

GEOHERMAL THERMAL ENERGY TRANSFER Profitable, More Efficiency Cannabis Growth

Carl Orio, Chairman, CGD, AI
ZACH PATNAUDE, M.Me, AI, Project
Manager

Design & Training Division
Water Energy Distributors Inc
Hampstead NH



GROW FACILITY and GEOTHERMAL

- ▶ **GEO 101**
 - **Different Earth Heat Transfer Systems and Which is Right for You**
 - **How does a Geothermal Earth Coupling Work**
- ▶ **GROW FACILITY BENEFITS**
- ▶ **CASE STUDY OF A LARGE GROW FACILITY**



ABOUT WATER ENERGY

**DISTRIBUTING, DESIGNING & TRAINING - OVER 20,000
GEOTHERMAL HEAT PUMPS SINCE 1974.**

- ▶ **NORTHEAST & NEAR-BY NEW YORK - Primary**
- ▶ **STAFF INCLUDES: TWO AEE/IGSHPA CERTIFIED
GEOEXCHANGE (CGD) DESIGNERS, TWO NATE CERTIFIED
INSTRUCTORS**
- ▶ **ACTIVE ASHRAE TRANSECTIONS, SEMINARS &
RESEARCH**
- ▶ **PLUS: AUTHOR/COAUTHOR:**
 - “ MODERN GEOTHERMAL HVAC, ENGINEERING..”***
McGRAW- HILL TEXT-
 - “NEW YORK CITY GEOTHERMAL MANUAL”- NYC DDC***
 - “ANSI/IGSHPA/CSA - 448-16 – “GEOTHERMAL HEAT PUMP
STANDARD”***

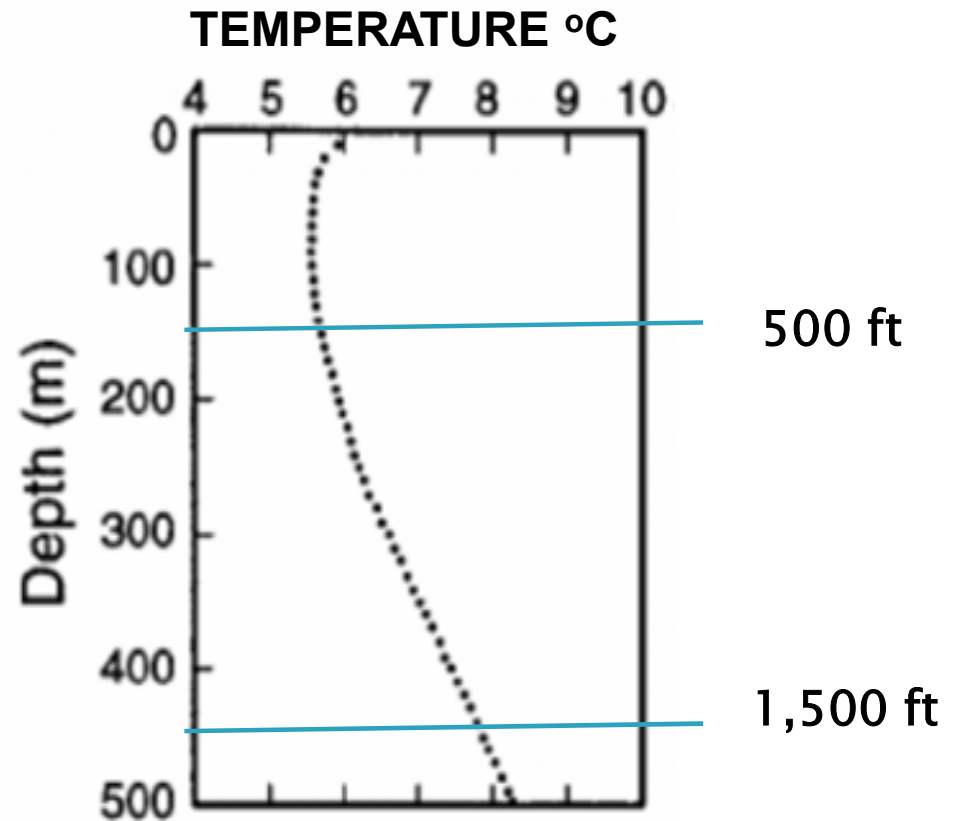
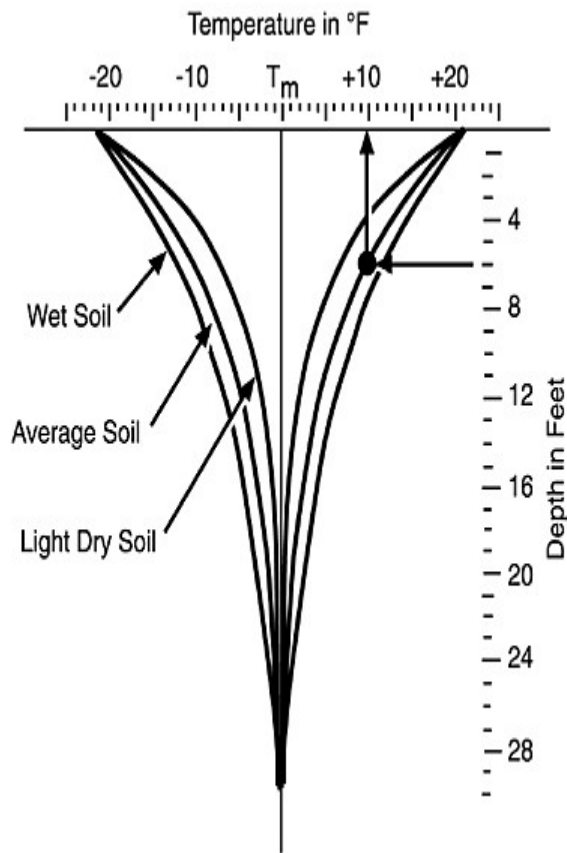


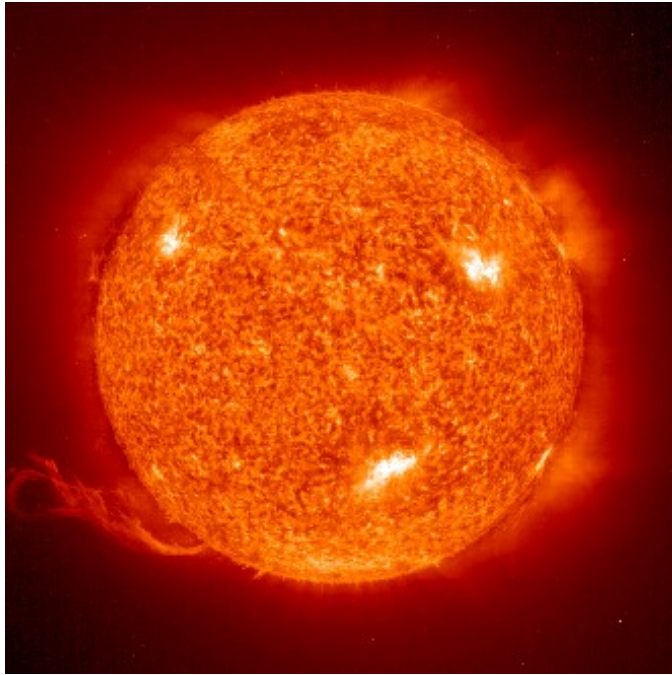
How Does Geothermal Work?



**EARTH'S LITHOSPHERE IS A
MASSIVE THERMAL ENERGY
STORAGE AND TRANSMISSION
MEDIA**

EARTH AS A HEAT SOURCE AND STORAGE MEDIA





- ▶ THE SOURCE OF EARTH ENERGY IS DERIVED FROM NUCLEAR REACTIONS
- ▶ THE MAJORITY COMES FROM OUR SUN –
- ▶ 50% IS ABSORBED, STORED & RE-EMITTED INTO THE EARTH

*MUCH OF THE EARTH ENERGY IS
STORED IN THE EARTH'S WATERS*

Why Is Earth Coupling Right Match For Thermal Energy Transfer??



EVERY 55 DAYS –



The waters of the
earth, both surface
and underground
**ABSORB, STORE &
RE-EMIT**

as much sun energy
as all the known oil
and gas reserves in
the world

What are my EARTH COUPLING OPTIONS ?

HOW CAN WE TAP INTO THE EARTH TO TRANSFER ENERGY?

GEOHERMAL HEAT PUMPS

EARTH COUPLING OPTIONS

- **Closed Loop Applications**
- **Standing Column Wells**
- **Open Well Applications**

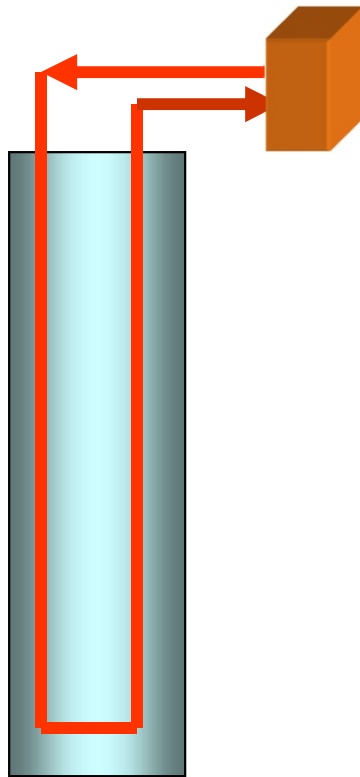


Earth Coupling

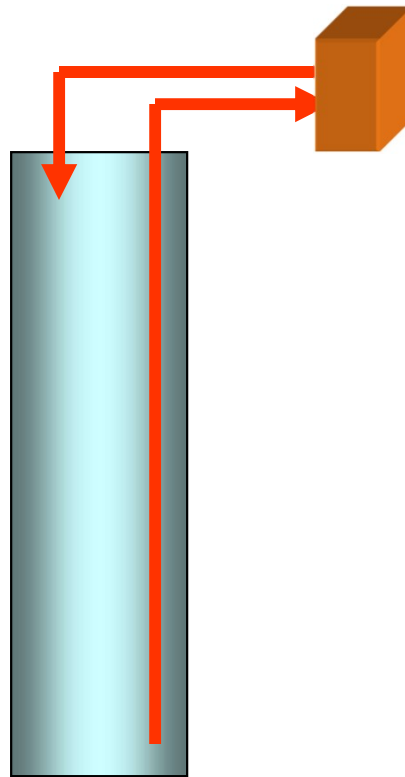
Water Energy Design

Types of Earth Coupling

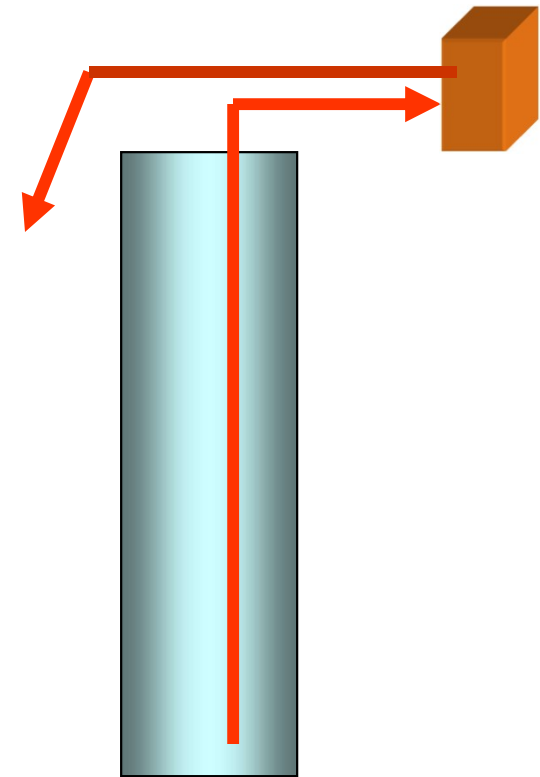
Closed
Loop



Standing
Column

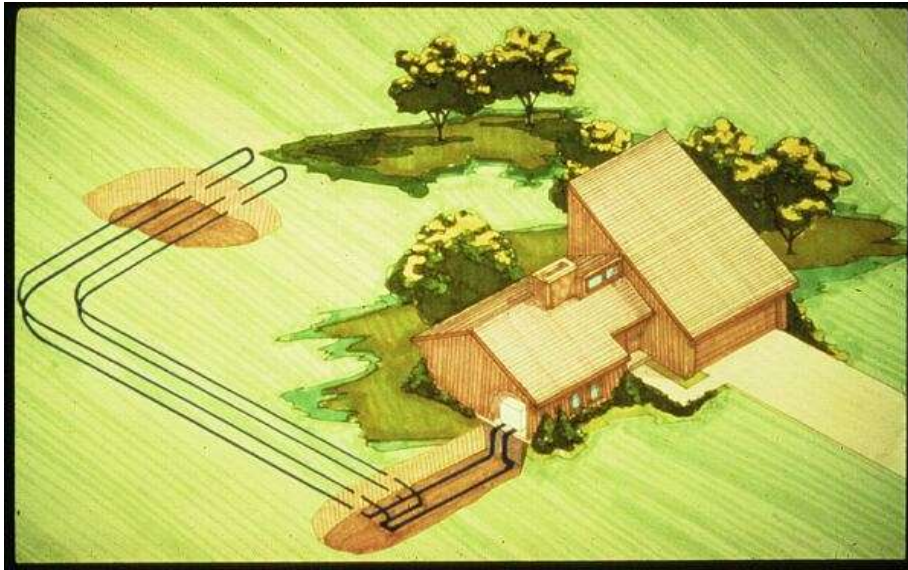


Open to
Recycle



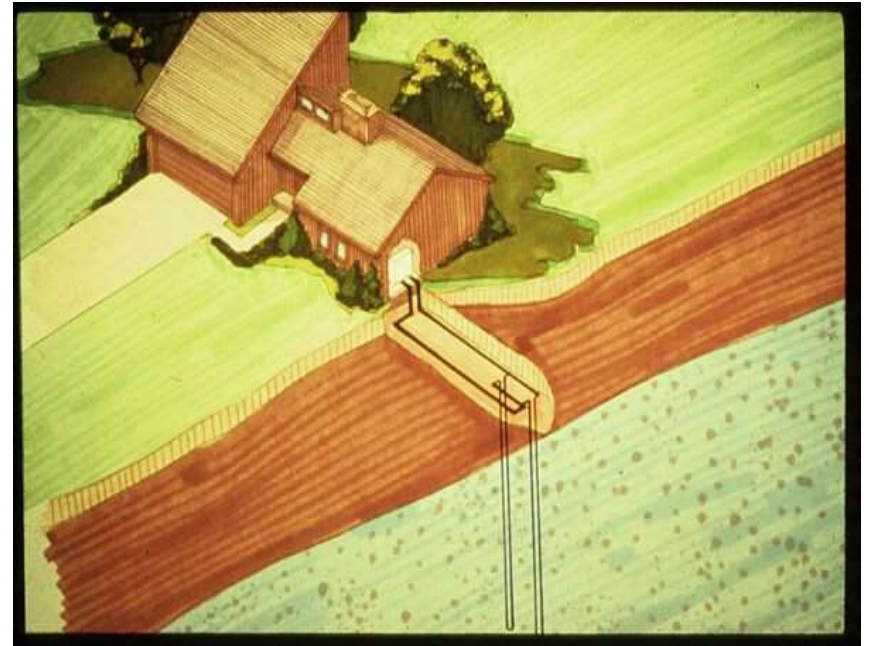
EARTH COUPLING

Typical Closed Loop



Horizontal Closed Loop

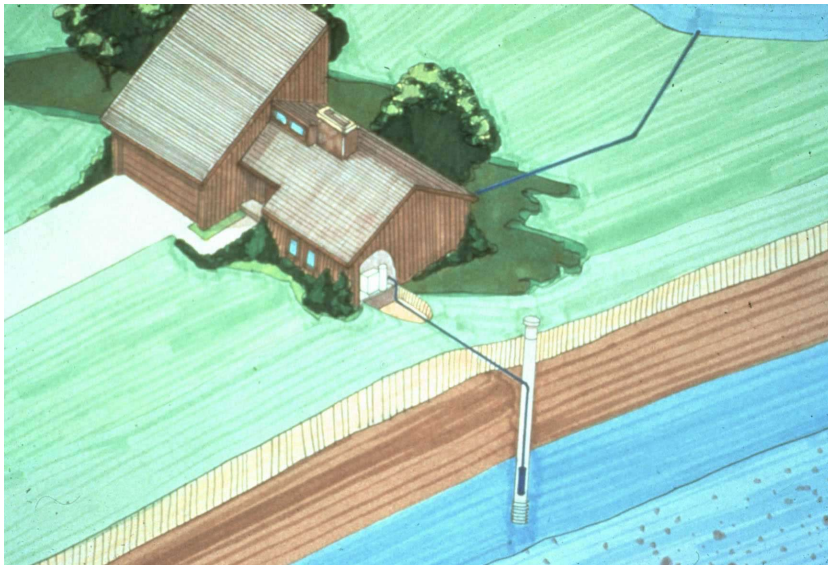
Vertical Closed Loop



Earth Coupling

EARTH COUPLING

Standing Column Well



A Standing Column Well
Bridges the Gap
between the Closed
Loop System and the
Open-Recycle System

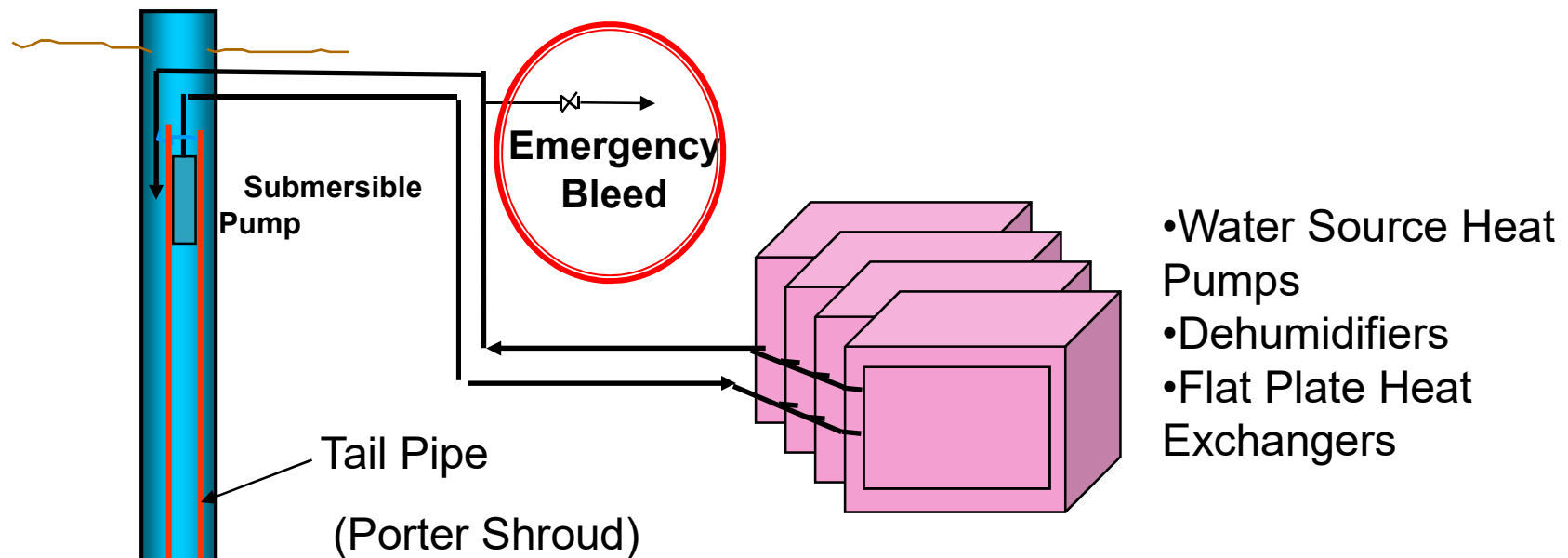
EARTH COUPLING CHOICES

Closed ↔ Standing Column ↔ **Open**

Earth Coupling

Standing Column Well

COMMERCIAL- Thermal Energy Transfer



Typically 500-1,500 ft
30-43 tons/ bore -

6" & 8" bores

Urban Costs may also include traffic, protection, unions, abutters, rehab, etc

STANDING COLUMN WELL THERMAL CAPACITY & BLEED RATE

**GEOLOGY & BLEED
RATE CAN
INCREASE A SINGLE
SCW TO 40+ TONS
OF HEAT
TRANSFER**

*Figure ASHRAE RP-
1119*

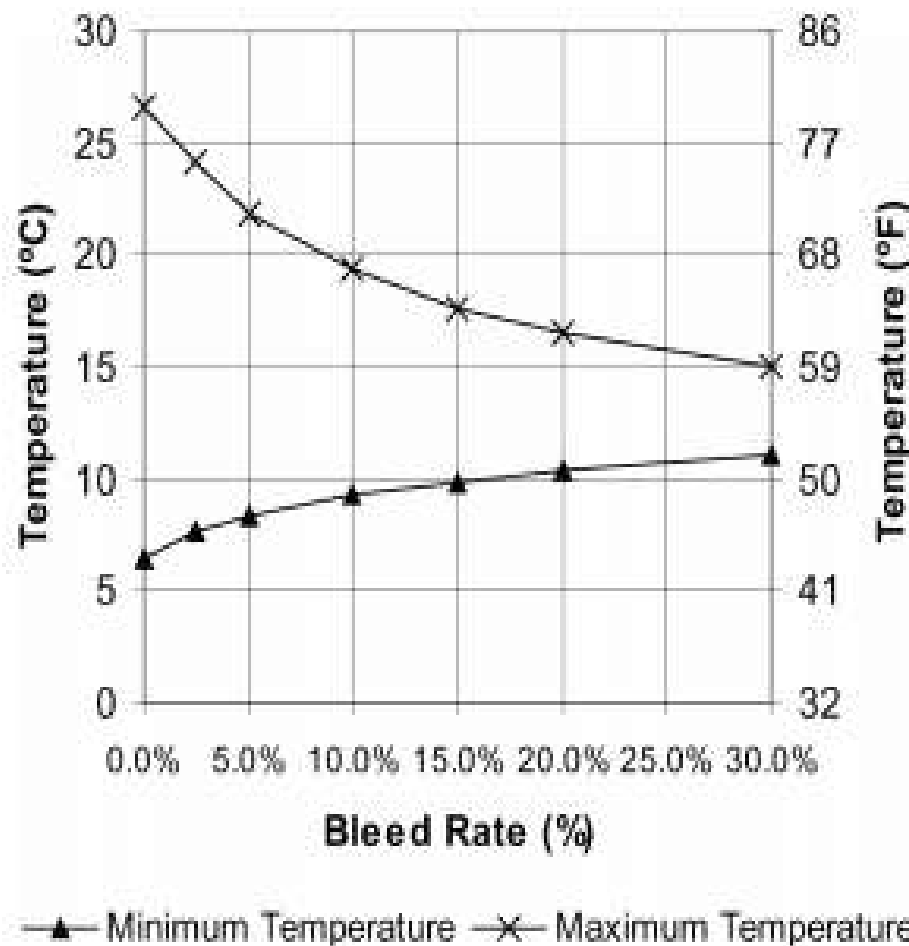
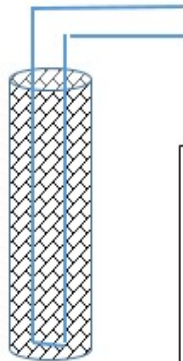


Figure 8 *The effect of bleed rate on the water temperature back to the heat pump.*

CLOSED LOOP BORE



Flow of 7
gpm for
2.5 tons

500 feet
Depth =
1,000 feet
1.25"
HDPE

Practical
500 foot
bore is 6
inches in
diameter.

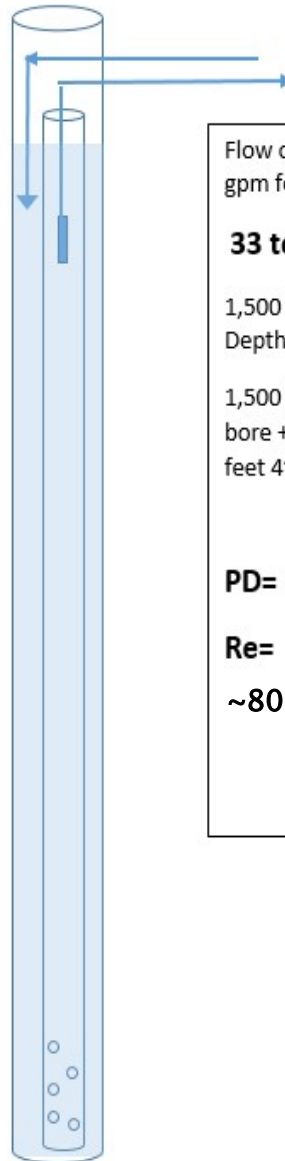
Bore is
filled with
thermal
grout

PD=20psi

**Re=
~3,000**

Reynold Number (Re) must be
above 2,000 to provide turbulent flow
with efficient heat transfer on HDPE
pipe and on rock bore surface.

STANDING COLUMN WELL



Flow of 100
gpm for
33 tons

1,500 feet
Depth =
1,500 feet 6"
bore + 1,500
feet 4" pipe

PD= 23 psi

**Re=
~80,000**

CLOSED LOOPS VS. STANDING COLUMNS FOR ENERGY STORAGE -

**OVER 10x MORE
THERMAL TRANSFER
PER WELL**

Water Energy Design

EARTH TEMPERATURE GRADIENT ABOUT A BORE HOLE

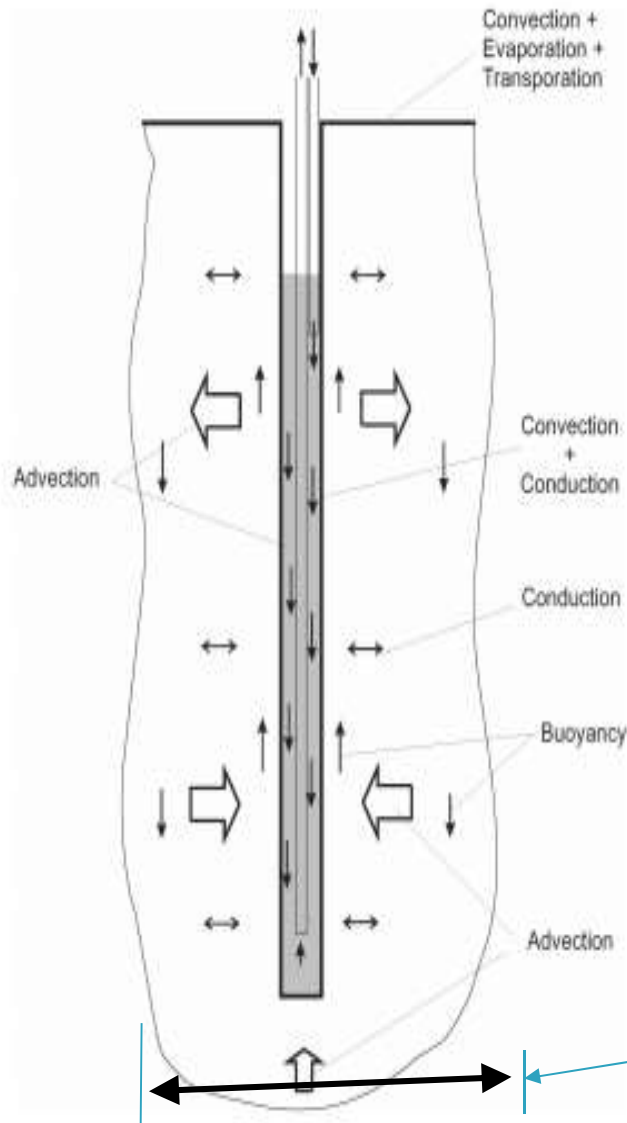


Figure 1 A diagram showing the different modes of heat transfer in and around a standing column well.

**Primary Gradient
Approximately 50 feet**

*figure ASHRAE
RP-1119*

Compare 100 Ton Thermal Load Grow Facility

Closed Loop

40x 500' Wells Required

Total Drilled Depth:
20,000'

Estimated Amount of Pipe
Required: 50,000'+

Real Estate Required: ~0.5
Acres

Standing Column

3x 1500' Wells Required

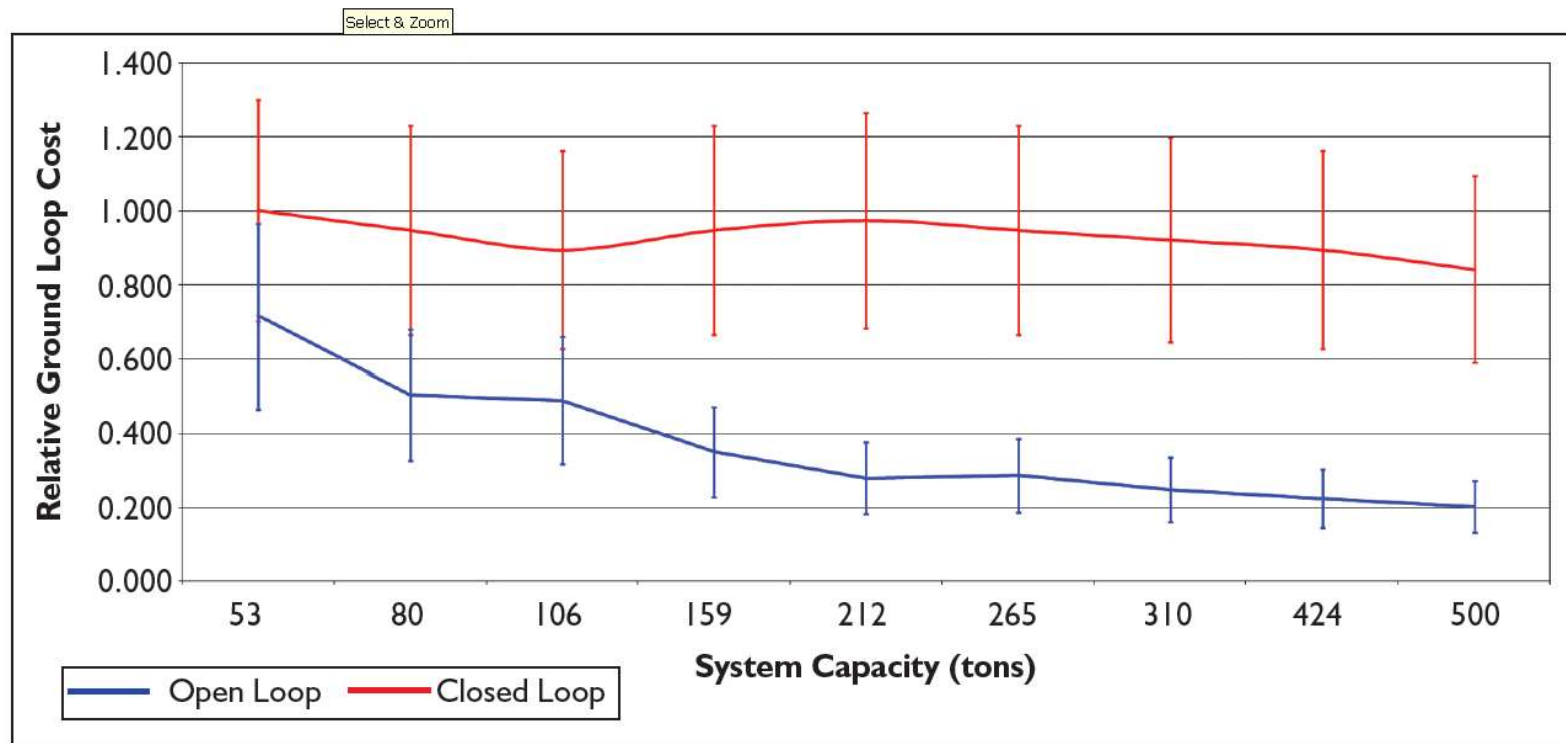
Total Drilled Depth:
4,500'

Estimated Amount of Pipe
Required: 1,500'+

Real Estate Required:
~0.05–0.1 Acres

**10 Times Less Real Estate Required!!
...AND IS LESS EXPENSIVE**

Comparative Cost of Open vs. Closed Loop



Rafferty -ASHRAE Journal March 2009

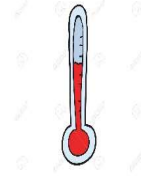
Grow Facilities & Their Thermal Needs



REQUIREMENTS FOR OPTIMUM GROWTH

CONTROL OF:

▶ **TEMPERATURE**



▶ **HUMIDITY**



▶ **LIGHT**



LED vs HPS
Grow Lights

**ALL
REQUIRE
THERMAL
ENERGY
TRANSFER**

▶ **GROW WATER TEMPERATURE
AND AVAILABILITY**



Thermal Requirements

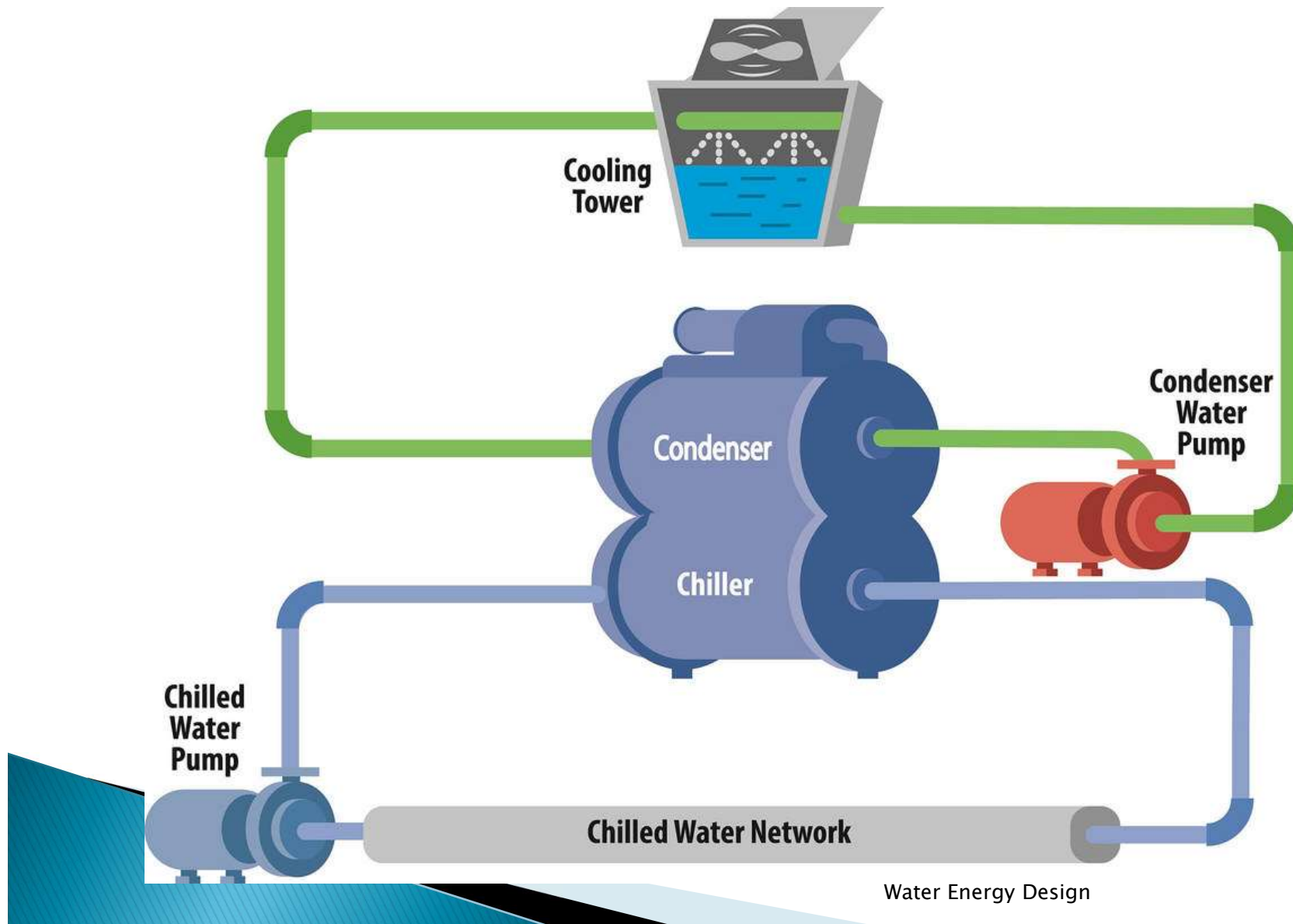
COOLING REQUIREMENT FOR:

- HUMIDITY CONTROL
- REHEAT (as required)
- LIGHTING COOLING
- GROW ROOM CONDITIONING
 - *ABILITY TO VARY GROW ROOM TEMPERATURE DURING VEGITATION & HARVEST PHASES OR (NIGHT & DAY)*

HEATING REQUIREMENT FOR

- GROW WATER
- DOMESTIC & SANITATION
- OFFICE/LAB COMFORT

How are Thermal Loads Resolved?



Chiller/Cooling Tower Vs Geothermal

CHILLER & COOLING TOWER SYSTEM

- ▶ Peak Performance occurs at lowest outdoor temperature
- ▶ No ability to store heat, any heat that cannot be rejected by system stays in building
- ▶ Visible on site taking up real estate (possibly on roof)
- ▶ Maintenance & water cost \$\$
- ▶ Substantial roof structural strength or large surface mount

Humidity Affects Cooling Tower Performance

GEO THERMAL EARTH COUPLING

- ▶ Constant Performance due to constant ground temperature
- ▶ Ability to store thermal energy in the ground, results in slowly warming surrounding earth
- ▶ Minimal Maintenance cost
- ▶ Buried Underground – out of sight/sound

CASE STUDY - A SUCCESSFUL GEOTHERMAL GROW APPLICATION

▶ PHYSICAL

- **FITCHBURG MA: 200,000+ Sq FEET OF EXISTING MILL BUILDING**
 - **MULTIPLE & EXISTING STANDING COLUMN WELLS**
-
- ▶ Over 400+ ton cooling requirement (First Floor Only)**
 - ▶ Project initiated 2014**
 - ▶ Facility Operational 2017**

CONVERTED MILL BUILDING FITCHBURG MA



**STANDING
COLUMN WELL
FIELD**

**TWELVE
STANDING
COLUMN WELLS-**

**SPACING 75Ft
APART**

**1,300 FT DEPTH -
Drilled before HVAC
requirements
specified**

**DESIGN BLEED
RATE 20% to
RIVER**

CONVERTED MILL BUILDING FITCHBURG MA

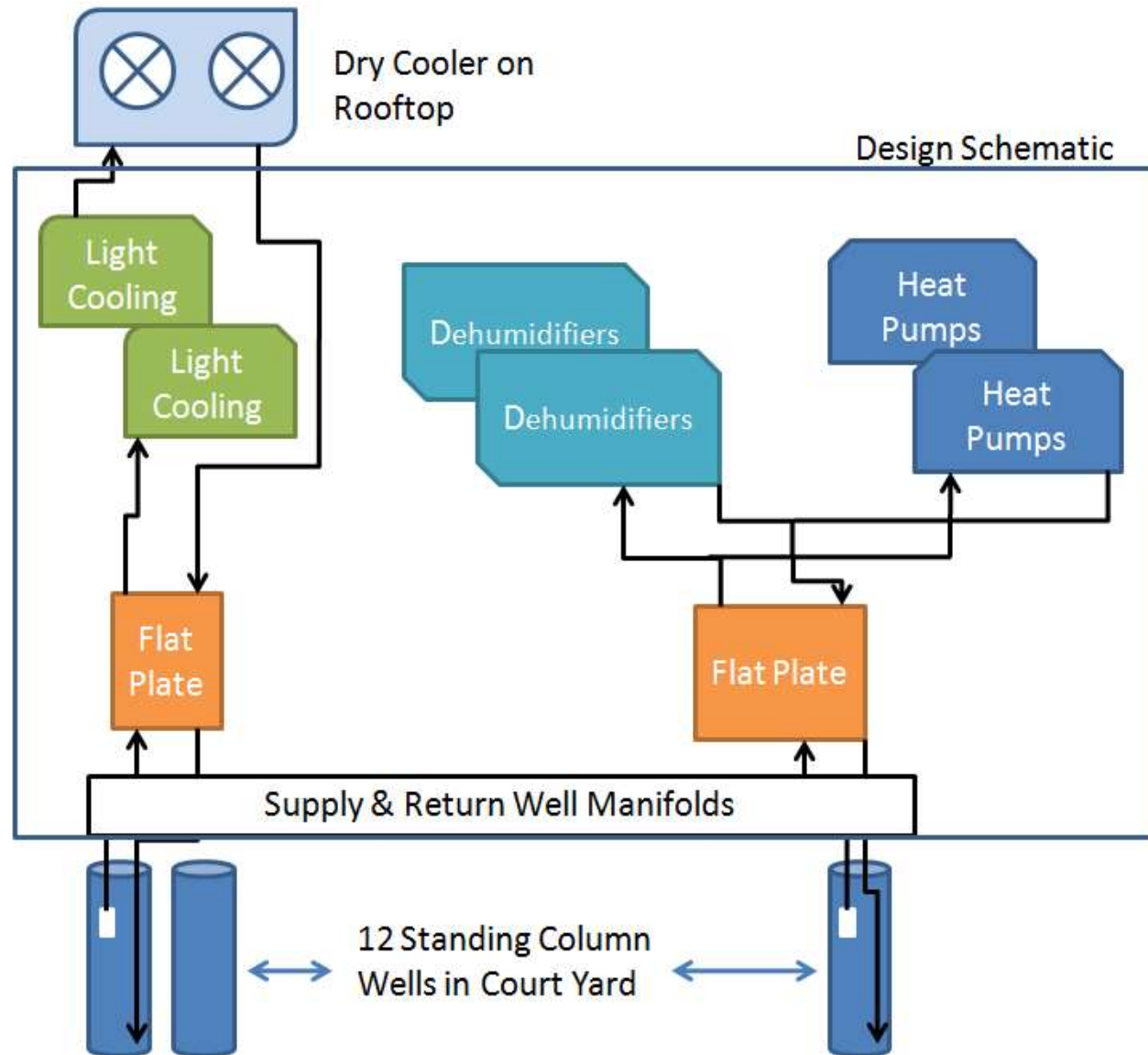


MECHANICAL
ROOM LOCATION

~5 % OF TOTAL
FACILITY AREA

**GEOHERMAL
EARTH
COUPLING
CAN SAVE
INCOME
PRODUCING
SPACE!**

GEOHERMAL W/ ROOFTOP AUGMENTATION



TAKE AWAYS

- ▶ Geothermal Thermal Energy Transfer Systems can Provide Most Efficient & Lowest Cost Process Cooling and Heating
- ▶ The Earth's Thermal Energy "Bank" Cannot be Duplicated
- ▶ Insensitive to the Thermal System internal to the facility
- ▶ Geothermal HVAC Systems are Not Seasonally Temperature Dependant



Thank You

questions ?



WATER ENERGY

NORTHEASTGEO.COM