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TOPICS OF DISCUSSION



- I. BACKGROUND OF GAS STORAGE IN MINED CAVERNS

- II. SITE SELECTION AND VERIFICATION PROCESS (Geotechnical Feasibility Study)

- III. MARYLAND STUDY AREA GEOLOGY AND SELECTION OF PROSPECTIVE CAVERN AREA

I. BACKGROUND OF GAS STORAGE IN MINED CAVERNS



- ◆ NATURAL GAS SUPPLY/DEMAND
- ◆ SURFACE VS. UNDERGROUND STORAGE
- ◆ TYPES OF UNDERGROUND STORAGE
 - POROUS MEDIA
 - SALT CAVERNS (Solution Mined)
 - ROCK CAVERNS (Conventionally Mined)
 - Igneous Rock - Dolomite
 - Metamorphic Rock - Anhydrite
 - Limestone - Shale
- ◆ BASIC GEOLOGICAL AND HYDROLOGICAL REQUIREMENTS FOR ROCK CAVERNS
- ◆ EXAMPLES OF GAS STORAGE IN MINED CAVERNS

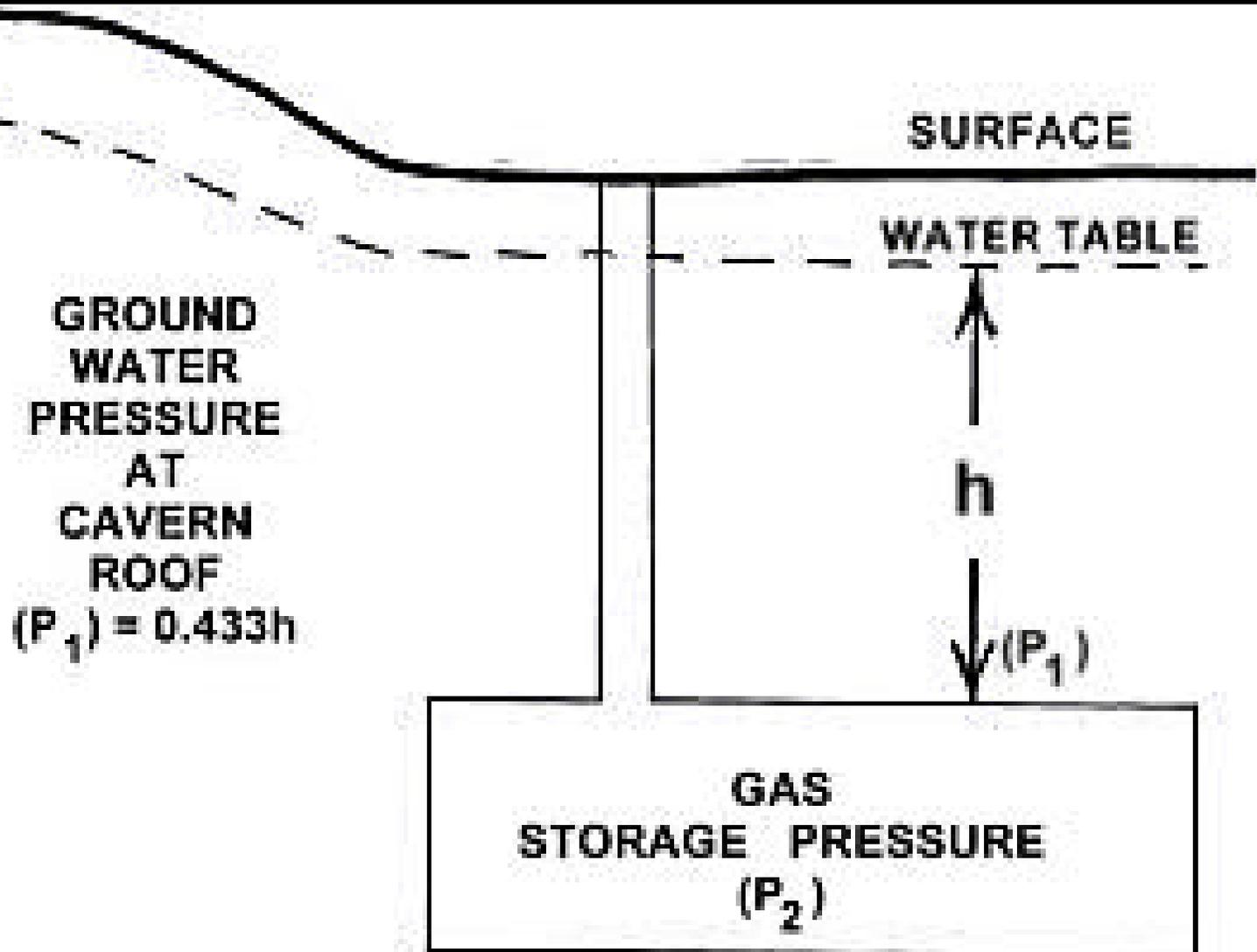
BASIC GEOLOGICAL AND HYDROLOGICAL REQUIREMENTS



- ◆ ADEQUATE ROCK STRUCTURAL STRENGTH
- ◆ LOW ROCK PERMEABILITY
- ◆ ADEQUATE GROUND WATER PRESSURE OVER CAVERN (See Figures)
- ◆ CAVERN ROCK NONREACTIVE WITH STORED PRODUCT
- ◆ CAVERN ROCK NOT WATER SENSITIVE

BASIC HYDROLOGIC GAS CONTAINMENT PRINCIPLE

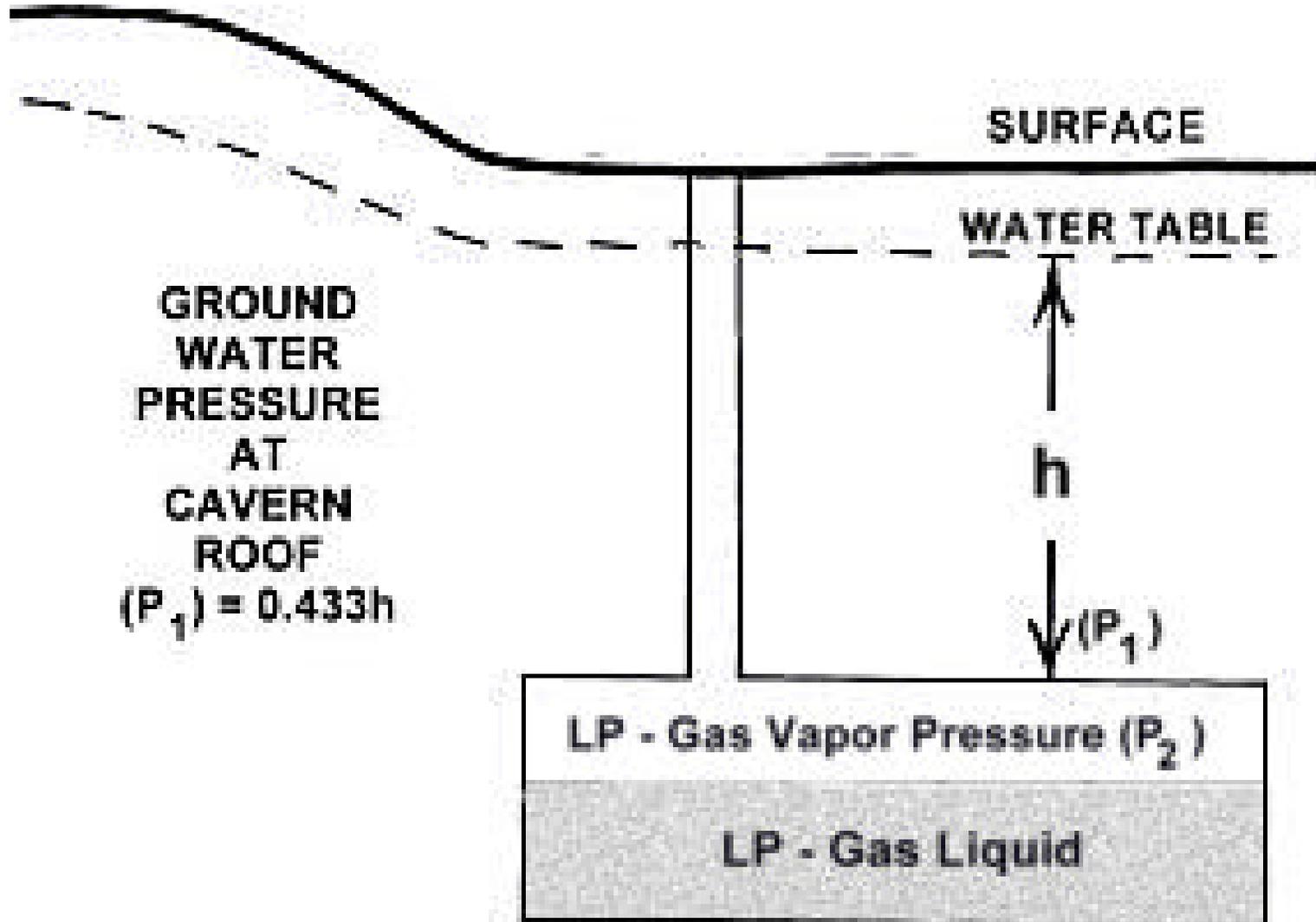
(Natural Gas Illustration)



HYDROLOGIC CONTAINMENT REQUIREMENT: $P_1 > P_2$

BASIC HYDROLOGIC GAS CONTAINMENT PRINCIPLE

(LP - Gas Illustration)



HYDROLOGIC CONTAINMENT REQUIREMENT: $P_1 > P_2$

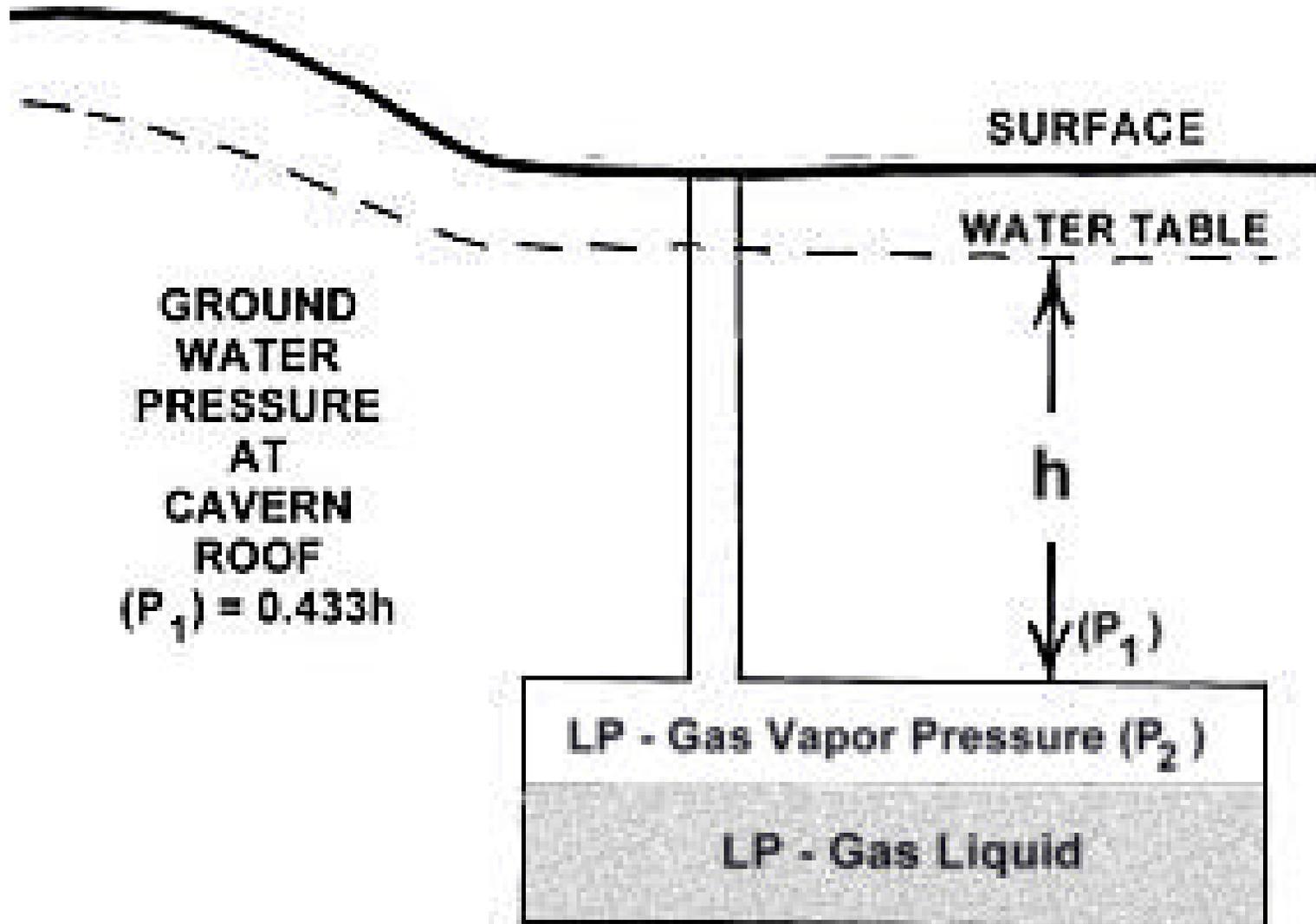
EXAMPLES OF GAS STORAGE IN MINED CAVERNS



- ◆ COMPRESSED AIR STORAGE IN MINES
- ◆ LIGHT HYDROCARBON LIQUID STORAGE IN CAVERNS
 - LP-GAS
 - OLEFINS
 - ANHYDROUS AMMONIA
- ◆ NATURAL GAS STORAGE IN COAL MINES
- ◆ COMPRESSED AIR CUSHION CHAMBERS FOR UNDERGROUND HYDROPOWER PLANTS

BASIC HYDROLOGIC GAS CONTAINMENT PRINCIPLE

(LP - Gas Illustration)



HYDROLOGIC CONTAINMENT REQUIREMENT: $P_1 > P_2$

II. SITE SELECTION AND VERIFICATION PROCESS

(Geotechnical Feasibility Study)



- ◆ PRELIMINARY GEOTECHNICAL INVESTIGATIONS
- ◆ INTERMEDIATE GEOTECHNICAL INVESTIGATIONS
- ◆ DETAILED GEOTECHNICAL INVESTIGATIONS

PRELIMINARY GEOTECHNICAL INVESTIGATIONS



- ◆ SCOPE OF PROJECT DETERMINATION
- ◆ STUDY AREA SELECTION
- ◆ GEOLOGICAL/GEOPHYSICAL/HYDROLOGICAL INFORMATION SEARCH
- ◆ PRELIMINARY SEISMIC RISK EVALUATION
- ◆ PRELIMINARY STUDY AREA INSPECTION AND SITE SELECTION
- ◆ PRELIMINARY BUDGET CONSTRUCTION COST ESTIMATE

INTERMEDIATE GEOTECHNICAL INVESTIGATIONS



- ◆ PHOTOGEOLOGIC INSPECTION
- ◆ GEOLOGIC MAPPING
- ◆ SURFACE GEOPHYSICAL SURVEYING
- ◆ FINAL SELECTION OF PREFERRED SITE
- ◆ PLANNING OF CORE DRILLING AND TESTING PROGRAM
- ◆ SELECTION OF CORE DRILLING AND LABORATORY CONTRACTORS

DETAILED GEOTECHNICAL INVESTIGATIONS



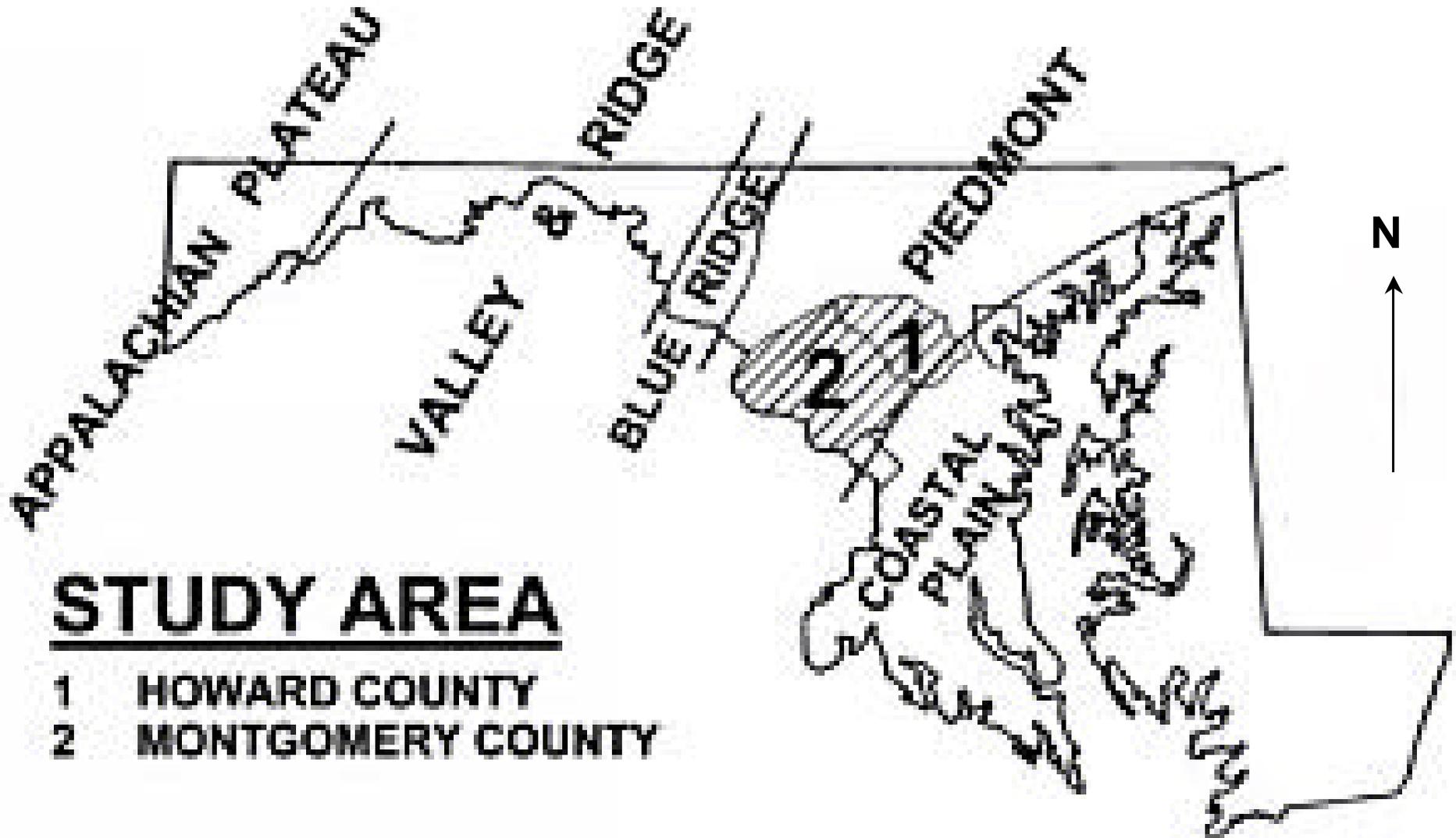
- ◆ CORE DRILLING
- ◆ CORE LOGGING
- ◆ CORE HOLE HYDROLOGIC TESTING
- ◆ CORE HOLE GEOPHYSICAL LOGGING
- ◆ IN SITU STRESS DETERMINATION
- ◆ LABORATORY TESTING OF REPRESENTATIVE CORE SAMPLES
- ◆ PREPARATION OF GEOTECHNICAL FEASIBILITY REPORT
- ◆ CONCEPTUAL STORAGE FACILITY DESIGN AND COST ESTIMATE

III. MARYLAND STUDY AREA GEOLOGY AND SELECTION OF PROSPECTIVE CAVERN AREA



- ◆ SUMMARY OF PRELIMINARY GEOTECHNICAL INVESTIGATION
- ◆ MARYLAND PHYSIOGRAPHIC PROVINCES (See Figure)
- ◆ GEOLOGY AND PROSPECTIVE CAVERN AREA - Howard and Montgomery Counties (See Figure)
- ◆ GEOTECHNICAL ASSUMPTIONS FOR CONCEPTUAL CAVERN DESIGN

MARYLAND PHYSIOGRAPHIC PROVINCES

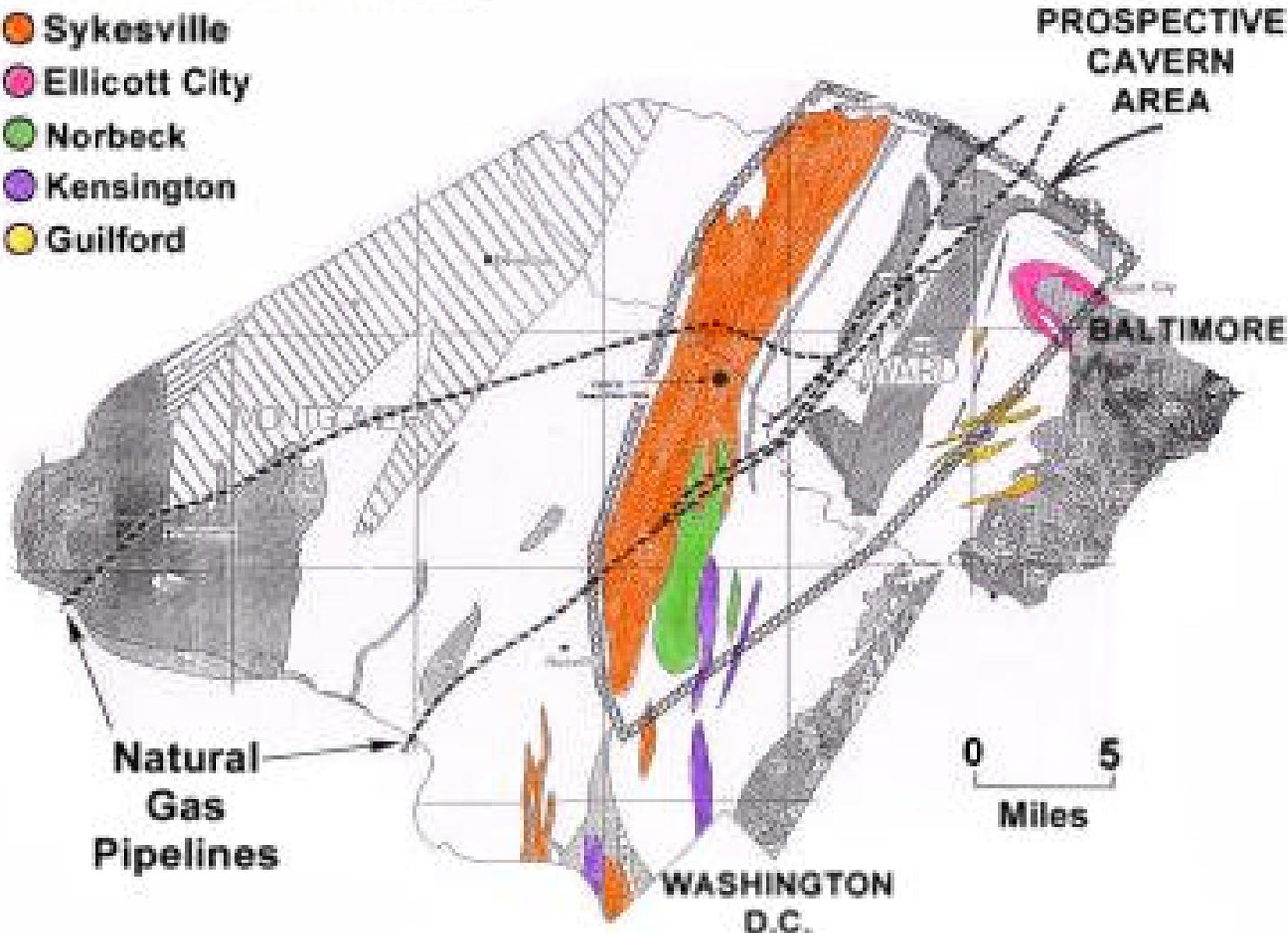


GEOLOGY AND PROSPECTIVE CAVERN AREA

Howard and Montgomery Counties

FAVORABLE FORMATIONS

- Sykesville
- Ellicott City
- Norbeck
- Kensington
- Guilford



GEOLOGICAL CONCLUSION



- ◆ GOOD QUALITY ROCK SUITABLE FOR DEEP REFRIGERATED CAVERN CONSTRUCTION APPEARS TO EXIST IN STUDY AREA