REMEDIATION OF A PETROLEUM SPILL USING PURE OXYGEN

COLTER BAY VILLAGE MARINA

TETON NATIONAL PARK, WY

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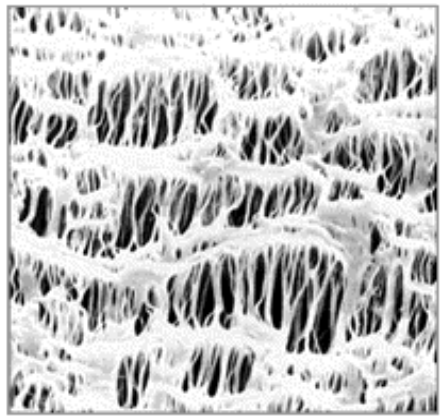
J.S. Roemmel, SECOR International

iSOC® TECHNOLOGY

Microporous Hollow Fiber

Cross Section 200 µm



Inner Surface 1 µm

Mass Transfer Device

iSOC®

How Does It Work?

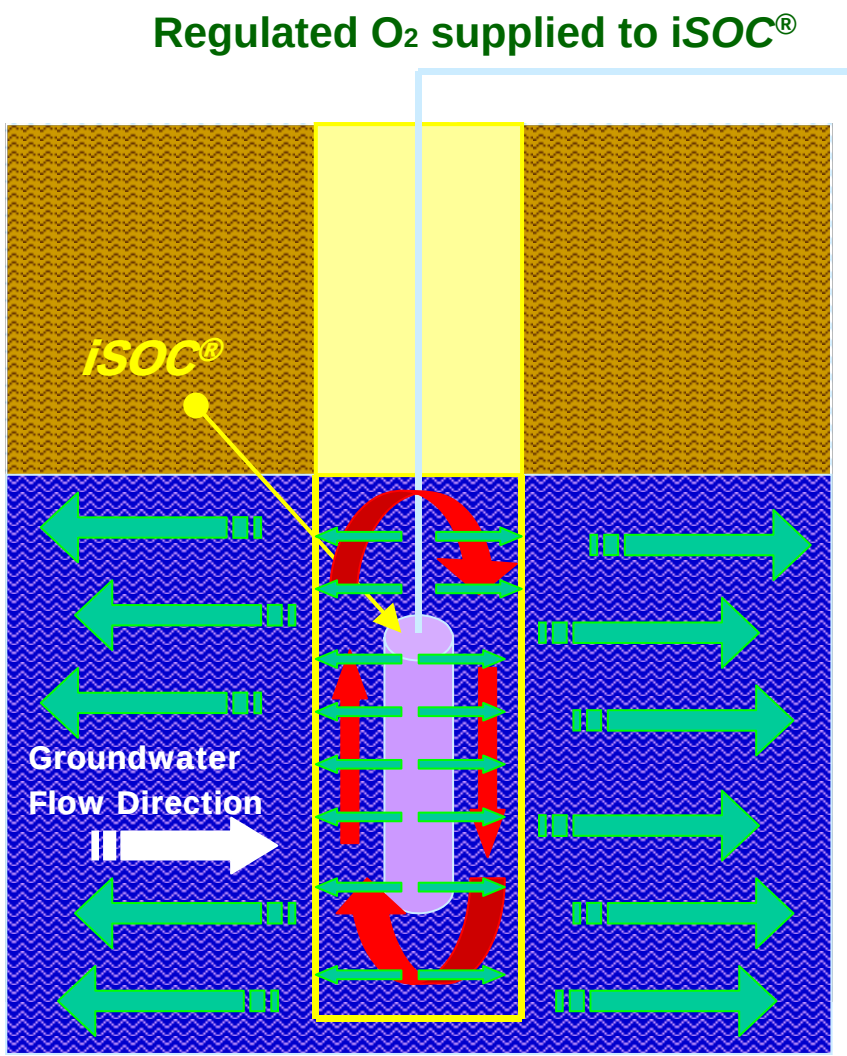
- 700 Hollow fibers filled with holes
- Provides large surface area for mass transfer (7000 sq ft per cu ft)
- Mass transfer occurs when gas pressure is less than GW
- GW in well is saturated with high DO (without bio-sparging)
- High DO levels migrate to surrounding biomass
- Microbial population increases
- Microbes degrade targeted compounds

iSOC® DISSOLVED GAS CONCENTRATIONS (ppm)

Atmospheric Pressure Determines DO Levels

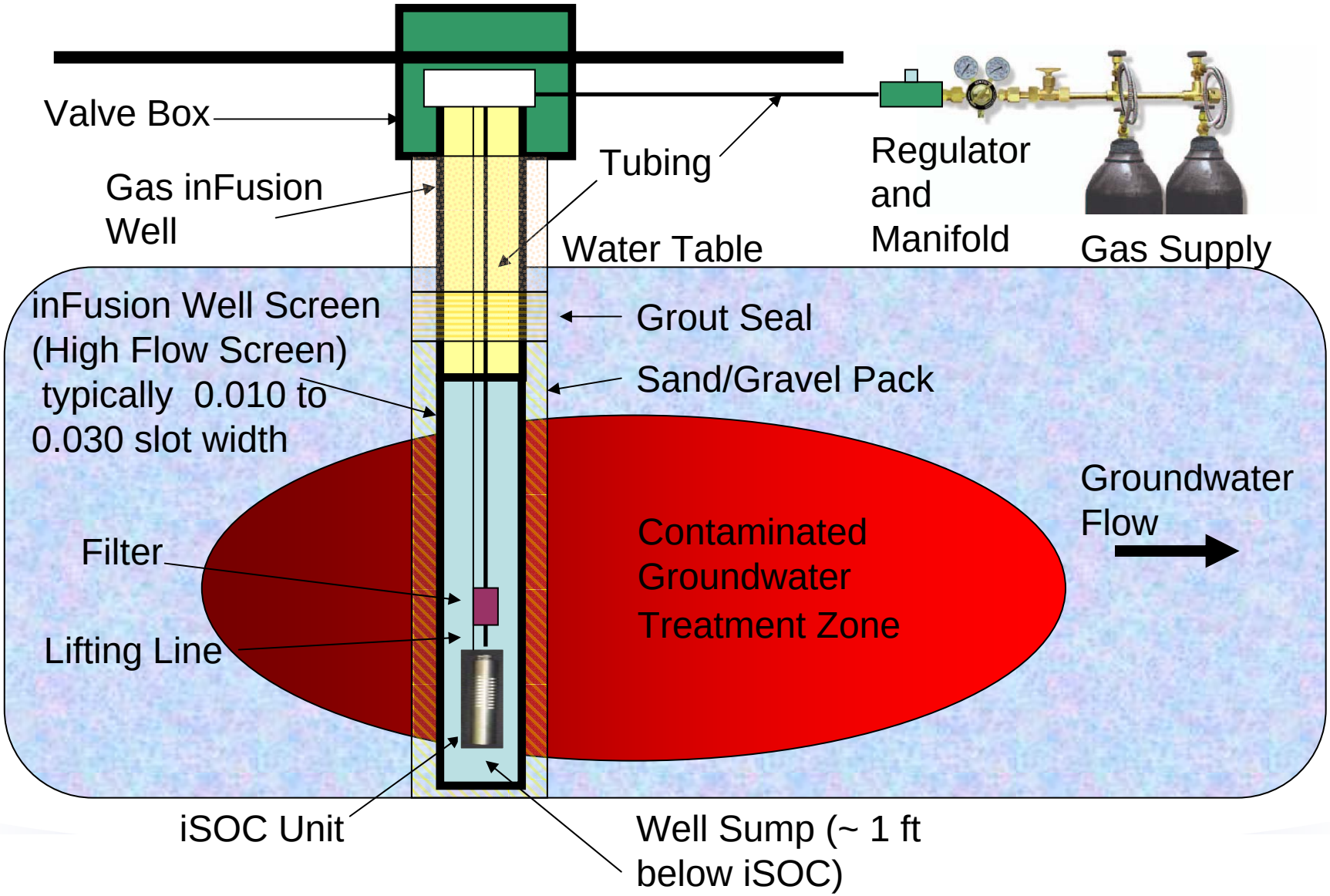
Gas Type	Water Column Depth (ft)				
	5’	10’	15’	20’	50’
Oxygen	42	55	62	69	111
Methane	22	30	33	37	59
Propane	66	88	99	110	175
Hydrogen	2	2	3	3	5
Ethane	57	75	85	95	150

iSOC® TREATMENT PROCESS



- Install up gradient of source, in the plume or cut-off curtain
- Screen injection well in target zone
- Natural convection current distributes DO in the well
- DO disperses around well and into groundwater
- GW velocity, oxygen demand of aquifer and molecular dispersion affect ROI
- Supersaturates well with Dissolved Oxygen (DO) 40 to 200 PPM depending on depth of iSOC® in the well
- High DO stimulates microbes to remove target compounds

TYPICAL iSOC WELL SCHEMATIC




GRAND TETON
NATIONAL PARK
NATIONAL PARK SERVICE
Department of the Interior

TETON N.P. GROUND WATER REMEDIATION SYSTEMS

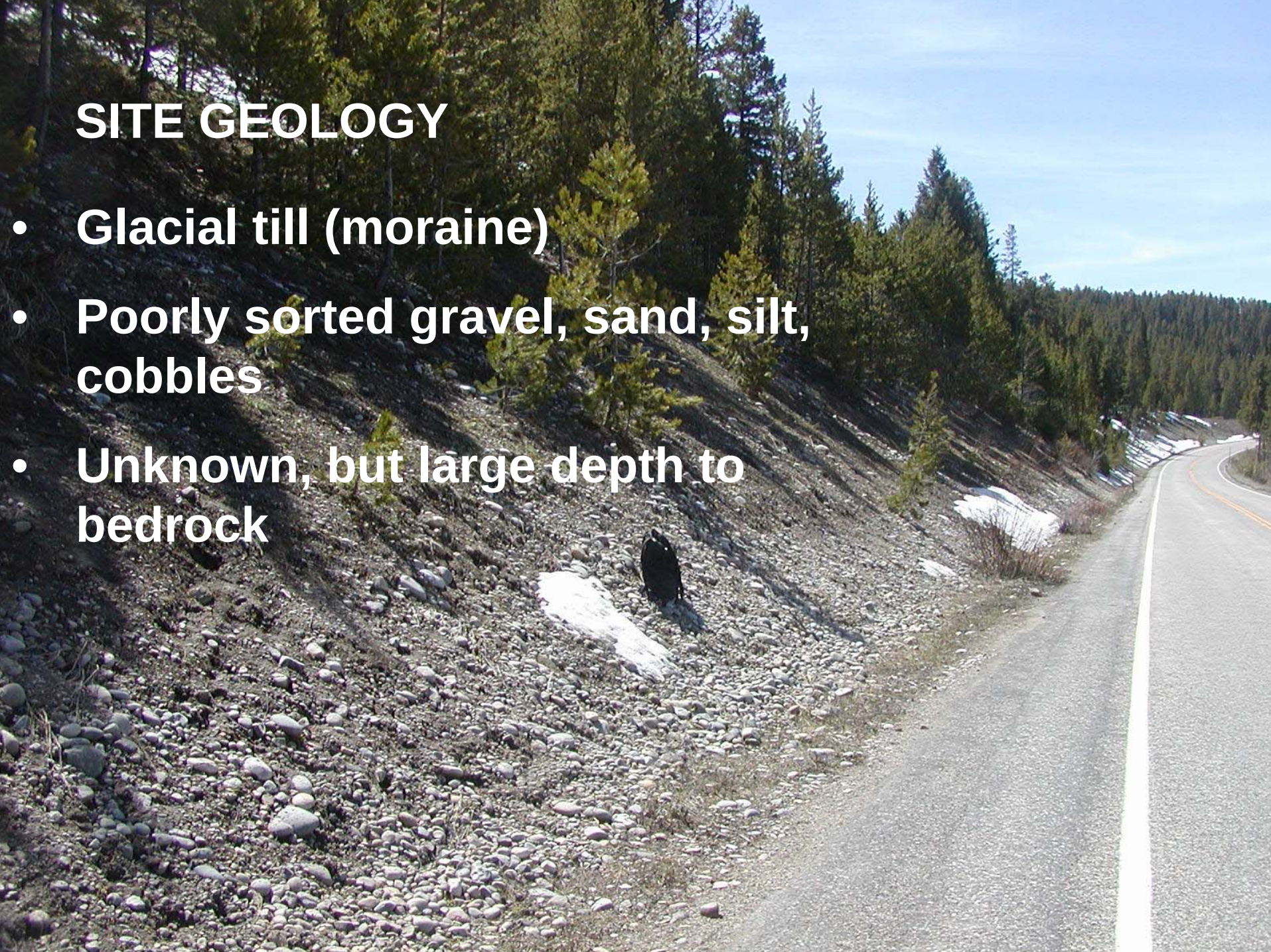
Park Locations

Signal Mountain Lodge: SVE,Ozone Sparge

Leeks Marina: SVE, Ozone Sparge

Flagg Ranch: SVE, Sparge

Colter Bay Marina: iSOC® System



SITE GEOLOGY

- Glacial till (moraine)
- Poorly sorted gravel, sand, silt, cobbles
- Unknown, but large depth to bedrock

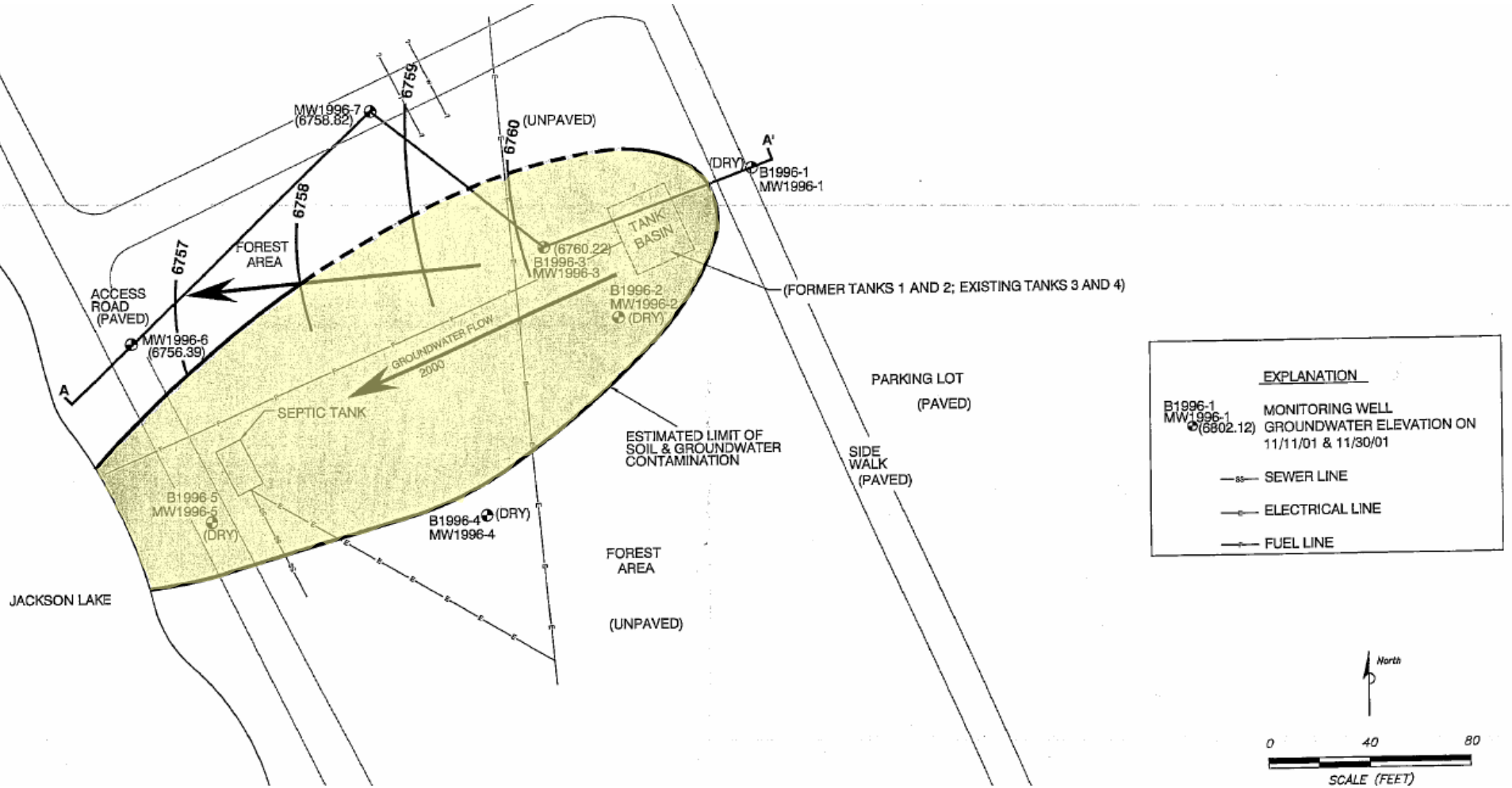
GROUND WATER CONDITIONS

- Depth to water table fluctuates from 11 ft – 30 ft below ground surface
- Hydraulic conductivity 2.3 x 10^{-5} ft/sec
- Generalized flow across site west to southwest toward Jackson Lake
- In 2000, petroleum contamination plume extended 250 ft downgradient of UST basin, with maximum width of 110 ft.

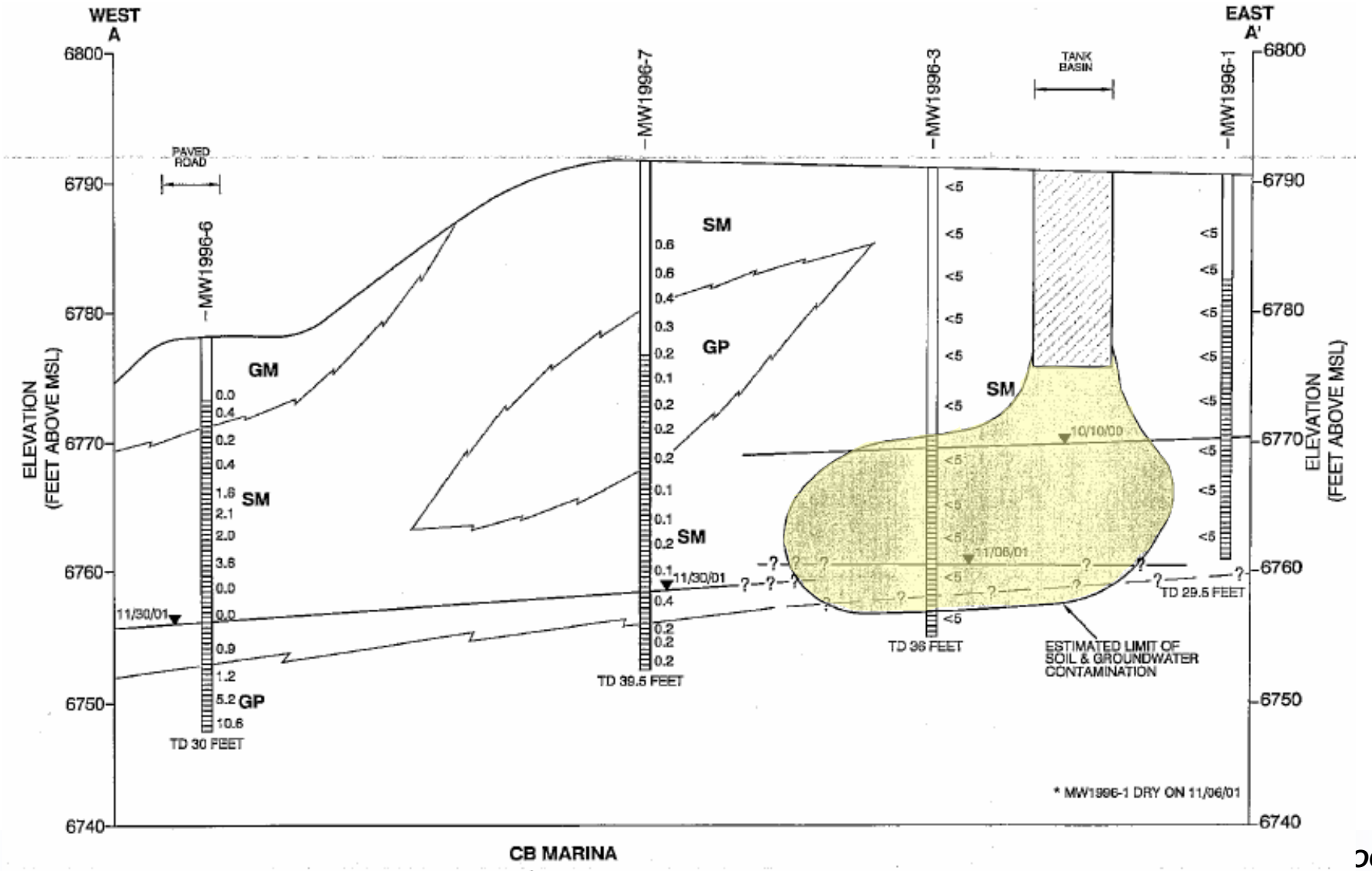
PETROLEUM RELEASE HISTORY

- Release of gasoline and diesel from 2 USTs and product line
- 2 steel tanks installed in 1975, removed in 1994
  - 1992 failed tightness test for Tank 1 product line
  - Large hole observed in Tank 1 during removal
  - No holes observed in Tank 2
  - Soil discoloration, moderate petroleum contamination in soils
- 2 replacement tanks installed in May, 1995 (same tank pit)

EXTENT OF CONTAMINATION - 2000



GEOLOGIC CROSS-SECTION - 2000



REMEDIATION ALTERNATIVE ANALYSIS

Alternative #1:

Monitored Natural Attenuation (MNA)

Alternative #2:

Enhanced Natural Attenuation – iSOC® Technology

Alternative #3:

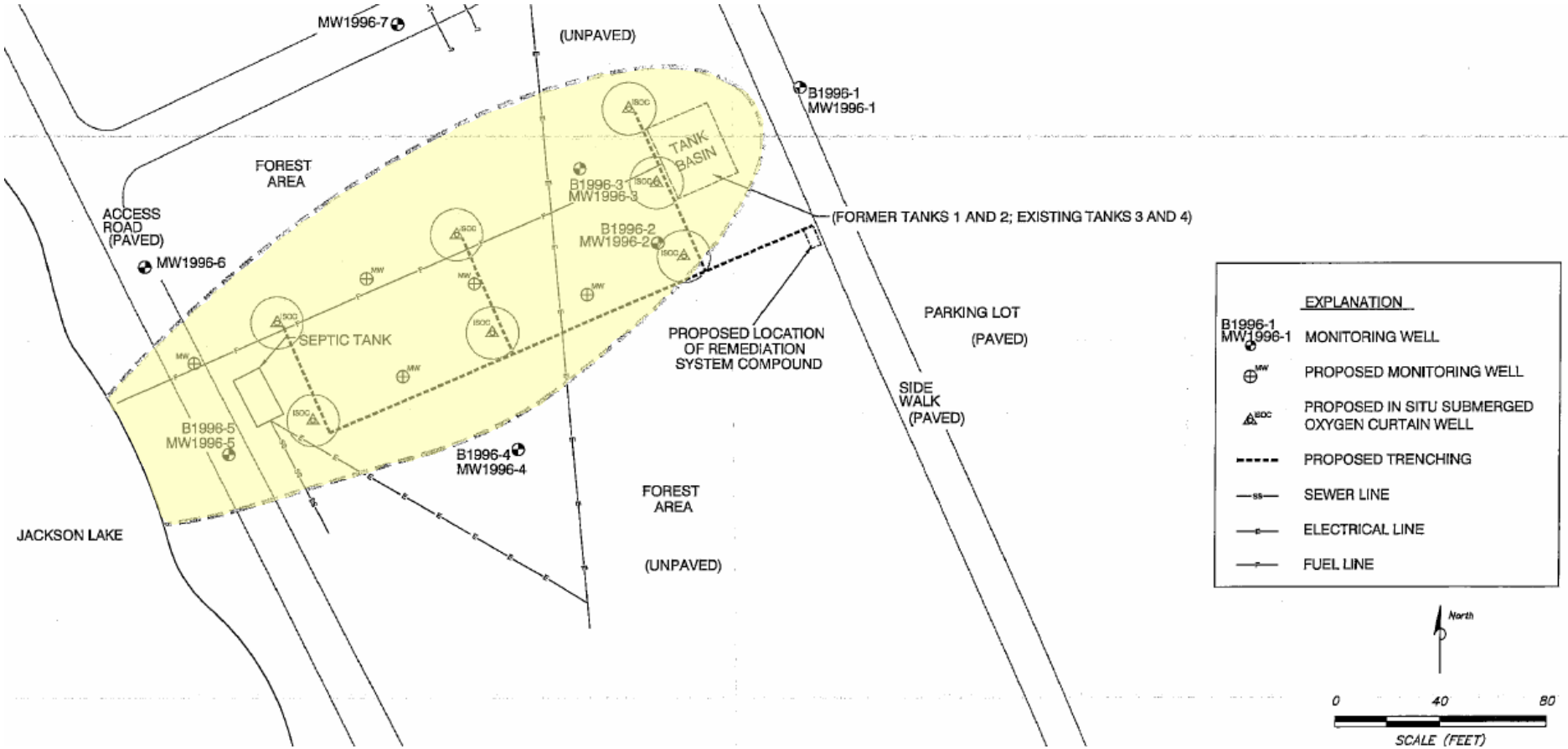
Ozone Sparging/SVE Venting

CRITERIA FOR *ALTERNATIVE #2 (iSOC®)* SELECTION

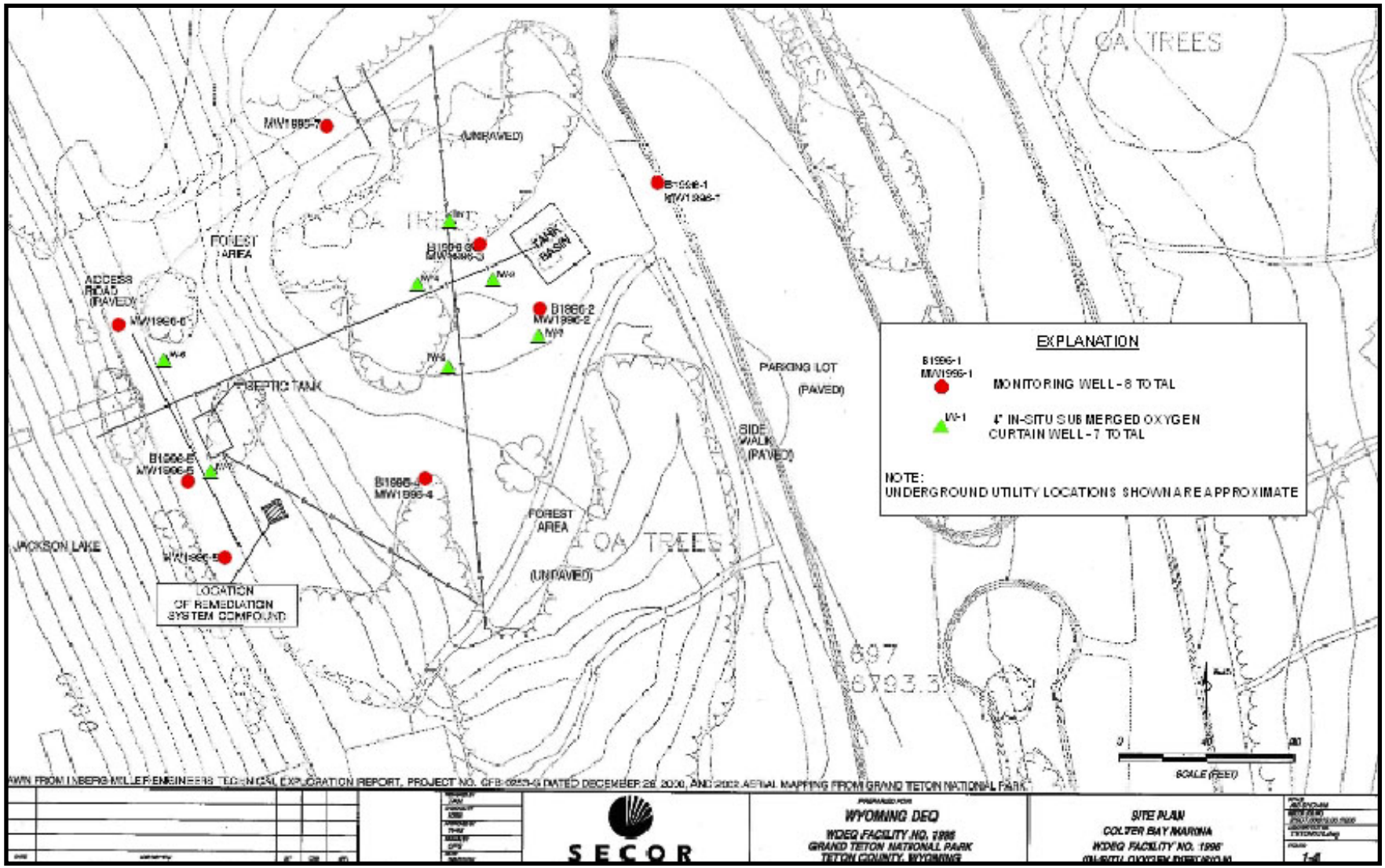
- Protective of human health and environment
- No electric power supply requirement onsite
- No noise impacts to Marina/National Park visitors
- Technology proven to work in cold climates with no freeze-ups
- Remediation projected to be completed within 3 years


IN CASE OF AN
EMERGENCY
CALL 911
NO SMOKING

ALTERNATIVE #2 – iSOC® TECHNOLOGY



COLTER BAY MARINA SITE MAP

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STORAGE TANK PROGRAM
REMEDIATION PROJECT
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SECOR INTERNATIONAL
INCORPORATED
(801) 261-7100
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EMERGENCY, CALL 911
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MAY, JUNE 2005 OXYGEN PARAMETERS

May 2, 2005

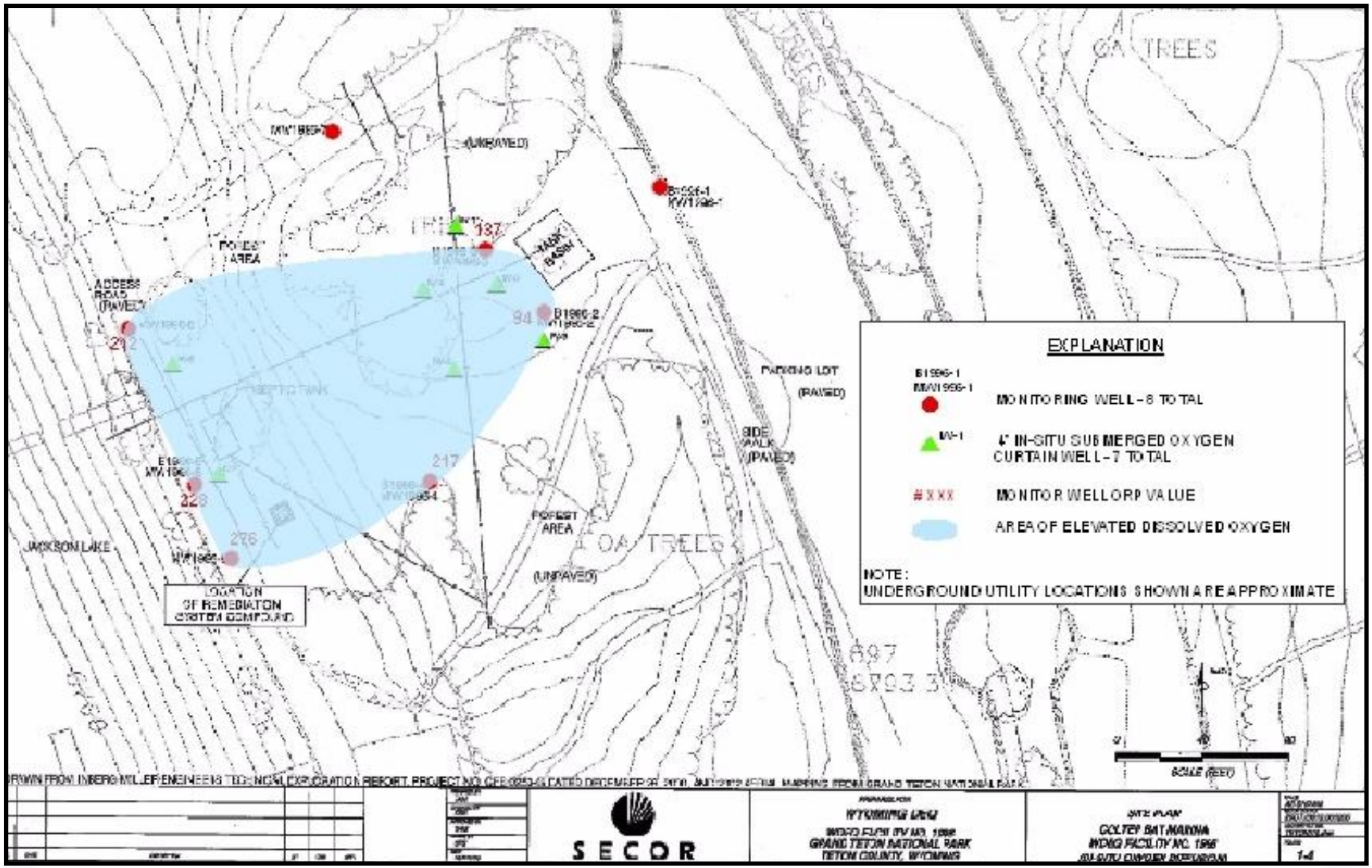
MONITOR WELL NUMBER	OXIDATION-REDUCTION POTENTIAL (ORP)	DISSOLVED OXYGEN (DO) ppm
2	+ 94	0
3	+ 137	0
4	+ 217	2.77
5	+ 228	0
6	+ 212	2.9
8	+ 276	3.25

JUNE 21, 2005 — **iSOC Injection Well Random DO Measurements (ppm)**

INJECTION WELL NUMBER	DISSOLVED OXYGEN (DO) ppm	LOCATION
IW-3	54 ppm	Near Tanks
IW-7	16.1 ppm	Near Lake

iSOC® System installed June, 2004

May 2, 2005: Oxidation-Reduction Potential in Monitor Wells



Teton National Park, WY Monitor Well Results

Tank Basin Area Wells				
	2000-2002 pre-iSOC	iSOC Installed Oct 2004	May 2005	May 2006
Benzene	49-310		4-28	BDL
Toluene	1200-1300		151-2820	BDL
Ethyl-benzene	380-430		104-584	BDL
Xylenes	1700-3400		788-3260	BDL
Naphthalene	79-110		26-102	BDL

Colter Bay Marina Site, WY Monitor Well Results

Near Lake Wells				
	2000-2002 pre-iSOC	iSOC Installed Oct 2004	May 2005	May 2006
Benzene	1-190		BDL-5	BDL
Toluene	<1-16		BDL-18	BDL
Ethyl-benzene	<1-73		BDL	BDL
Xylenes	<2-7		BDL-58	BDL
Naphthalene	<5		BDL	BDL

TETON N.P. GROUND WATER REMEDIATION SYSTEMS

Comparison of Operating Efficiencies at Teton Park Sites

SITE/SYSTEM	PERCENT RUN TIME SINCE NOVEMBER 7, 2006
Signal Mountain Lodge SVE	88%
Signal Mountain Lodge Ozone Sparge	61%
Leeks Marina SVE	69%
Leeks Marina Ozone Sparge	17%
Flagg Ranch SVE	78%
Flagg Ranch Sparge	49%
Colter Bay iSOC™	100%

iSOC® Remediation Completed in 1.5 years

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Questions / Comments

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