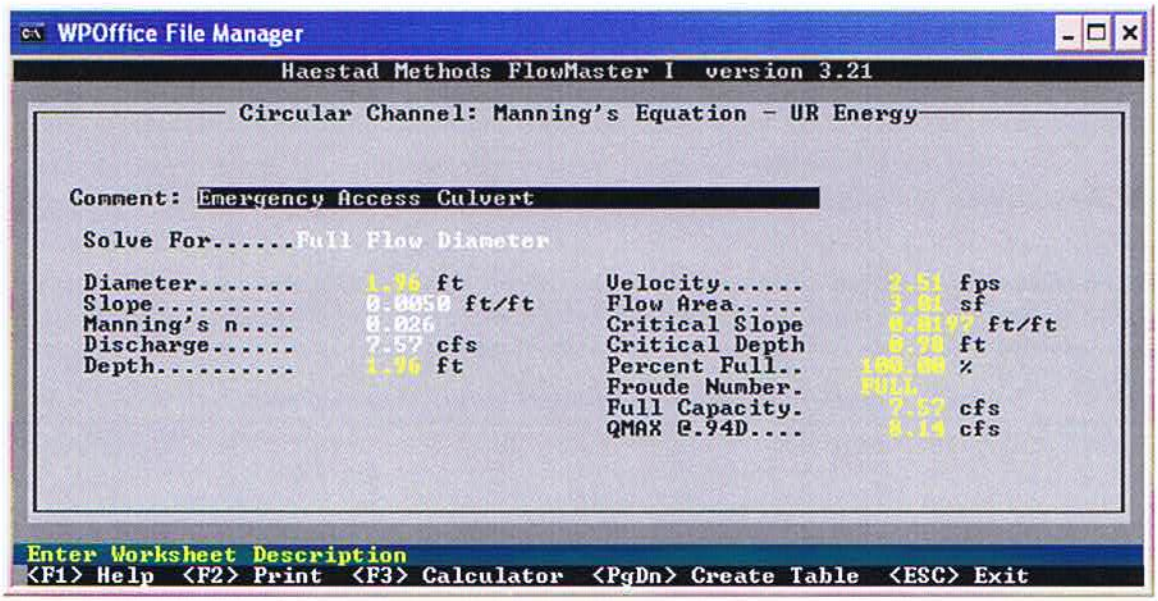
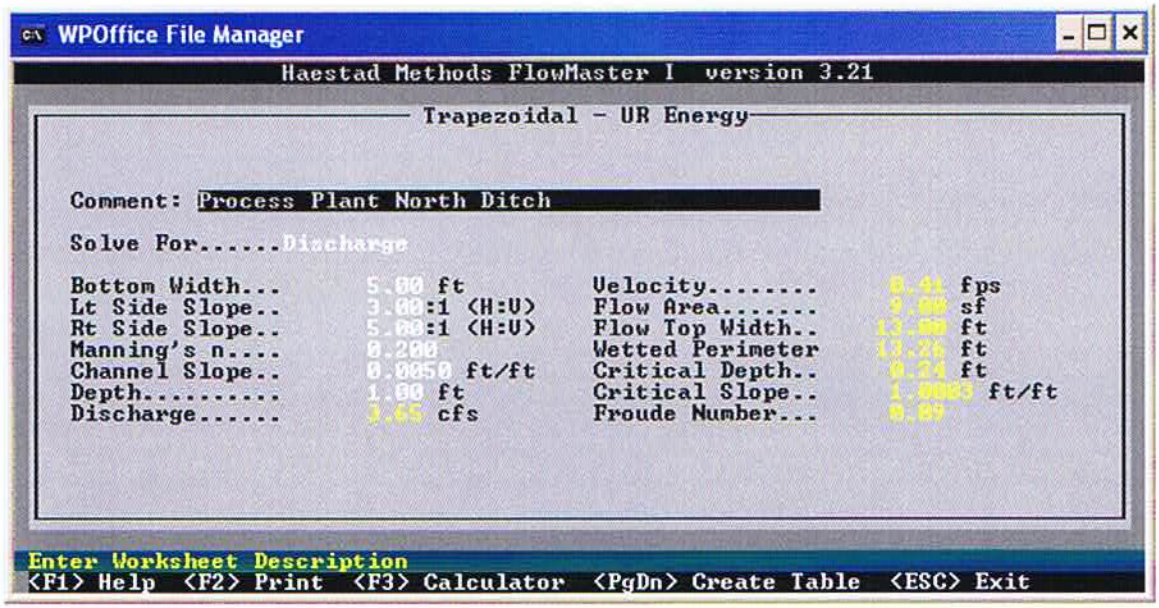


Need at least a 2 ft CMP culvert to handle the flow under the emergency access road near the Process Plant.



This is new ditch geometry to keep the 25 yr event from approaching the building. Use for North and West ditches. A relatively large portion of the basin flows into the West ditch, so it is assumed that this 1 ft depth conveying approximately half of the 7.57 cfs will suffice for the North ditch.

Trihydo-98

UR Energy Wamsutter Road Approach
SCS Type II, 24-Hour General Storm
25-Year Return Period

Basin Characteristics	
Drainage Area (A)	0.010 square miles
Stream Length of Longest Watercours	0.100 miles
Elevation Difference of Watercourse	7.000 feet
Runoff Curve Number (CN)	70.000
Minimum Infiltration Loss (iph) inches/hour	0.150
Precipitation for Specified Storm	
Adjusted Precipitation for Selected	2.200 inches
Resultant Hydrograph Values	
Peak Discharge	2.47 cfs
Runoff Volume	0.07 acre-feet
Time to Peak Discharge	12.04 hours
Time of Concentration	0.12 hours

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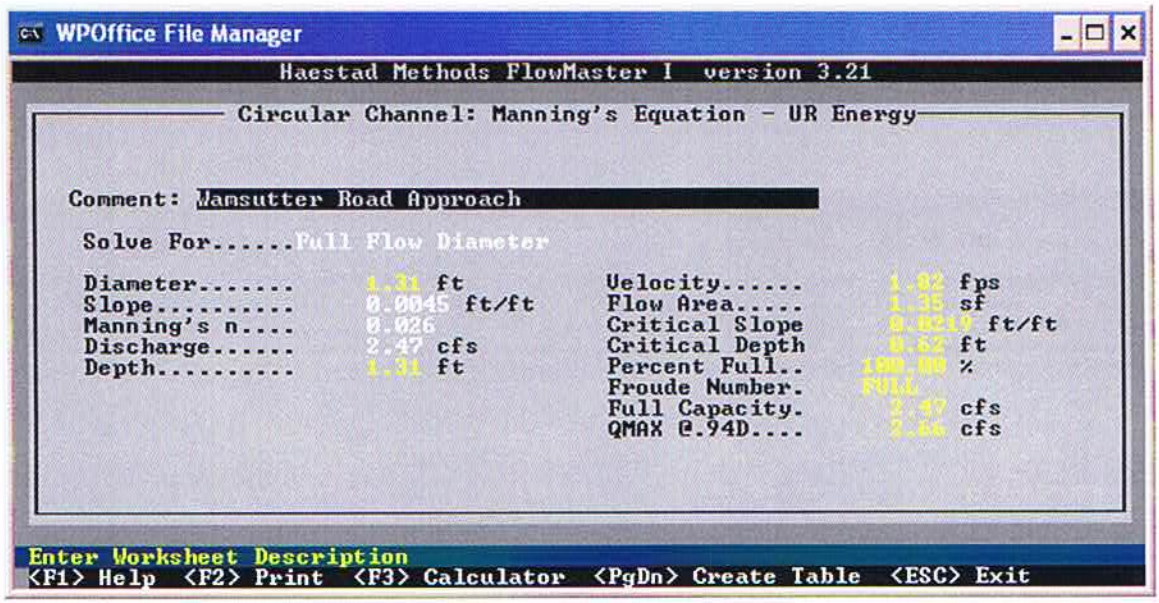

18" CMP will suffice.

Trihydo-98

UR Energy Pond Area
SCS Type II, 24-Hour General Storm
25-Year Return Period

Basin Characteristics	
Drainage Area (A)	0.490 square miles
Stream Length of Longest Watercours	1.160 miles
Elevation Difference of Watercourse	80.000 feet
Runoff Curve Number (CN)	70.000
Minimum Infiltration Loss (iph) inches/hour	0.150
Precipitation for Specified Storm	
Adjusted Precipitation for Selected	2.200 inches
Resultant Hydrograph Values	
Peak Discharge	39.83 cfs
Runoff Volume	3.23 acre-feet
Time to Peak Discharge	12.63 hours
Time of Concentration	0.80 hours

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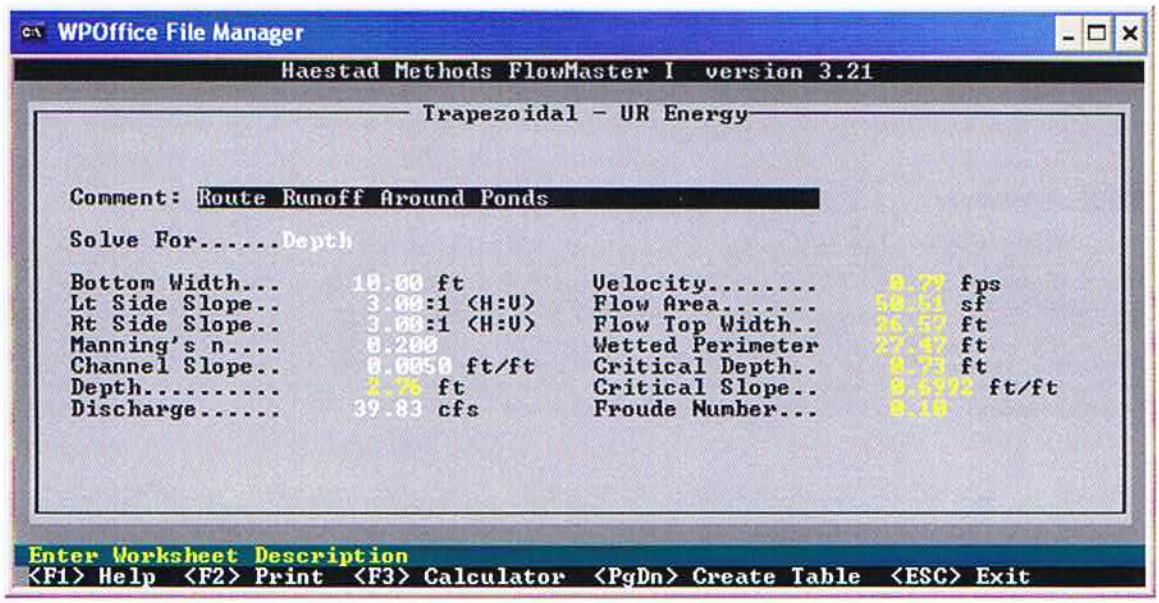

Need about a 3 ft deep trapezoidal channel with the above dimensions to route the natural drainage around the ponds in the Diversion Ditch.

Trihydo-98

UR Energy Ditch Between Process Plant & Ponds
SCS Type II, 24-Hour General Storm
25-Year Return Period

Basin Characteristics	
Drainage Area (A)	0.010 square miles
Stream Length of Longest Watercours	0.210 miles
Elevation Difference of Watercourse	15.000 feet
Runoff Curve Number (CN)	70.000
Minimum Infiltration Loss (iph)	0.150
inches/hour	
Precipitation for Specified Storm	
Adjusted Precipitation for Selected	2.200 inches
Resultant Hydrograph Values	
Peak Discharge	1.93 cfs
Runoff Volume	0.07 acre-feet
Time to Peak Discharge	12.10 hours
Time of Concentration	0.21 hours

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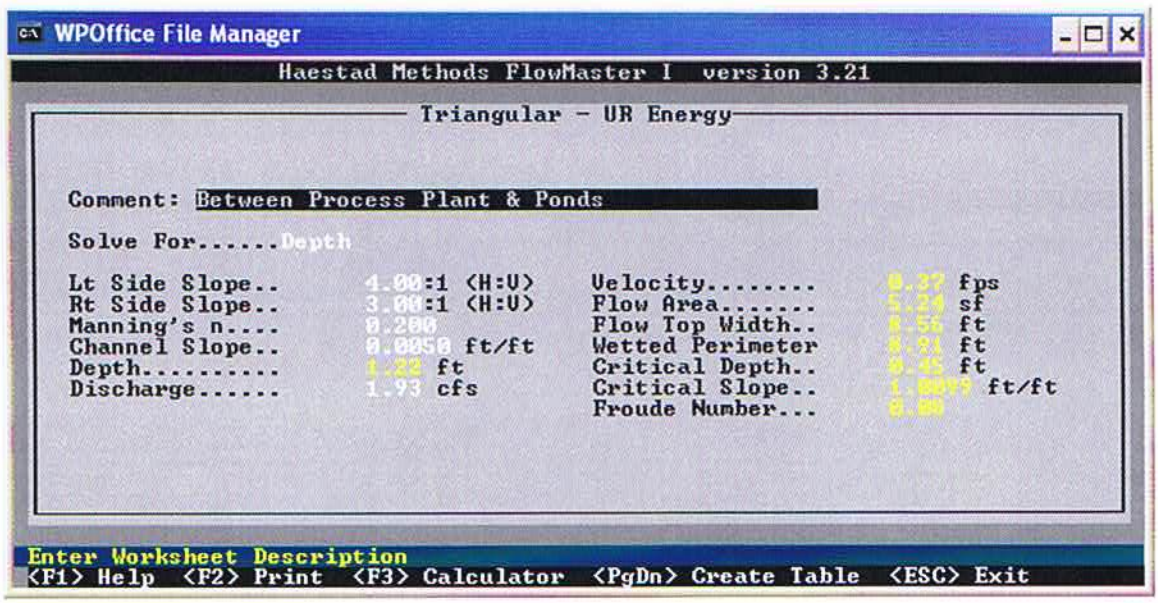
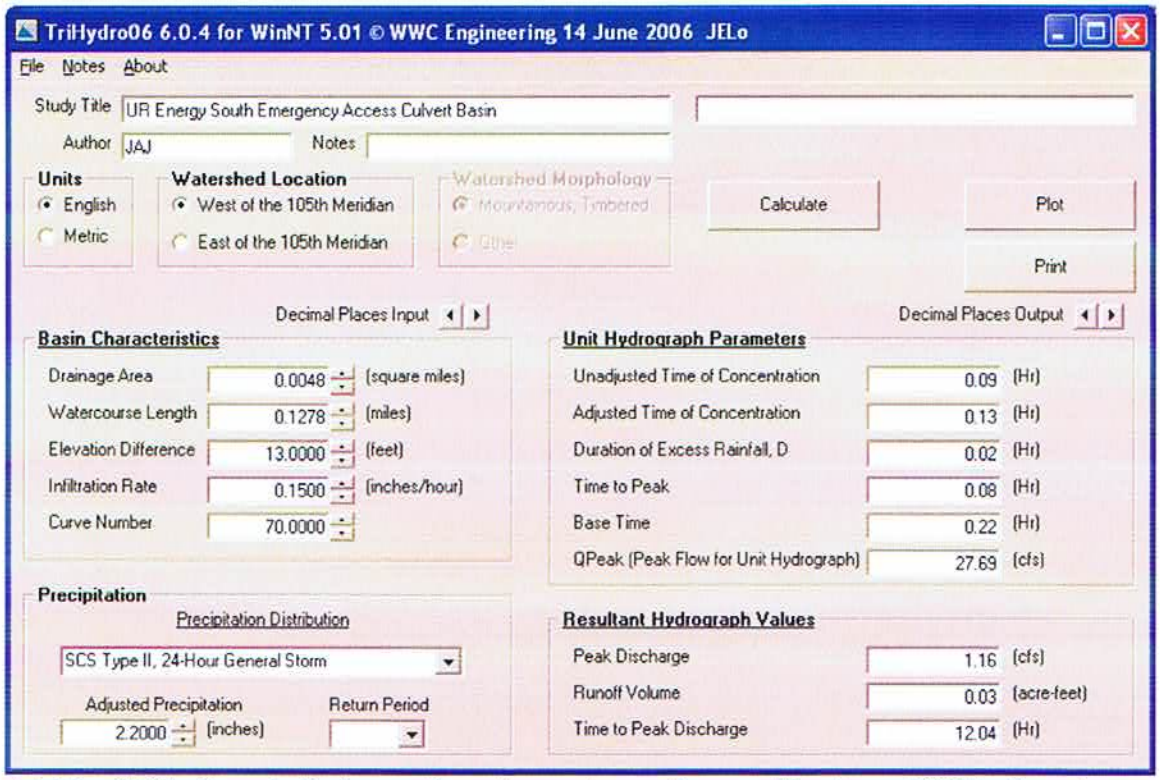
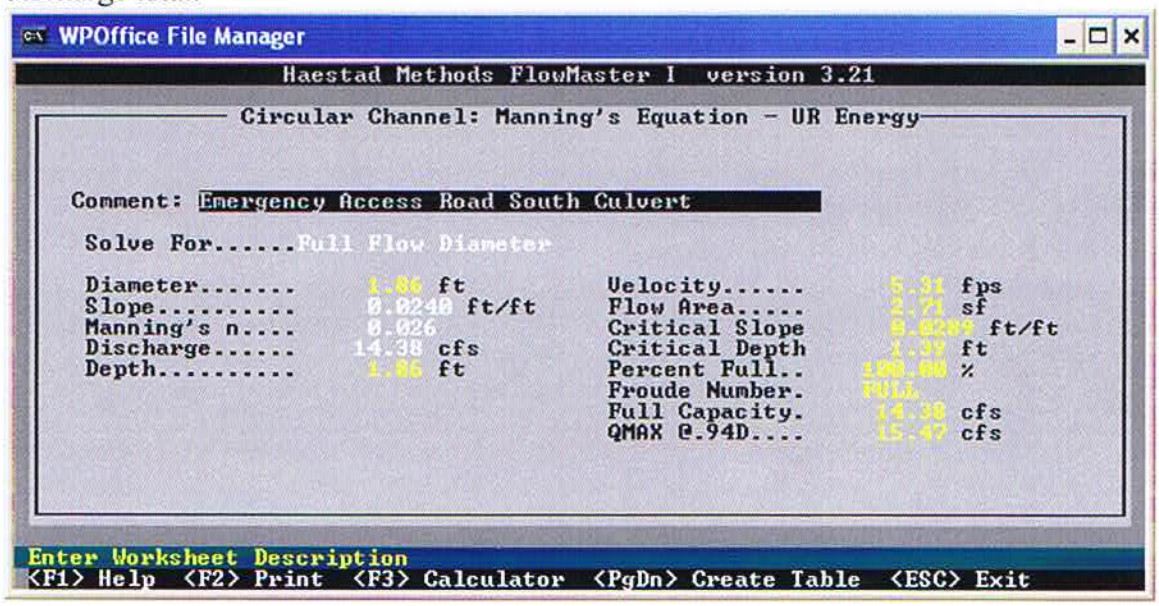


Need 1.25 ft deep ditch between Process Plant and Ponds to contain the runoff.



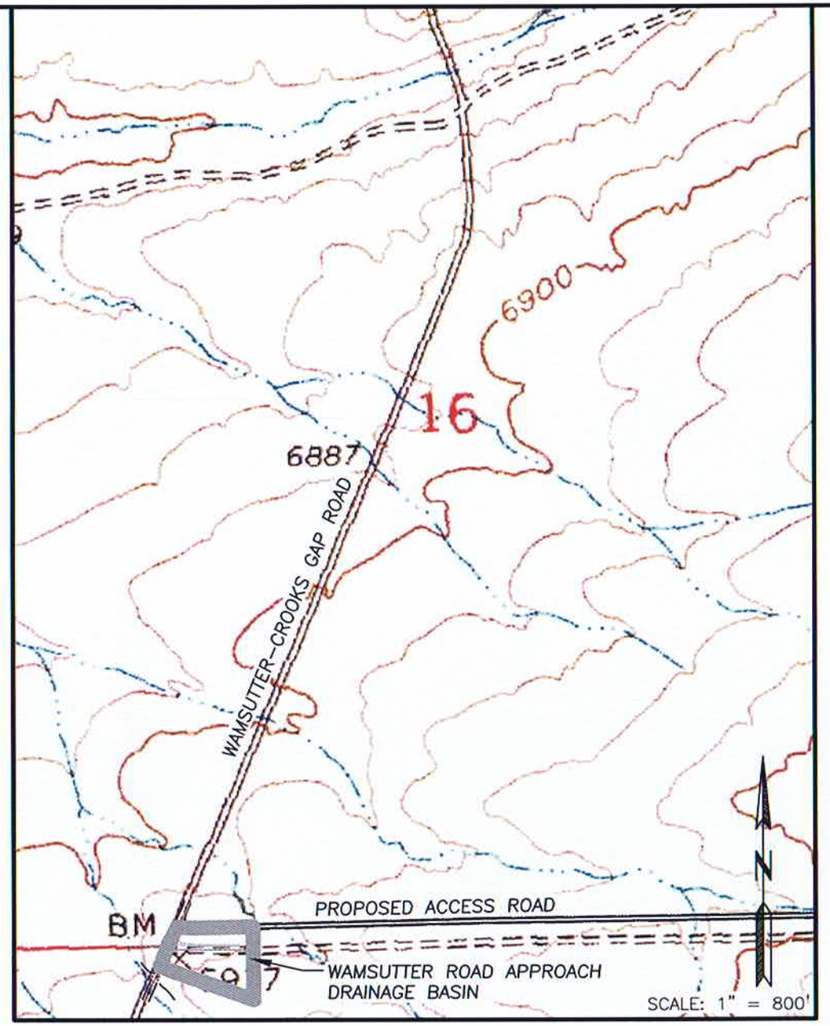
Add the 7.57 cfs peak discharge from the upstream Process Plant to get 8.71 cfs peak discharge total.

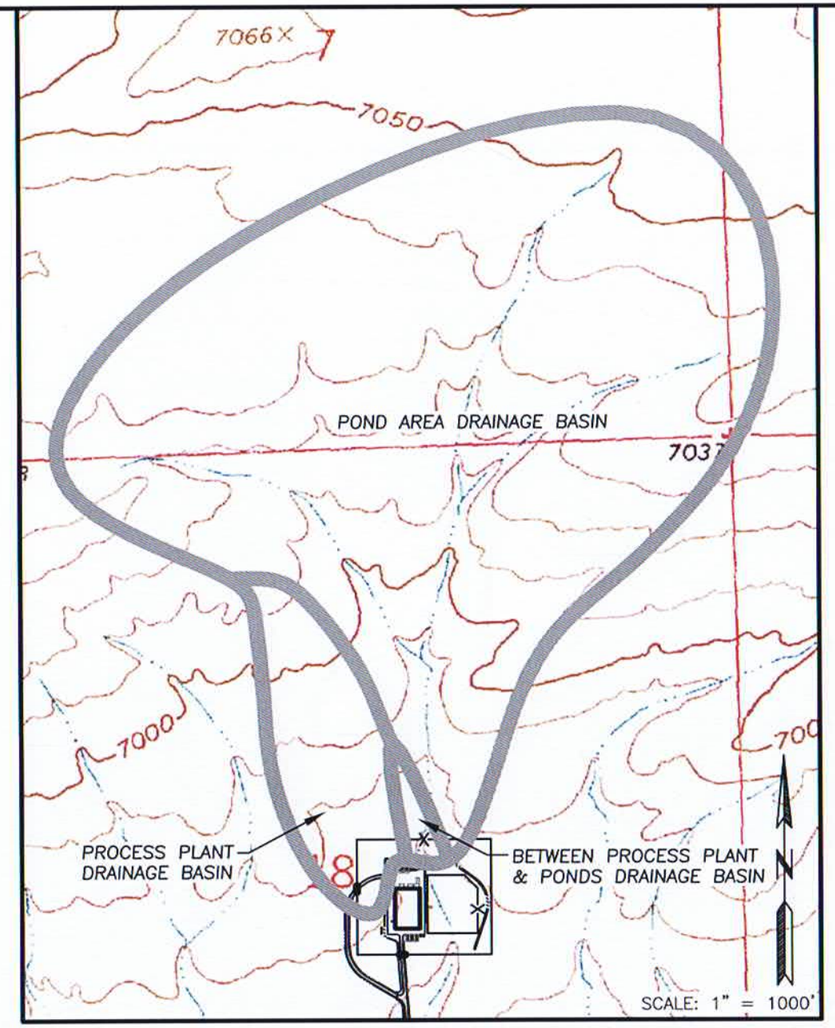


Need at least a 2 ft CMP culvert to handle the flow under the emergency access road south of the Process Plant. The 2 ft CMP can pass much more than 8.71 cfs.

ATTACHMENT B

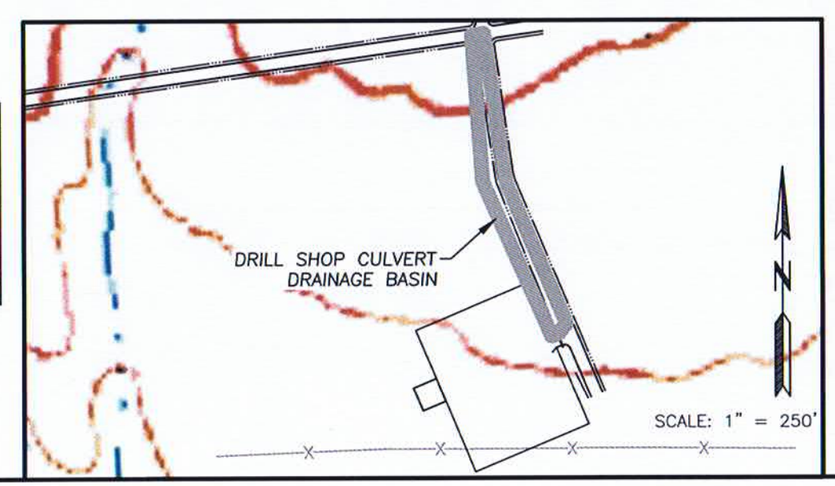
DRAWINGS





LEGEND:

DRAINAGE BASIN BOUNDARY



BASIN	MI^2 DRAINAGE AREA	MI WATERCOURSE LENGTH	FT ELEV. DIFF.	CFS PEAK DISCHARGE	AC-FT RUNOFF VOLUME
PROCESS PLANT	0.0500	0.42	40	7.57	0.33
BETWEEN PLANT & PONDS	0.0070	0.21	15	1.93	0.07
POND AREA	0.4900	1.16	80	39.83	3.23
WAMSUTTER ROAD APPROACH	0.0050	0.10	7	2.47	0.07
DRILL SHOP CULVERT	0.0006	0.10	10	0.15	0.00

NOTE:

PEAK DISCHARGE AND RUNOFF VOLUME CALCULATED USING TRIHYDRO-98 FOR 25 YR 24 HR EVENT
PIPE SIZES WERE CALCULATED USING PEAK DISCHARGES FROM TRIHYDRO IN FLOWMASTER

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PE-9486
DATE 12-18-09
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UR ENERGY

DRAINAGE PLAN
DRAINAGE AREAS
SHEET 1 OF 7

REVISIONS
Date By

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Casper, WY 82609
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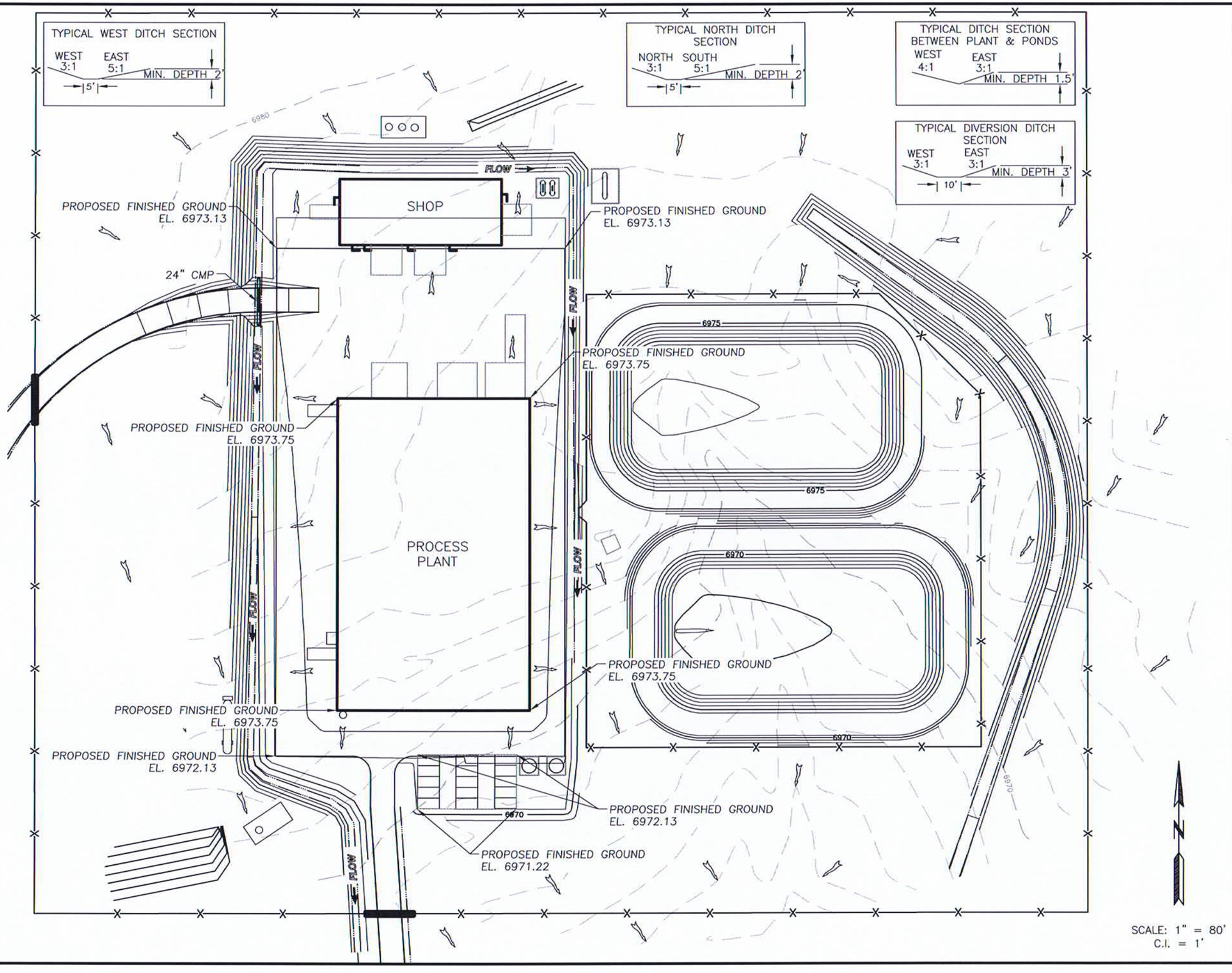

LEGEND:

- PROPOSED DRAINAGE DITCH AND DIRECTION OF FLOW (FLOW)
- EXISTING DRAINAGE FLOW DIRECTION
- FINISHED GROUND CONTOUR
- EXISTING GROUND CONTOUR

DRAINAGE FROM THIS PROPERTY WILL NOT ADVERSELY AFFECT ADJACENT PROPERTY OWNERS.

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UR ENERGY

DRAINAGE PLAN
PROCESS PLANT
SHEET 2 OF 7

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08/09	JAJ

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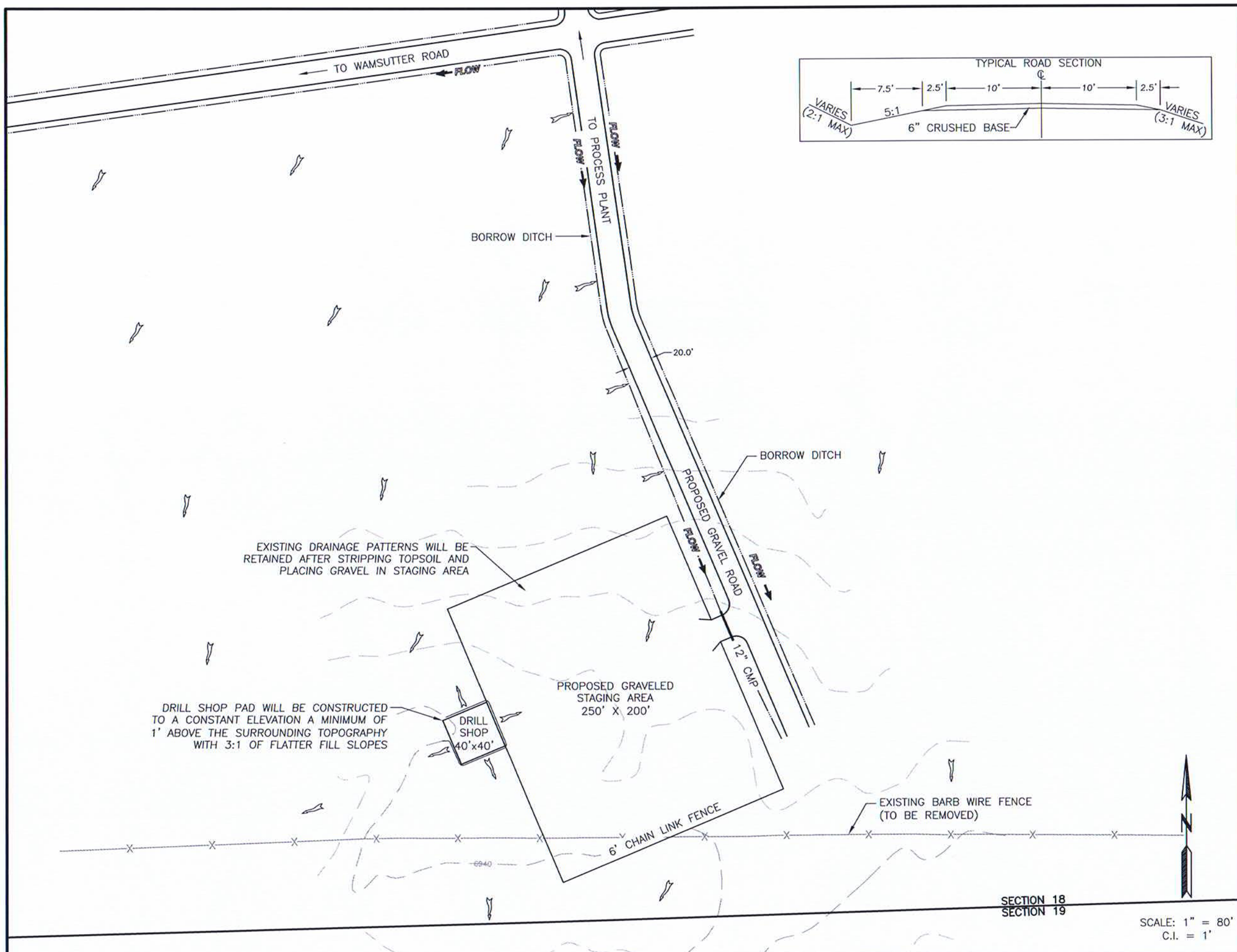

TYPICAL ROAD SECTION

LEGEND:

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- EXISTING DRAINAGE FLOW DIRECTION
- FINISHED GROUND CONTOUR
- EXISTING GROUND CONTOUR

DRAINAGE FROM THIS PROPERTY WILL NOT ADVERSELY AFFECT ADJACENT PROPERTY OWNERS.

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DRAINAGE PLAN
DRILL SHOP
SHEET 3 OF 7

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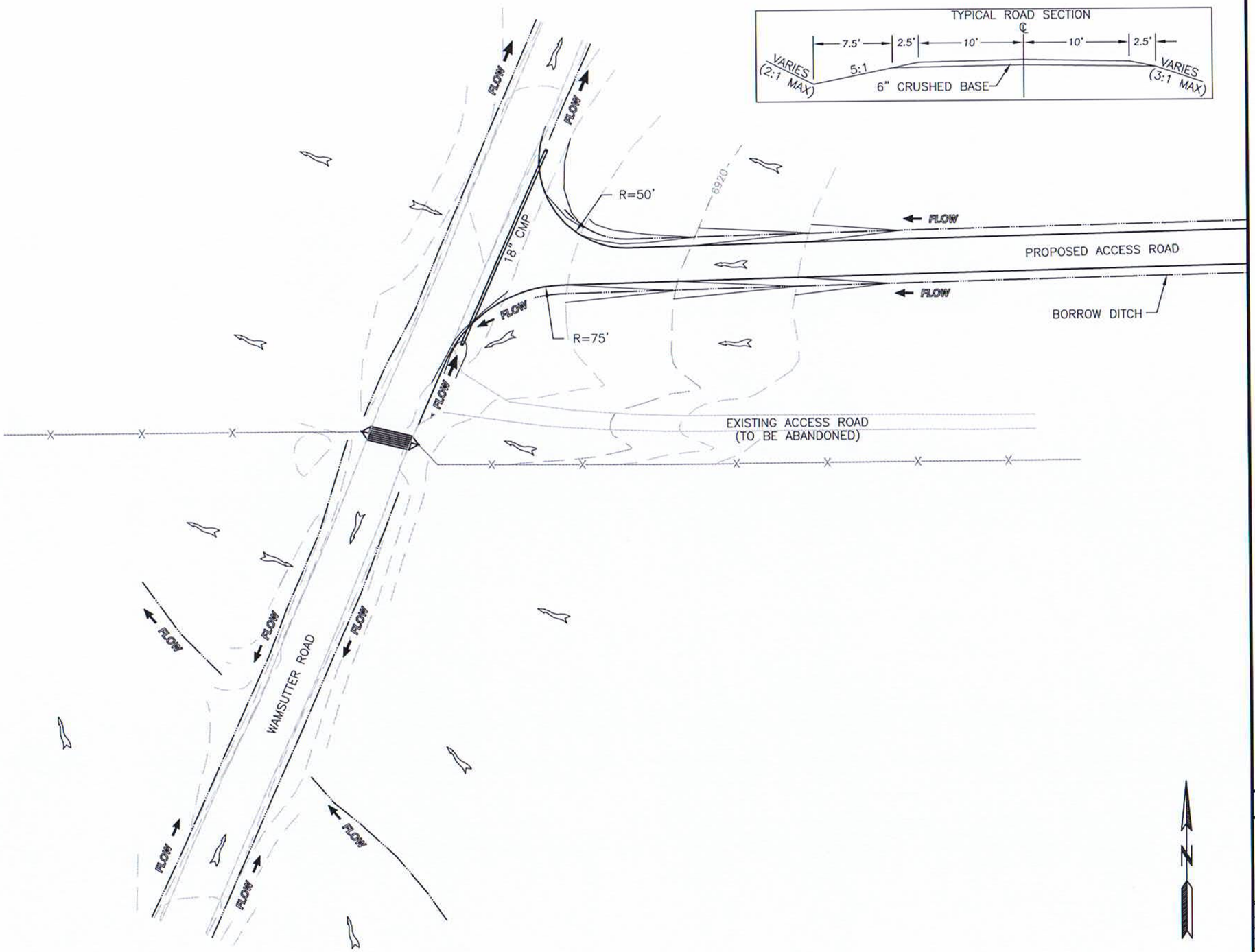

LEGEND:

- PROPOSED DRAINAGE DITCH AND DIRECTION OF FLOW
- EXISTING DRAINAGE FLOW DIRECTION
- FINISHED GROUND CONTOUR
- EXISTING GROUND CONTOUR

DRAINAGE FROM THIS PROPERTY WILL NOT ADVERSELY AFFECT ADJACENT PROPERTY OWNERS.

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SCALE: 1" = 60'
C.I. = 1'

UR ENERGY

DRAINAGE PLAN
WAMSUTTER ROAD APPROACH
SHEET 4 OF 7

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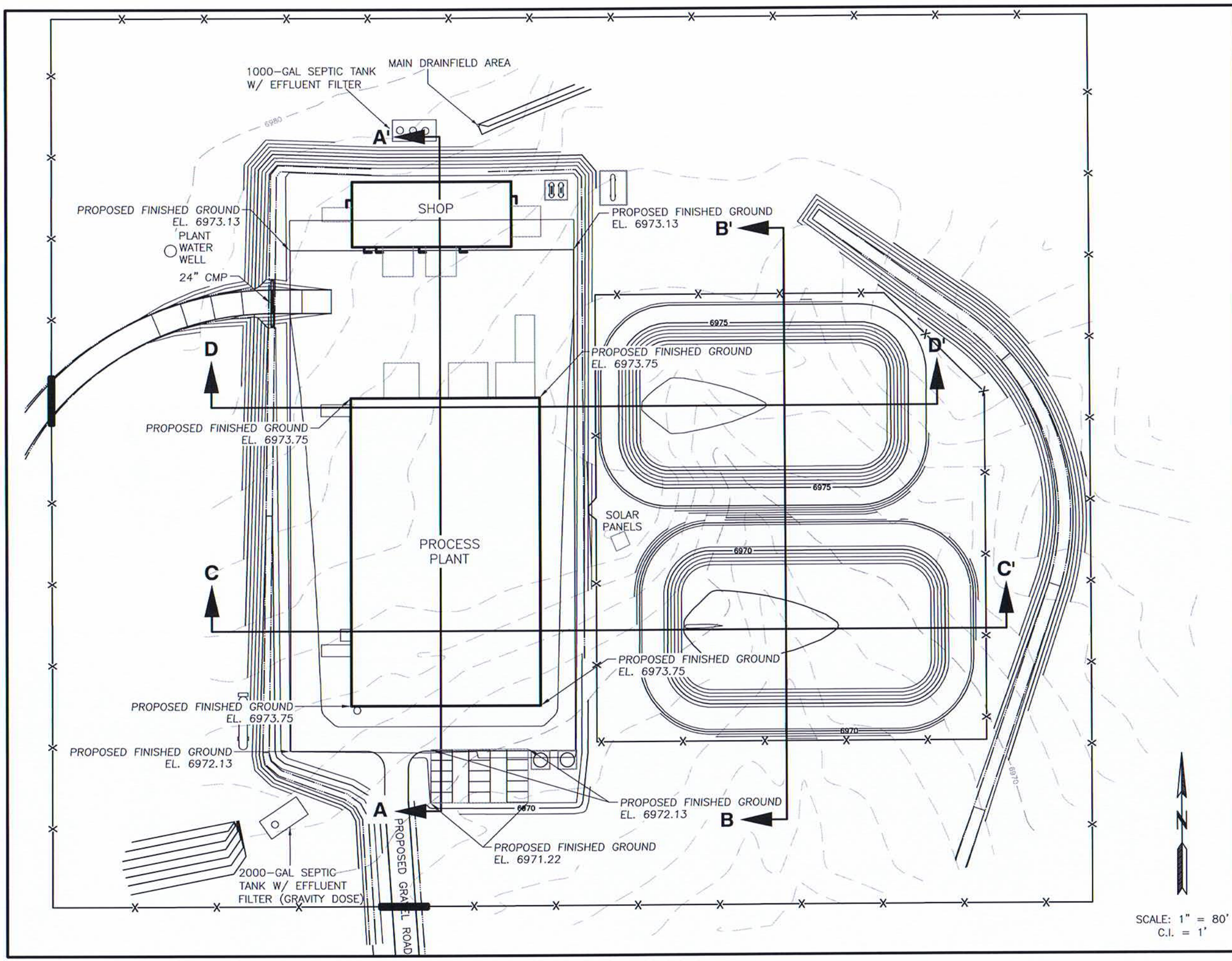

LEGEND:

FINISHED GROUND CONTOUR

EXISTING GROUND CONTOUR

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UR ENERGY

DRAINAGE PLAN
PROCESS PLANT SITE PLAN
SHEET 5 OF 7

REVISIONS	
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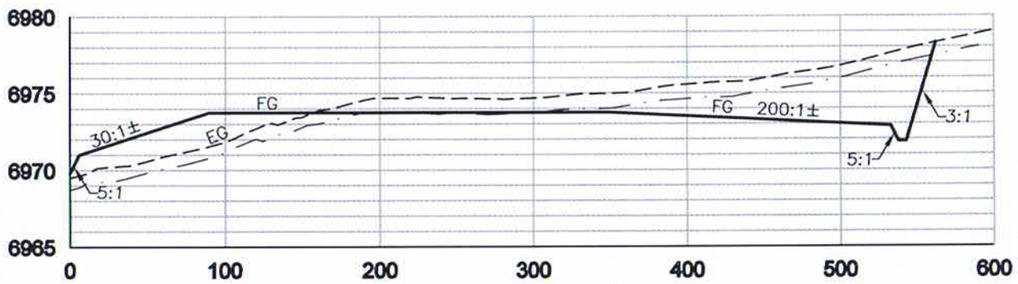
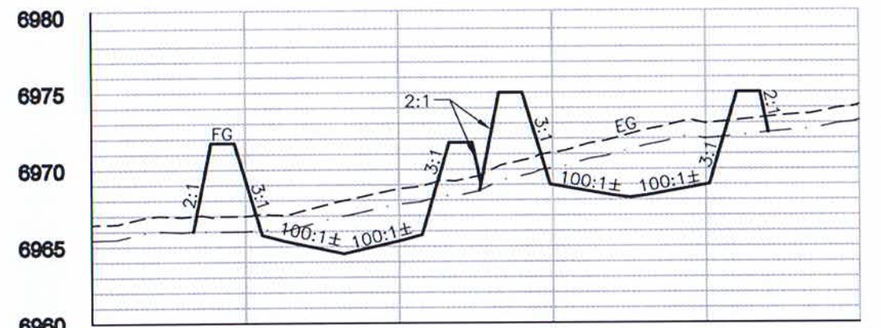


PROFILE A–A'



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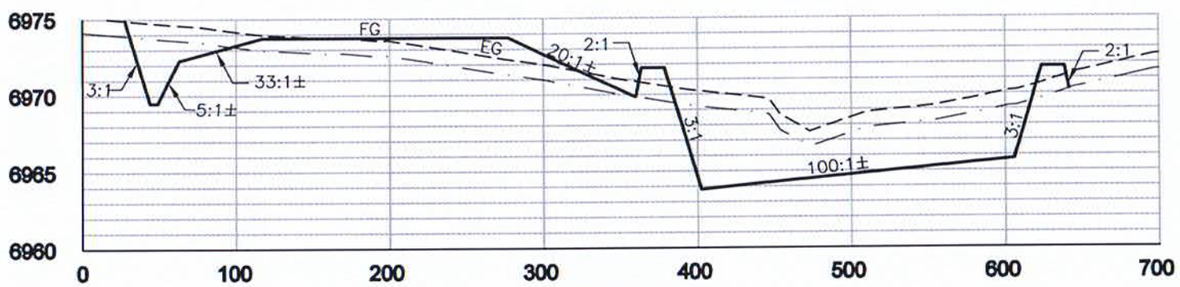

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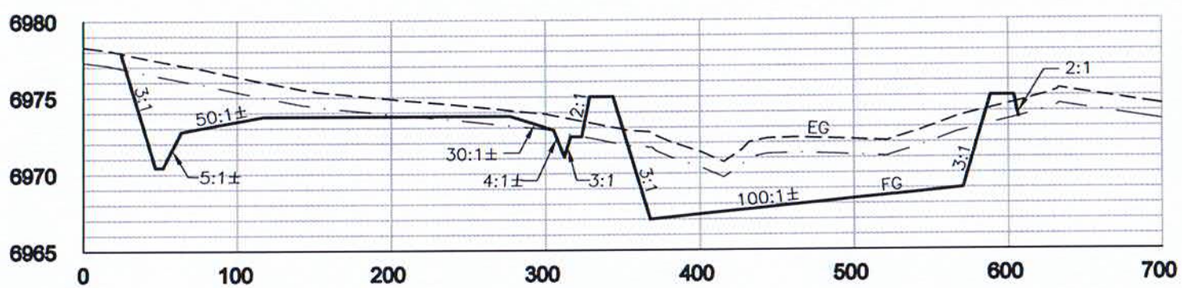

PROFILE D–D

HORIZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 10'

LEGEND:

- EXISTING GROUND SURFACE
- 1' TOPSOIL REMOVAL SURFACE
- FINISHED GROUND SURFACE

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DRAINAGE PLAN
PROCESS PLANT SITE PLAN
SHEET 6 OF 7

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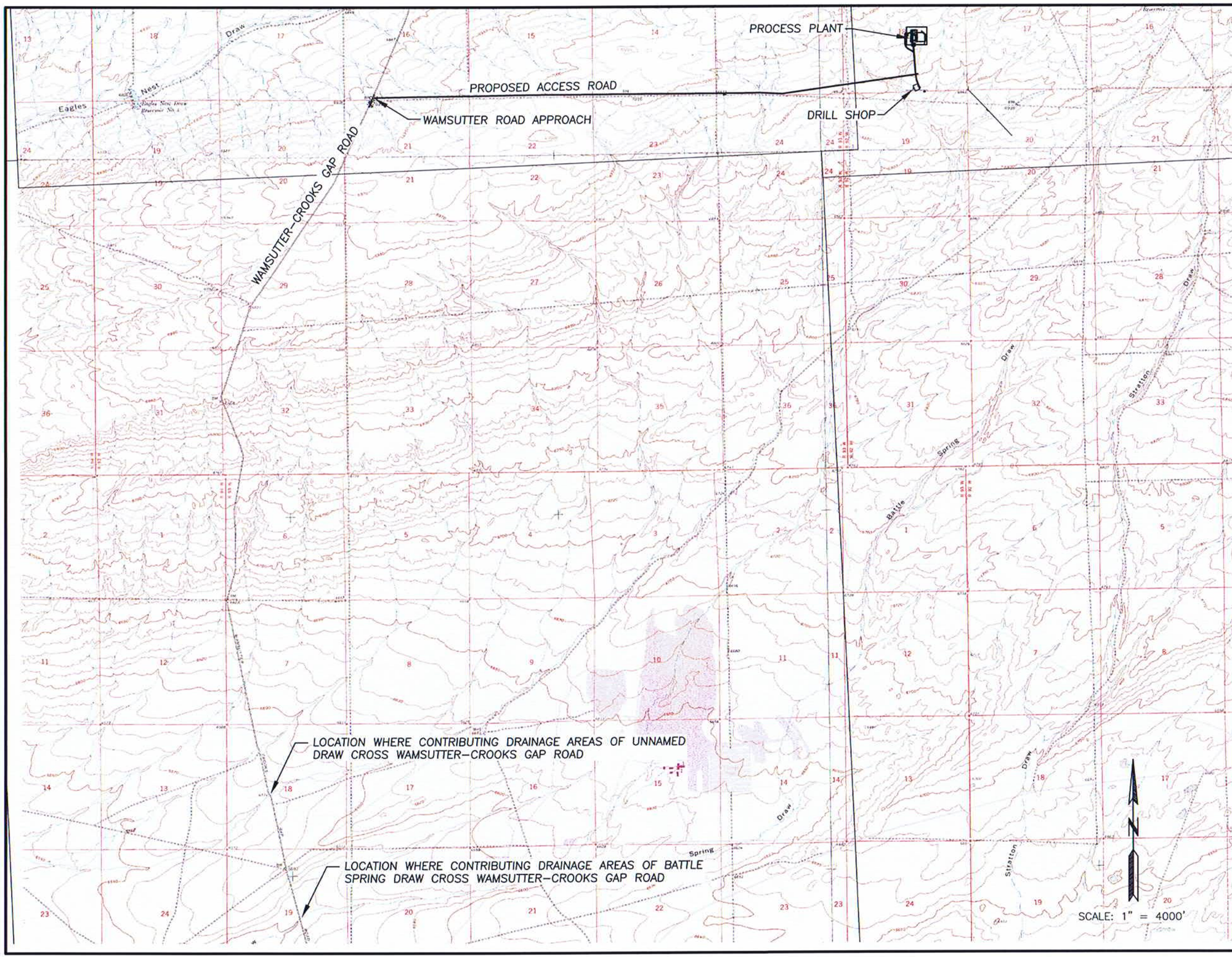

UNNAMED DRAW

APPROX. AREA OF ROAD IMPROVEMENTS = 0.007 MI^2

PREDEVELOPED RUNOFF = 0.20 CFS

POST DEVELOPED RUNOFF = 1.21 CFS

ESTIMATED INCREASE IN RUNOFF SEEN AT ROAD CROSSING = 1.01 CFS

BATTLE SPRING DRAW

APPROX. AREA OF ROAD IMPROVEMENTS = 0.073 MI^2

PREDEVELOPED RUNOFF = 1.75 CFS

POST DEVELOPED RUNOFF = 10.46 CFS

ESTIMATED INCREASE IN RUNOFF SEEN AT ROAD CROSSING = 8.71 CFS

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WYOMING

UR ENERGY

DRAINAGE PLAN WAMSUTTER-CROOKS GAP ROAD AREA SHEET 7 OF 7

REVISIONS	
Date	By

WWC ENGINEERING
6000 E. 2nd Street, Suite 1004
Casper, WY 82609
(307) 473-2707

FILE: Lost Creek Drill Shed | Drawn By: JAJ | Checked By: DAT | Date: 08/27/09 | Scale: AS SHOWN

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