THE WELDON SPRING PROJECT

SITE TOUR

Association Of Missouri Geologists

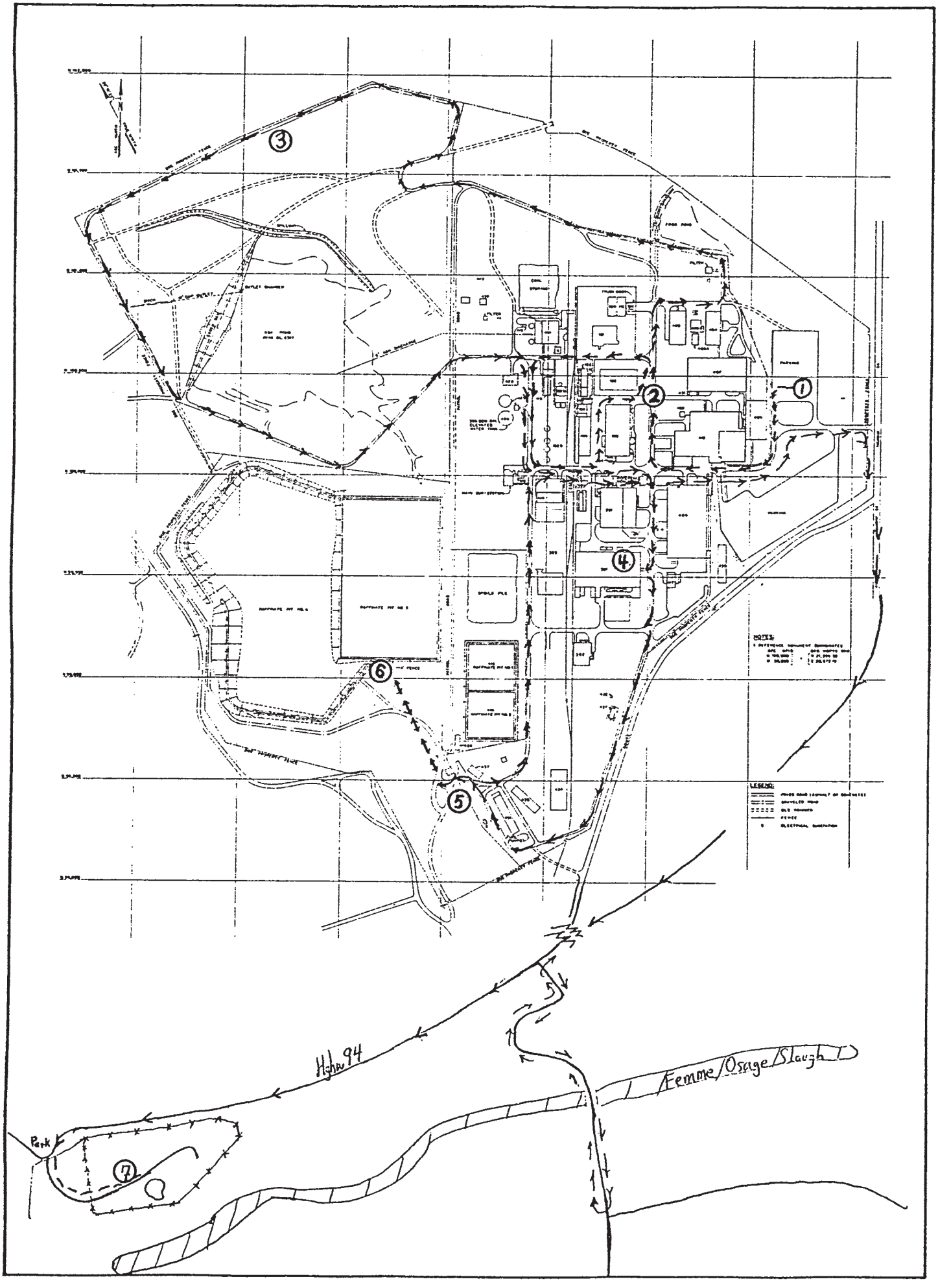
34th Annual Field Trip

Sponsored By :

MODNR - Division Of Geology & Land Survey
Rolla, Mo.
&
U.S. Department Of Energy
Weldon Spring, Mo.

September 25, 1987

STATION #1



HISTORY OF THE WELDON SPRING SITE

LOCATION

The Weldon Spring Site is located about 30 miles west of St. Louis and 14 miles southwest of St. Charles. The site is comprised of four areas: raffinate pits, chemical plant and quarry area cover approximately 229 acres. The vicinity properties are specific areas located outside of the current boundaries, but are radioactively contaminated above current criteria for unrestricted use, and are mainly along ditches, roads and railroads.

1941-1944

The Department of the Army operated the Weldon Spring Ordnance Works for the production of the trinitrotoluene (TNT) and dinitrotoluene (DNT). The Army used the quarry for disposal of rubble contaminated with TNT.

1957-1966

During the mid 1950's, 220 acres of the ordnance works property was transferred to the U.S. Atomic Energy Commission which is now the main site area consisting of the chemical plant and raffinate pits. From 1957-1966, the Atomic Energy Commission (AEC) operated a uranium processing facility which purified yellow cake uranium and shipped off uranium metal for further purification at other sites. Radioactive sludge residues (raffinates) resulting from the processing were placed in the four on-site pits. Other radioactive wastes, which included the entire contents of the Destrahan Street Facility operated by Mallinckrodt, were disposed of in the quarry by the Atomic Energy Commission (AEC).

1967-1969

After closure by the Atomic Energy Commission (AEC), the chemical plant was reacquired by the Army in 1967. The Army partially decontaminated the buildings, dismantled some of the equipment and began converting the facilities to produce an herbicide. In 1969, prior to becoming operational, the herbicide project was cancelled.

1969-present

In 1971 the Army returned the 52-acre portion of the site containing the raffinate pits to the Atomic Energy Commission (AEC). In November 1984, the Department of Energy (DOE) and the Department of the Army reached agreement on showing the cost for remediation of the chemical plant. In October 1985, the Department of Energy (DOE) accepted custody and accountability of the chemical plant from the Army. In February 1985, the Department of Energy (DOE) proposed designating the Weldon Spring Site and the activities that will be required to control and decontaminate the various facilities as a major project for the Department of Energy (DOE) management purposes. In August 1986, the Department of Energy (DOE) and the Environmental Protection Agency (EPA) signed a Federal Facilities Agreement for cleanup of the quarry area.

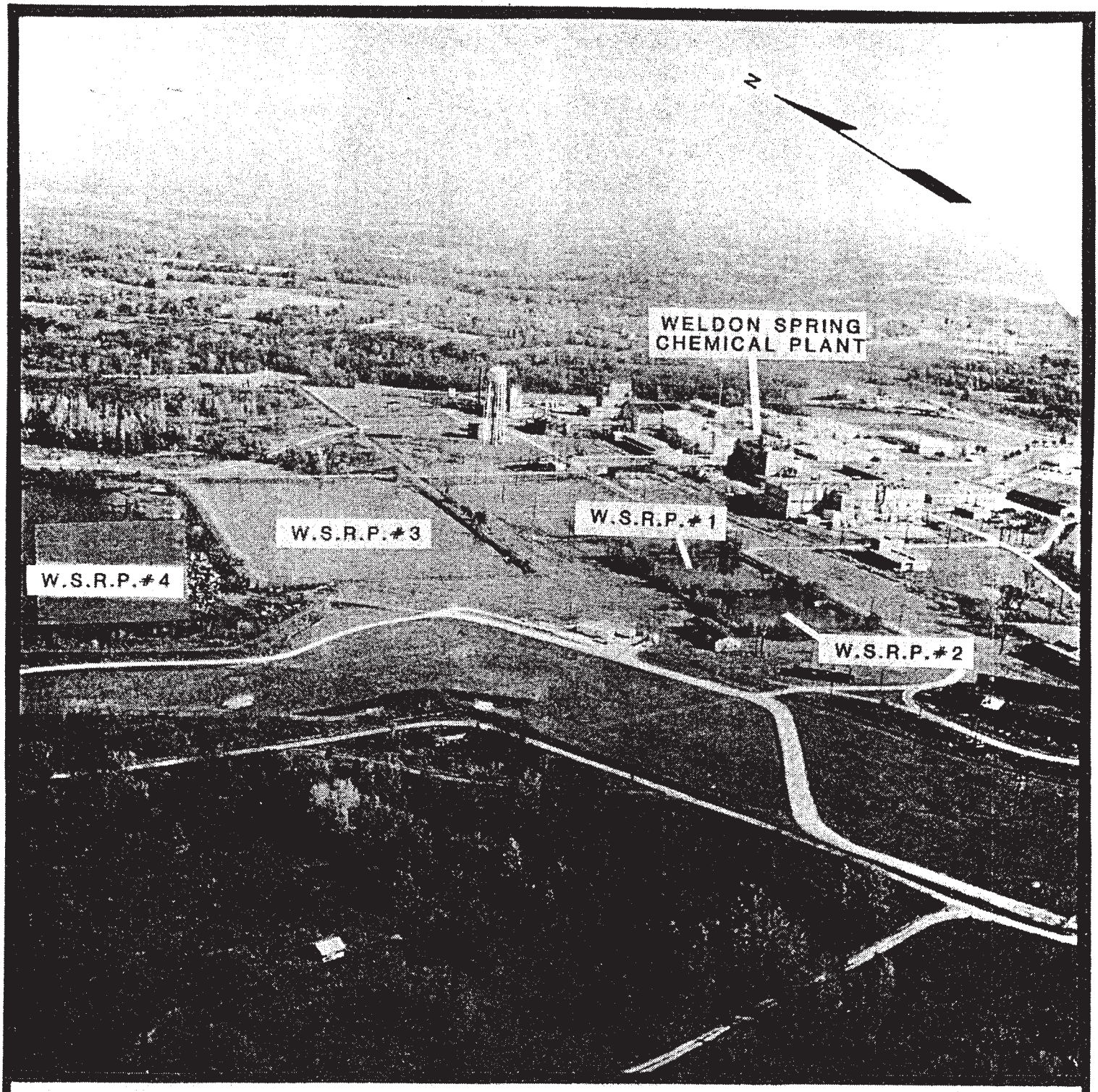


FIGURE 1-2

AERIAL VIEW OF THE W.S.R.P. AND W.S.C.P..

DISPOSAL FACILITY

The Environmental Impact Statement (EIS) identified the Weldon Spring Site as a possible location for disposal of the contaminated wastes from the cleanup and dismantling of the industrial facility. If this site is selected by the regulatory process, a shallow land disposal facility would likely be built in the area currently occupied by many of the site structures.

The former Uranium Feed Material Plant was constructed on land that has several features that would enhance the long term integrity of a low-level radioactive and hazardous waste disposal facility. The plant sits astride the surface water divide separating the Mississippi and Missouri River basins. The location virtually eliminates upland watersheds and the resultant runoff that could erode the disposal facility cover system. The site surficial soils would provide an excellent foundation for the disposal facility. The near surface Ferrelview clay would also be used in constructing the final facility cover.

Preliminary geotechnical and geophysical site testing has been performed. The results from these programs are being used to direct additional boring, logging, sampling, trenching, and geophysical surveying characterization efforts. These programs will confirm or exclude this area for use as a disposal facility site.

The disposal facility design would include all short and long term performance aspects. The various design analyses include slope stability, short and long term settlement potential, differential settlement, cover cracking, radon diffusion, erosion resistance, and geomorphological hazards. These and other related design studies are performed to ensure that the completed facility would have a good probability of lasting for 1000 years with minimal maintenance.

STATION #3

THE WELDON SPRING PROJECT

FACT SHEET

INTERIM RESPONSE ACTIONS

The following is a description of nine interim response actions designed to ensure the health and safety of on-site personnel and to minimize or preclude off-site releases of contamination. They are:

I. ELECTRIC POWER LINE AND POLE REMOVAL: This action consists of removing all of the de-energized exterior power and telephone lines, estimated to be 150,000 linear feet of cable and wire, as well as 300 timber poles, their cross beams and support. All materials will be surveyed and classified. Non-contaminated material will be disposed off-site. Contaminated material will be stored on-site. Removal of these items will improve the safety conditions for workers on the site and prepare the area for further dismantling of buildings.

II. OVERHEAD PIPING/ASBESTOS REMOVAL: The action consists of removal of 33,000 linear feet of overhead piping and 500 structural supports holding the 13,000 linear feet of asbestos containing material. This asbestos containing material will be wrapped and dismantled, and soil contaminated with asbestos will be cleaned up. Removal of this potential threat to the health and safety of outside workers will improve the site and prepare it for future dismantling activities. Collecting of these materials will mitigate any potential for off-site airborne releases of asbestos containing materials. All materials will be surveyed and classified. Non-contaminated material will be disposed off-site. Contaminated material will be stored on-site.

III. PCB TRANSFORMER REMOVAL: An estimated 6,500 gallons of PCBs exist on-site in 21 transformers. Removal of these radiologically clean, out of service transformers from the site will comply with existing regulations and prevent leakage of the PCBs during remedial action activities on the site. Approximately 13,000 gallons of PCBs and flushing solutions will be removed and transported to a licensed disposal facility and the flushed units will also be transported off-site to a licensed disposal facility. Fourteen (14) additional non-PCB transformers will also be removed.

IV. DISPOSAL OF CONTAINERIZED CHEMICALS: There are 300 different kinds of containerized chemicals on-site, which are held in 4,000 individual containers. These contain about 5,000 gallons of liquid and 2,500 cubic feet of solids. Under this action, the chemicals will be stabilized for consolidation. Radiologically contaminated material will be separated out for on-site storage. The others will be sampled and tested for compatibility and bulk shipped off-site by a licensed hauler to a licensed disposal facility. This will prevent exposure to workers on-site of the chemicals and minimize any leaking/rupture of the containers during other remedial activities.

V. ASH POND ISOLATION DIKE: Surface water runoff is flowing into Ash Pond, the lowest level on the site; this runoff water flowing into Ash Pond is contaminated with uranium at levels up to 440 pCi/L. However, water discharged from the pond is going into the Busch Wildlife Area and is contaminated with uranium at levels up to 3500 pCi/L. By constructing a dike around Ash Pond, the surface water will be isolated from Ash Pond and erosion control provided. The action will reduce the amount of radiological contamination leaving the site via this pathway.

VI. DEBRIS CONSOLIDATION: Following the inventory and characterization of containerized chemicals and the scanning of major items for radiological contamination, action will be taken to consolidate debris (pipe, steel, rubble, etc) randomly scattered throughout the site. Placing this debris in one controlled area will improve conditions for environmental health and safety surveys of the site, as well as clearing the area for improved groundskeeping and for future dismantling and construction activities.

VII. ARMY VICINITY PROPERTY: More than 1,400 yards of radiologically contaminated material is present on the Weldon Spring Army Reserve property. Though it is low-level radiation (up to 281 pCi/g of uranium and up to 38 pCi/g of radium) the materials must be cleaned up to allow construction to get underway at the Army Reserve. This action will remove the contaminated material, haul it to an on-site staging area, verify and certify that the properties are cleaned up to meet excavation criteria, and then proceed to backfill, regrade and reseed.

VIII. DISMANTLING OF BUILDING 401-STEAM PLANT: The steam processing plant, is a 17,000 square foot building which contains asbestos. The asbestos from the building can be removed and transported to off-site disposal. Once the asbestos has been removed, the equipment and building can be dismantled and transported to off-site disposal.

IX. DISMANTLING OF BUILDING 409-ADMINISTRATION: The 2-story, 38,000 square foot former administration building has no known radiological or chemical contamination, but has some minor asbestos contamination. The asbestos will be removed and transported off-site, and the internal equipment, walls, and the superstructure will be dismantled and transported to off-site disposal.

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For more information, contact Martin Janowski or Sue Brotherton at (314) 441-8086.

WELDON SPRING URANIUM FEED MATERIALS PLANT

The Uranium Production Facility was operated from 1957-1966 for the Atomic Energy Commission (AEC) by Mallinckrodt Chemical Works. It produced approximately 13,400 tons of uranium metal during its operation. Each major step in the metallurgical process is described below:

1) **Sampling Plant - Raw Materials Preparation**

Drums of unassayed uranium concentrates (usually U_3O_8 - Yellowcake) were mechanically sampled for further analysis. A bucket elevation raised the concentrate to the top of the building. In ore form, the material was crushed and screened. Regardless of the feed source, the dry, sized and blended feed was transferred to the portable hoppers for transport to the Refinery (Steps 2 and 3).

2&3) **Refinery - Production of Uranium Trioxide**

The refining operation produced uranium trioxide in three steps: digestion, extraction, and evaporation/denitration. From the hoppers in Step 1, the material was digested in tanks containing heated concentrated nitric acid for several hours. Residues were pumped to the Raffinate Pits. Extraction of the uranium as uranyl nitrate was in contact with a solution of tributyl phosphate (TBP) in hexane (organic solvent extraction). Impurities staying in the aqueous phase were neutralized and pumped to the Raffinate Pits. The uranyl nitrate was evaporated and heated to drive off the nitrogen resulting in uranium trioxide.

4) **Green Salt Plant - Production of Uranium Tetrafluoride**

UF_4 (green salt) was produced by reduction of uranium trioxide to uranium dioxide and reaction of the dioxide with hydrogen fluoride.

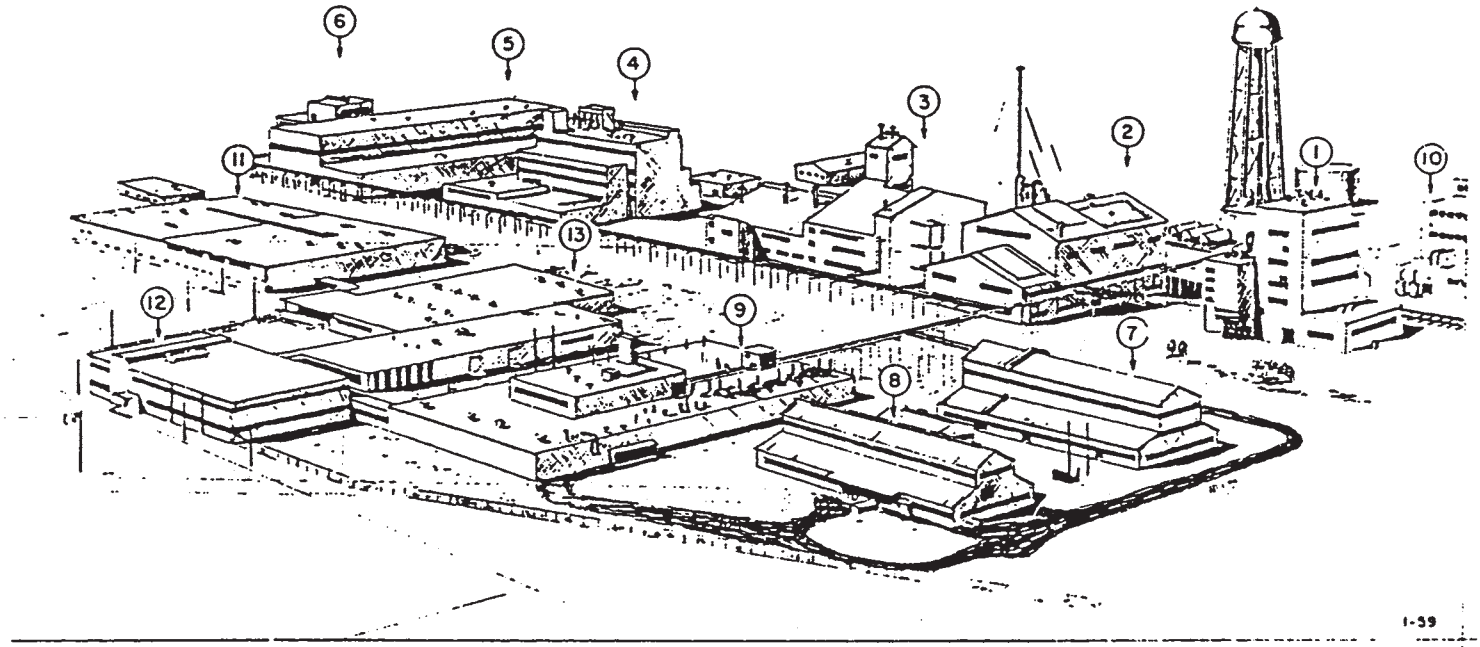
5) **Metal Plant - Production of Uranium Metal**

Uranium metal is made by the reduction of UF_4 with chips of magnesium metal. This was cone in refractory-lined steel vessels (called bomb shells) which were charged with blended green salt and magnesium. After the "bomb" was inductively heated, the reaction become exothesmic and the uranium metal formed at the bottom of the vessel. The magnesium slag topping was removed, and the uranium metal billet was then machined and extruded for shipment.

STATION #4

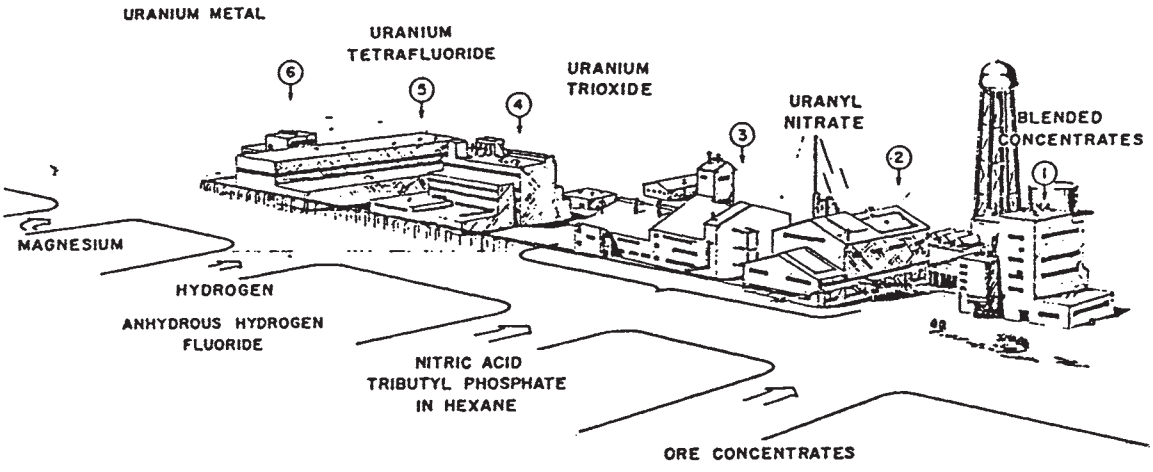
LEGEND

1. SAMPLING
2. EXTRACTION
3. DENITRATION
4. GREEN SALT
5. METAL
6. MAGNESIUM
7. CHEMICAL PILOT PLANT
8. METALLURGICAL PILOT PLANT
9. LABORATORY
10. BOILER HOUSE
11. MAINTENANCE
12. ADMINISTRATION BLDG.
13. DISPENSARY, CAFETERIA, & OTHER SERVICES



I-59

FLOW OF RAW MATERIALS AND INTERMEDIATE PRODUCTS



I-59

THE DEDICATED SAMPLING SYSTEM AND ROUTINE MONITORING AT THE WELDON SPRING SITE

The Department of Energy (DOE) produces an annual environment monitoring report presenting the environmental status of the Weldon Spring Site (WSS). All contaminated and perimeter monitoring wells are sampled quarterly. A dedicated sampling system consisting of teflon and stainless steel bladder pumps have been installed on all monitoring wells that are routinely sampled. This system eliminates cross-contamination concerns and has greatly increased the efficiency of sampling personnel. The need for decontamination of sampling equipment has also been eliminated. This systems conforms to Environmental Protection Agency (EPA) guidance documents and will increase sample integrity.

In line filters are used when dissolved analyses are desired. These disposable filters also increased efficiency dramatically.

These integrated sampling and monitoring programs established here on the site provide us with a hydrological "snapshot" of current conditions of ground and surface water on the Weldon Spring Site. Analysis of this data assists the Department of Energy (DOE) in its plans for cleanup of the site.

CHEMICAL PLANT/RAFFINATE PITS HYDROGEOLOGY

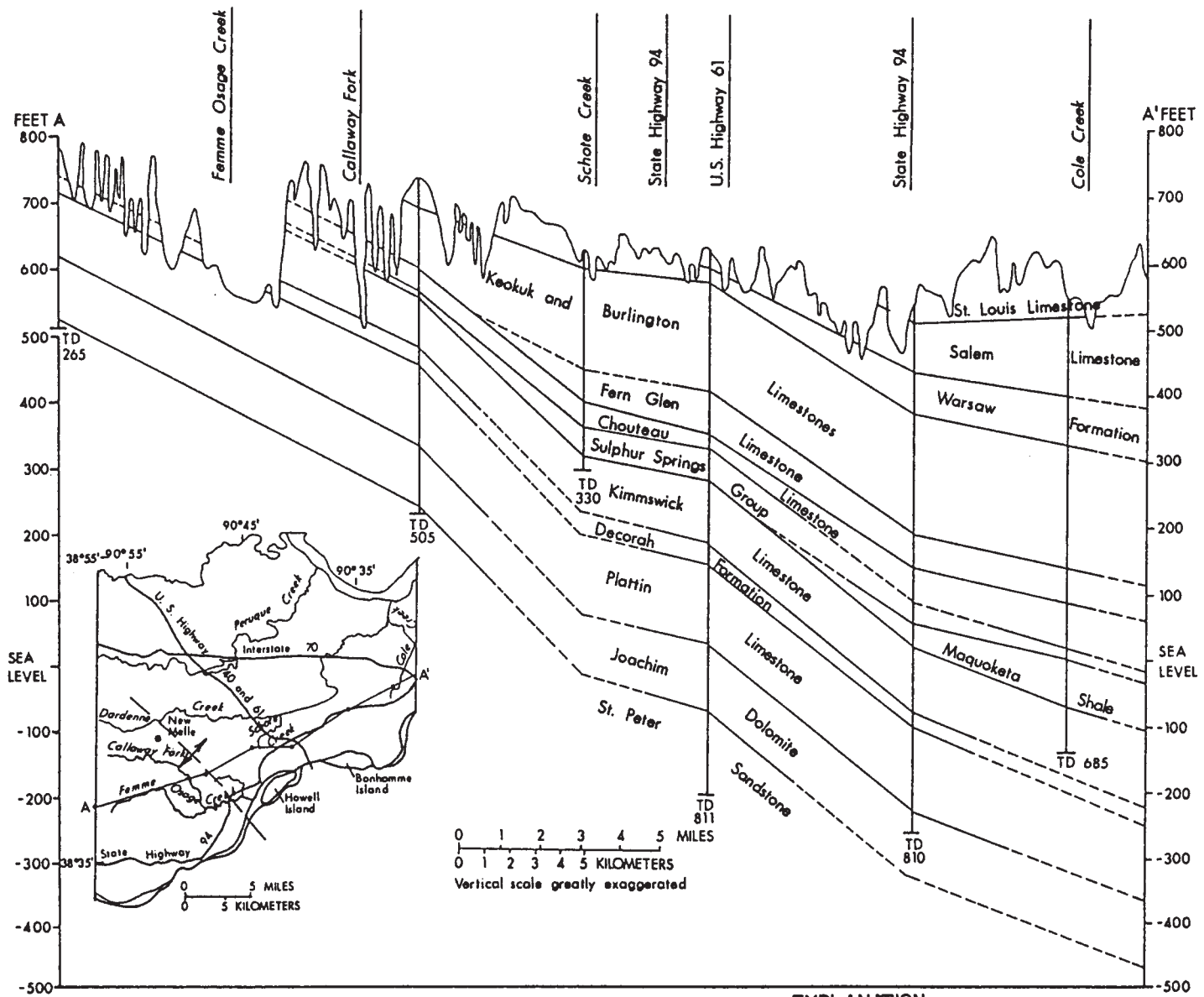
The Chemical Plant and Raffinate Pits are located in a fractured limestone terrain with complex ground water flow.

Existing data indicates a combined flow regime is present, exhibiting characteristics of Darcian flow typical of porous or highly fractured formations, and also exhibiting conduit flow and spring discharge typical of karst regions.

Dye-tracing studies performed by Tom Dean of the Missouri Department of Natural Resources indicate subsurface conduit flow from losing streams draining the site to local springs, most notably Burgermeister Spring approximately 6500 feet north of the site. Dye traces involving injection of dye in boreholes and monitoring of springs were inconclusive.

Recent ground water monitoring data show elevated levels of nitrate and other inorganic parameters in monitoring wells in the area surrounding the raffinate pits. These data indicate leakage from the Raffinate Pits forming a plume in a Darcian flow regime.

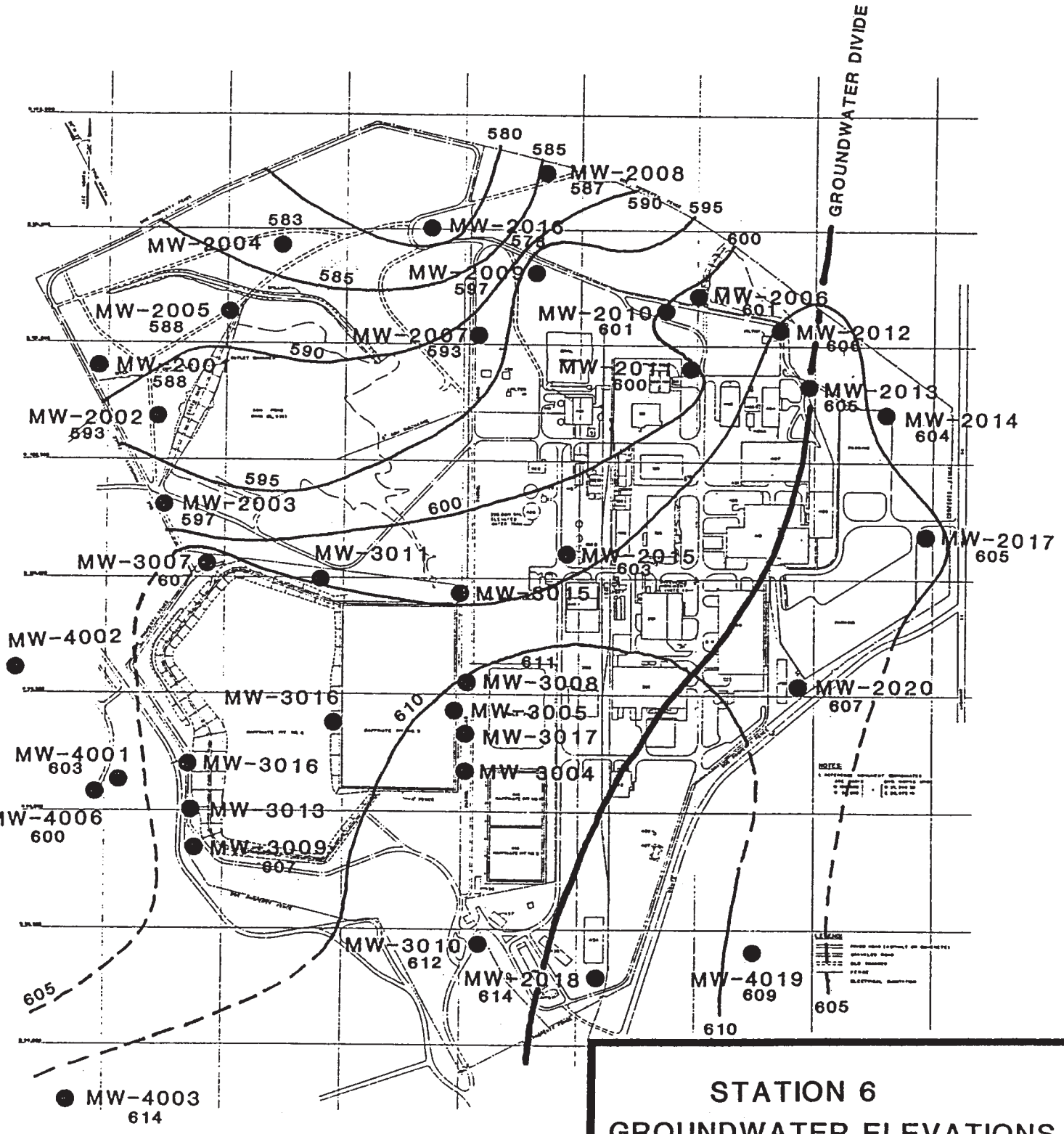
Another area of concern is the northeast corner of the site where nitroaromatic compounds (TNT and DNT) have been detected at parts-per-billion levels in samples from monitoring wells. Comprehensive studies are underway to fully characterize hydrogeologic conditions. The Department of Energy (DOE) will install and sample an extended monitoring well network and perform aquifer testing. The Missouri Department of Natural Resources, Division of Geology and Land Survey, is conducting karst hydrogeology studies, including additional dye traces. The U.S. Geological Survey is continuing studies of regional hydrogeology and water balance.



STATION #6

GEOLOGIC CROSS-SECTION NEAR THE WELDON SPRING SITE

SOURCE : U.S.G.S.



0 500' 1000'

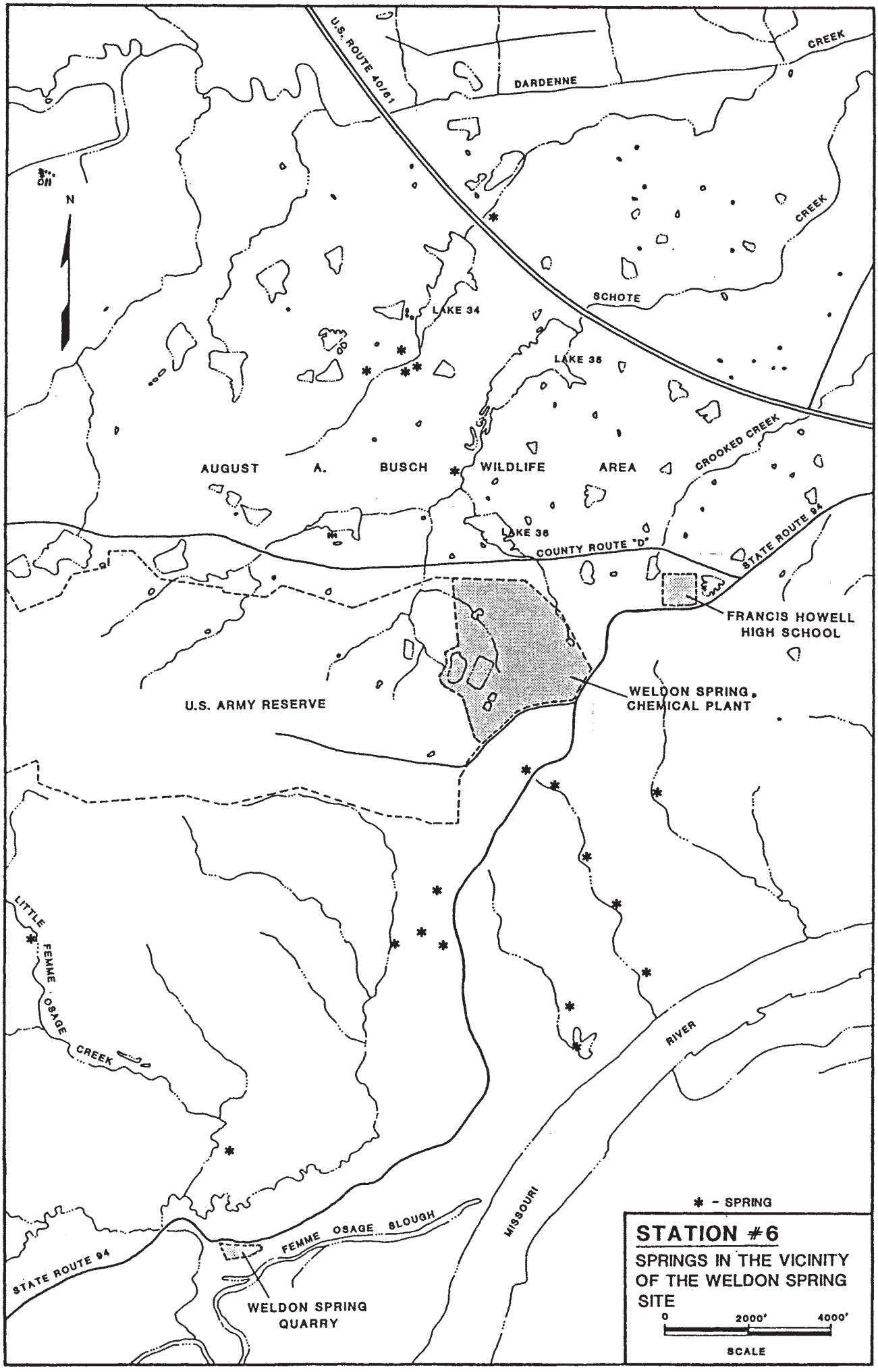
SCALE

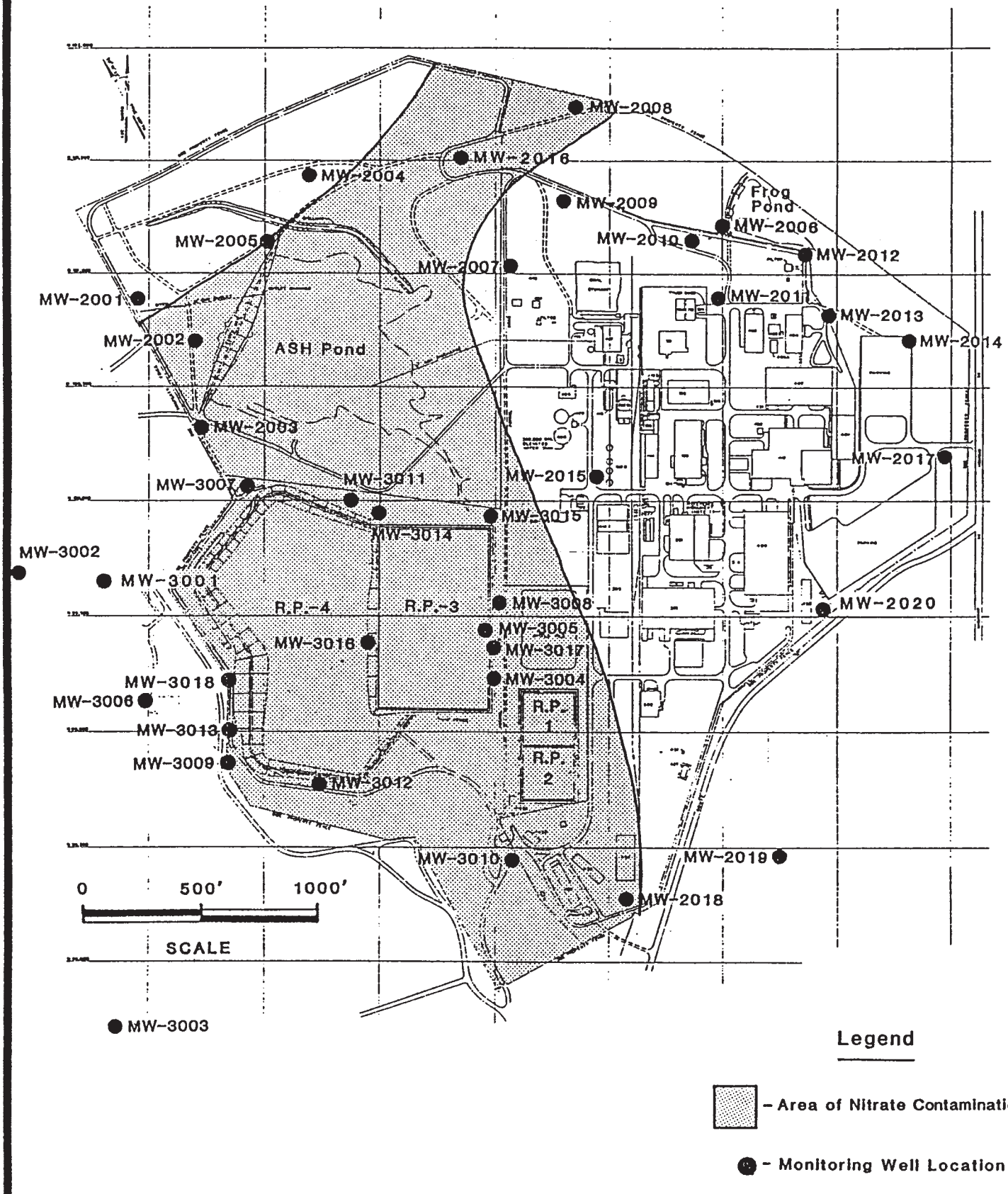
CONTOUR INTERVAL-5'

DASHED WHERE INFERRED

STATION 6
GROUNDWATER ELEVATIONS AND CONTOURS – W.S.C.P./W.S.R.P.

SOURCE : MK-FERGUSON 1987

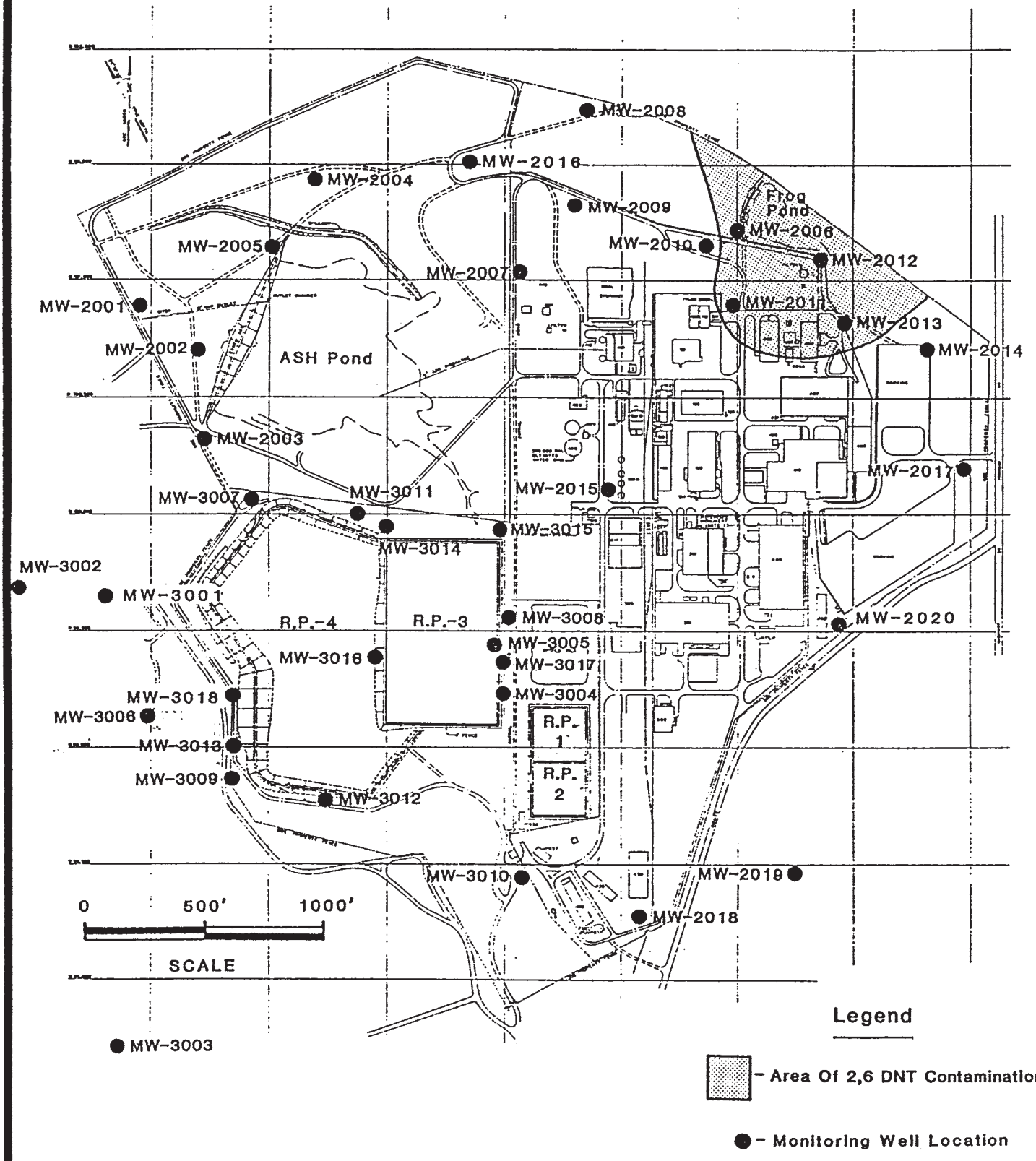

U.S. ROUTE 40/61
DARDENNE
CREEK
N
CREEK
SCHOTE
LAKE 34
LAKE 35
AUGUST A. BUSCH WILDLIFE AREA
CROOKED CREEK
LAKE 36
COUNTY ROUTE "D"
STATE ROUTE 94
FRANCIS HOWELL HIGH SCHOOL
U.S. ARMY RESERVE
WELDON SPRING CHEMICAL PLANT
LITTLE FEMME OSAGE CREEK
RIVER
MISSOURI
FEMME OSAGE SLOUGH
STATE ROUTE 94
WELDON SPRING QUARRY
* - SPRING
STATION #6
SPRINGS IN THE VICINITY OF THE WELDON SPRING SITE
0
2000'
4000'
SCALE



STATION 6

Area Of Nitrate Contamination At The Weldon Spring Site.

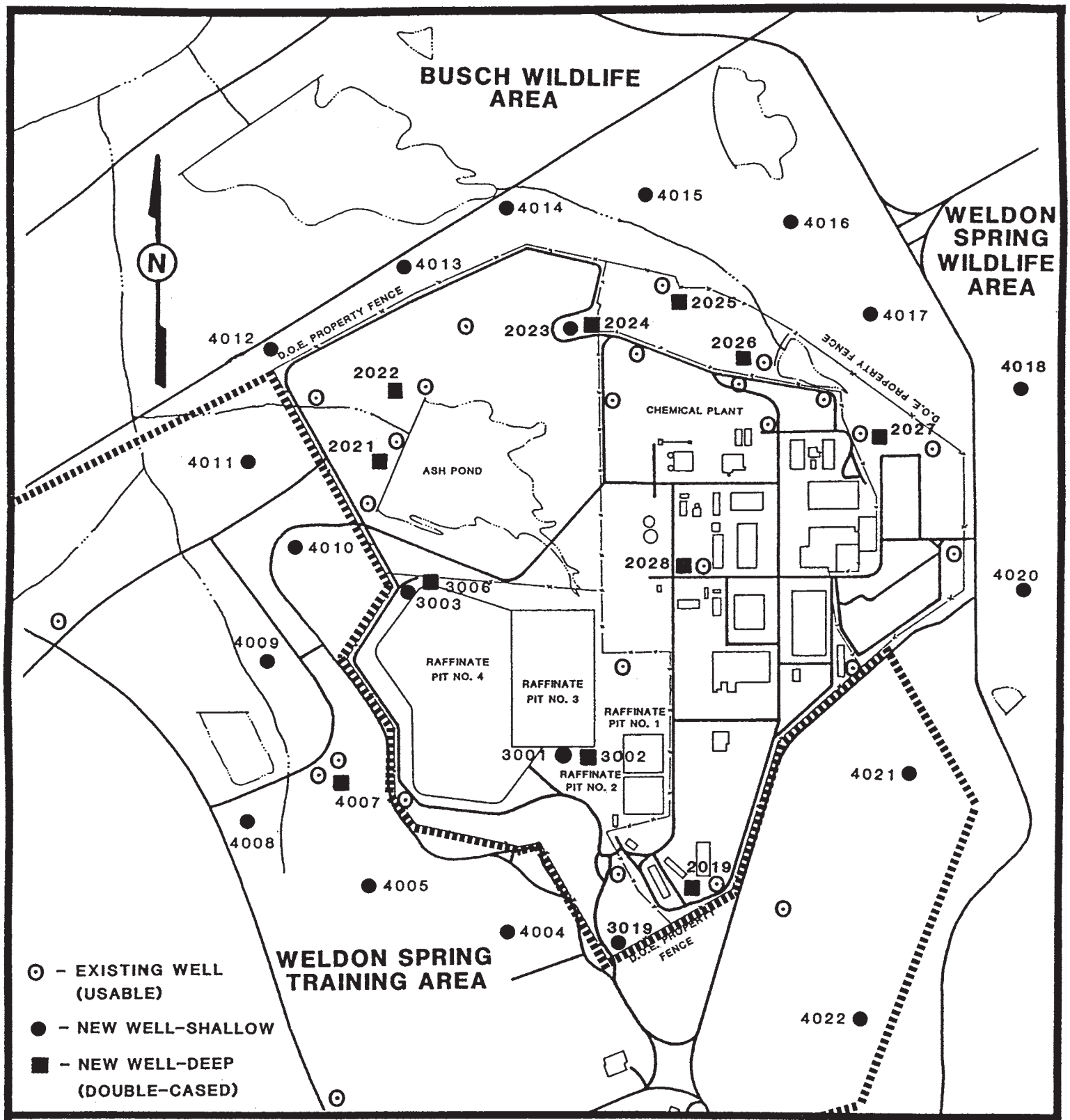
Source : MK Ferguson 1987



STATION 6

Area Of 2,6 - Dinitrotoluene (DNT) Contamination At The Weldon Spring Site.

Source : MK Ferguson 1987



STATION #6

EXTENDED MONITORING WELL NETWORK

GROUND WATER CONCERNS AT THE WELDON SPRING QUARRY

The Weldon Spring Quarry (WSQ) was originally excavated in 1941-1942 and has been used for waste disposal since 1942. Wastes currently present at the Weldon Spring Quarry (WSQ) include: nitroaromatic residues, uranium processing wastes, PCB, and others.

The Weldon Spring Quarry (WSQ) is excavated into the massive limestone comprising the Kimmswick Formation . Solution-enlarged fractures and vertical joints are present in the Kimmswick and are preferred pathways for contaminant migration. A one-half acre sump is present in the Weldon Spring Quarry (WSQ) and receives nearly all precipitation falling on the nine-acre Weldon Spring Quarry (WSQ). This sump appears to cause at least a seasonal mounding effect leading to contaminant migration in several directions. At the present time, contamination is known to exist in the alluvium to the south of the Weldon Spring Quarry (WSQ) and may be present on the north and west sides. Additional investigations are planned.

The major concern at the Weldon Spring Quarry (WSQ) is its proximity to the St. Charles County Well Field. This well field draws approximately 13 million gallons of water from 5 wells completed in the alluvial sediments of the Missouri River. The wells produce about 2000 gpm with 10 to 20 feet of drawdown. Recharge of the alluvial aquifer is primarily (~95%) from the Missouri River.

To date, ground water contamination (radiological and nitro-aromatics) appears to be limited to the area north of the Femme Osage Slough. Recently installed wells will improve monitoring capabilities in the Weldon Spring Quarry (WSQ) area.

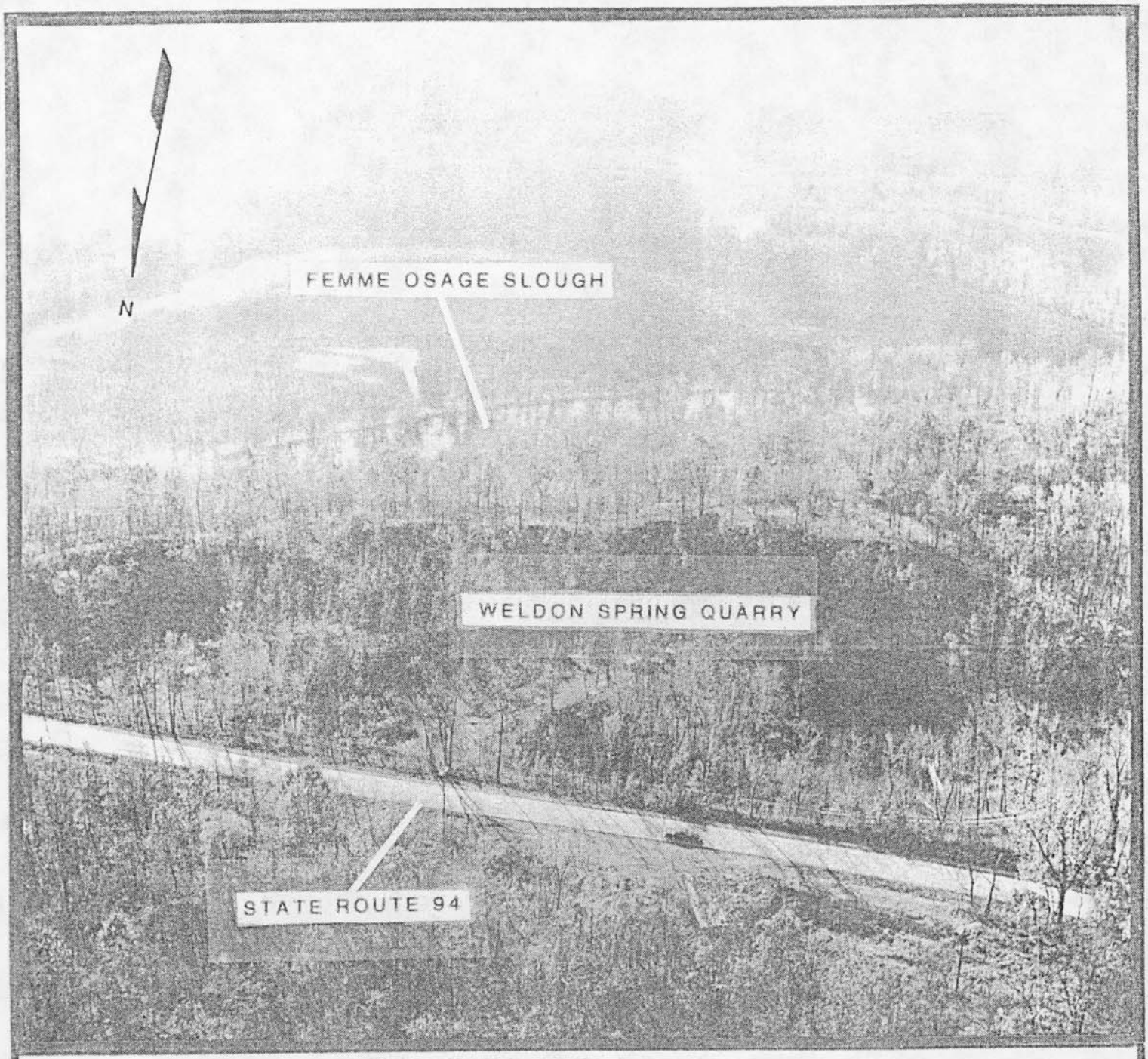
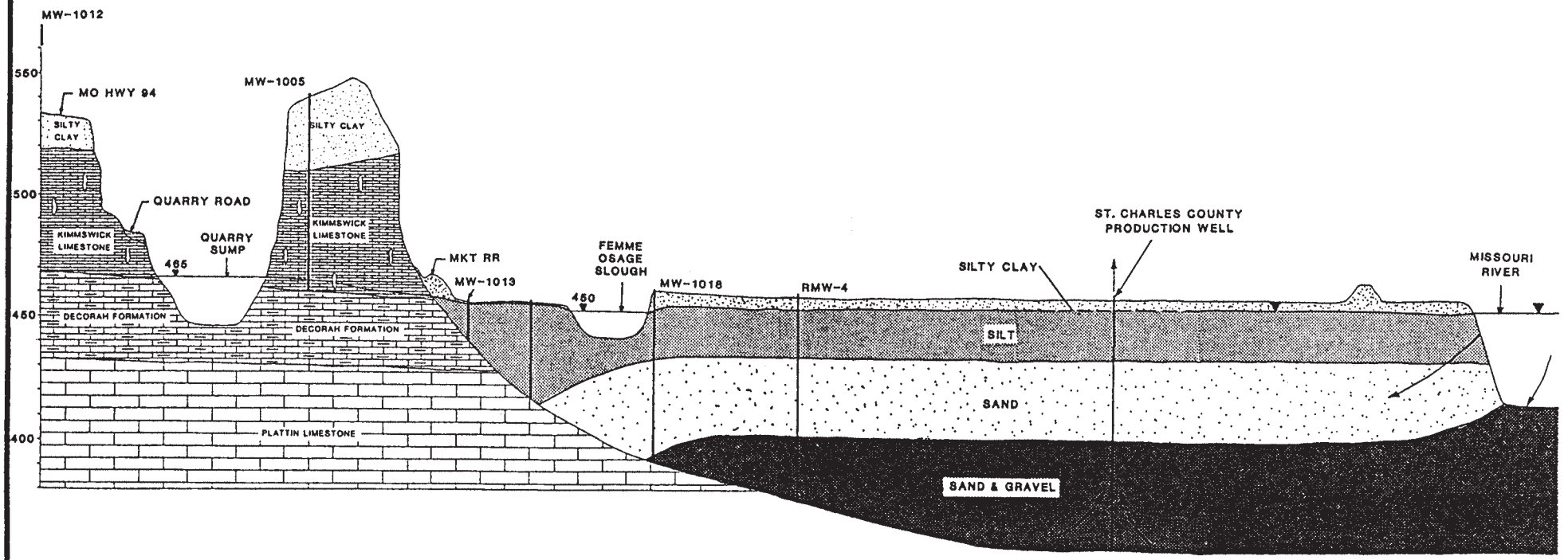


FIGURE 1-4

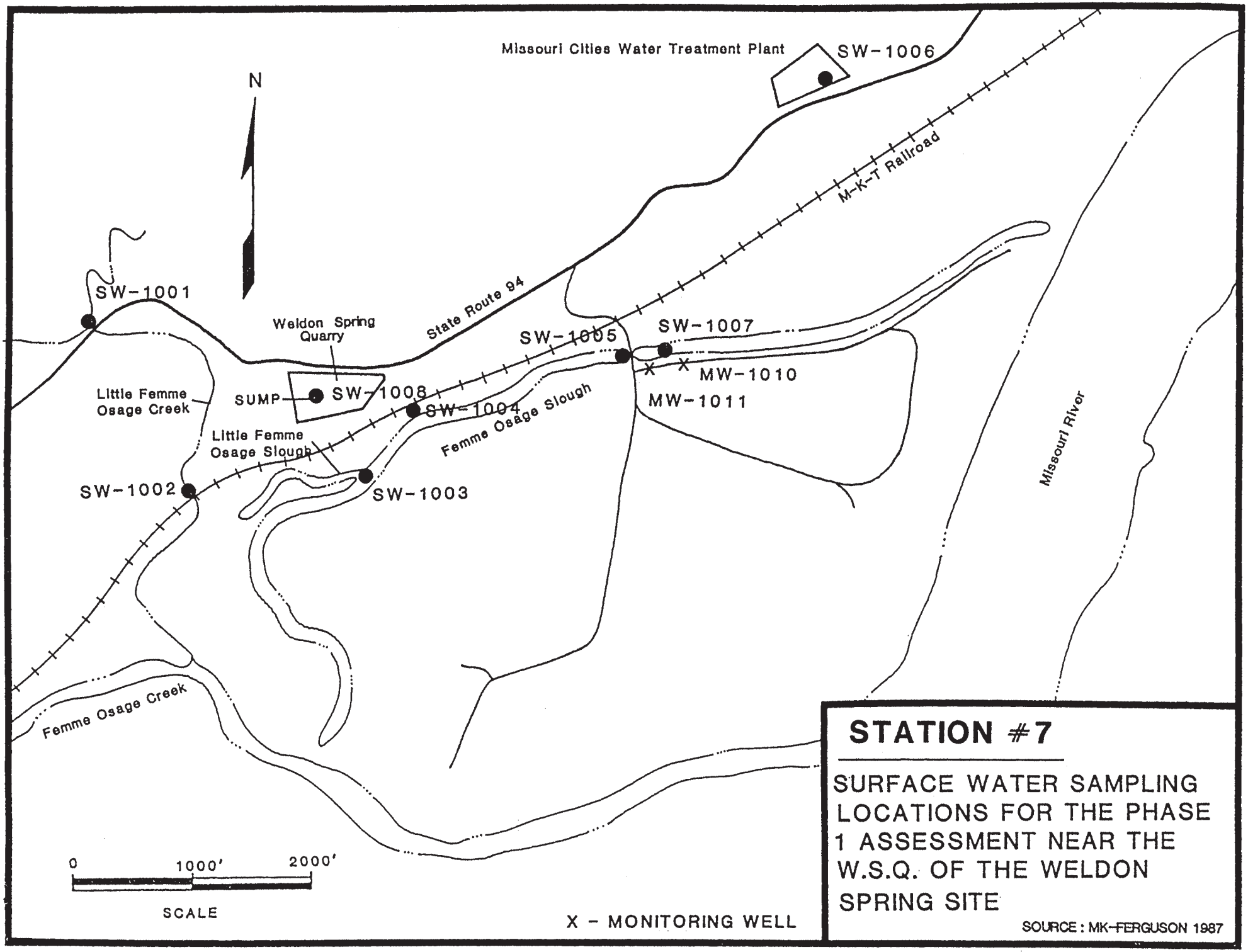
AERIAL VIEW OF THE W.S.Q..



STATION #7

HYDRO-GEOLOGIC CROSS-SECTION THROUGH W.S.Q.

SOURCE : MK-FERGUSON


Missouri Cities Water Treatment Plant
SW-1006
N
M-K-T Railroad
SW-1001
Weldon Spring Quarry
State Route 94
SW-1005
SW-1007
MW-1010
MW-1011
Little Femme Osage Creek
SUMP
SW-1008
SW-1004
Femme Osage Slough
Little Femme Osage Slough
Missouri River
SW-1002
SW-1003
Femme Osage Creek
0
1000'
2000'
SCALE
X - MONITORING WELL
STATION #7
SURFACE WATER SAMPLING LOCATIONS FOR THE PHASE 1 ASSESSMENT NEAR THE W.S.Q. OF THE WELDON SPRING SITE
SOURCE : MK-FERGUSON 1987