

NEW APPLICATION



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SOUTHWEST GAS CORPORATION

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May 31, 2001

Ms. Deborah Scott, Director
Utilities Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

G-01551A-01-0463

Dear Ms. Scott:

Pursuant to Decision No. 60352 issued in Docket No. U-1551-96-596, Southwest Gas Corporation herewith submits an original plus 10 copies of its Low Income Energy Conservation Extension Proposal for Staff's review and Commission approval.

If you have any questions, please contact the undersigned at 702-364-3271.

Very truly yours,

Edward B. Giesecking
Manager, State Regulatory Affairs

jmd

Enclosures

c Mr. Robert Gray, ACC
Parties of Record (w/o encl.)

Arizona Corporation Commission
DOCKETED

JUN 01 2001

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CERTIFICATION OF SERVICE

The undersigned hereby certifies that on the 31st day of May 2001, the following parties received notification by mail that Southwest Gas Corporation submitted its Low Income Energy Conservation Extension Proposal to the Arizona Corporation Commission Staff:

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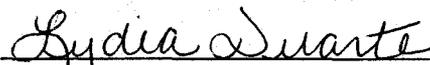
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An employee of
SOUTHWEST GAS CORPORATION

**SOUTHWEST GAS CORPORATION
PROPOSED EXTENSION AND EXPANSION
LOW-INCOME ENERGY CONSERVATION PROGRAM
JULY 2001 THROUGH JUNE 2004**

Program Objectives

- Promote energy and water conservation, education, health, and safety.
- Partner with other funding sources to cost-effectively conserve energy and/or improve the health and safety of participating households.
- Participants will be informed and encouraged to apply for the Southwest Gas Corporation's (Southwest or SWG) Low Income Residential Gas Service (LIRA) rate.

Customer benefits will include increased end-use efficiency, increased customer control over energy use and monthly bills, and increased comfort and safety. Not only is this an investment in the lives of those in need, it is an investment in the economic and environmental well being of the community as well.

Eligibility Criteria

- Southwest customers with a household income up to 125% of the poverty guidelines established by the federal Office of Management and Budget. Those customers who are elderly (age 60 and over) or handicapped may have an income of up to 150% of the federal poverty level.
- Owner occupied or rental (with the consent of the owner) units.

Program Operation

Conducted by Southwest through the Arizona Department of Commerce - Energy Office's (AEO) statewide weatherization program. The AEO will continue to include funding from SWG in their current contracts with community agencies.

Program Design and Services

Participants request assistance through the community agencies, who will screen respondents based on the criteria previously outlined. After participants have been selected, the agency will conduct an energy audit to gather, record and analyze data on the structures.

The current AEO weatherization program uses some very detailed, but flexible guidelines to optimize investment in energy efficiency through a systems approach. They divide the state into six climate zones. Each of these zones has a corresponding priority list of known cost-effective weatherization materials/measures that they can install. In cases where potentially cost-effective energy upgrades are not listed or are not an approved safety measure, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings-to-investment ratio (SIR). (See Appendix A, pp 3-14)

The air flow through a house can have a powerful impact on comfort, expense and air quality. Therefore, pressure diagnostics are a key activity on every priority list. A Blower Door test will provide a way to quantify air flow and the resulting heat loss. It will also pinpoint specific leaks. This method of air leakage diagnostics and repair is considered essential for effective (and cost-effective) air sealing. The AEO's pressure diagnostic procedures give agency personnel guidance on how much repair may be completed by climate zone to remain cost-effective. (See Appendix A, pp. 15-17)

While in the home, the agency personnel will explain the measures that they installed, and offer a variety of no-cost and low-cost energy conservation tips. They will inform participants, who are not on the LIRA rate, of the benefits, encourage them to sign up and offer assistance in filling out the application.

The AEO will bill Southwest monthly for the weatherization projects completed the prior month. Along with the invoice, they will also provide statistics on the number of customers served, the type of activities completed, detailed activity costs by measure, etc.

Follow up inspections will be conducted on ten percent of the weatherized homes.

Health and Safety

Southwest, the AEO and all subcontracted agencies agree that the health and safety of homeowners and their families is very important. The AEO requires agency personnel to conduct a thorough safety check of each home and it's appliances (see Appendix A, p. A-25). They also follow strict health and safety procedures while performing all weatherization activities for the protection of the occupants and themselves (see Appendix A, pp. A-19 to A-22).

Southwest encourages "Natural Gas Safety" to the entire community through a variety of forums including: brochures/pamphlets; bill inserts; radio; etc. This information is available both in English and Spanish. Anyone, SWG customer or not, can call any local office or our 1-800 number for assistance. SWG personnel are available 24 hours a day to respond to any emergency.

Eligible Activities

Table 1 lists measures that may be completed in eligible homes. All costs (excluding administration) required to complete the needed activities may not exceed \$1,500 per household. The combination of measures in each home must follow the AEO procedural guidelines. Based on past performance the AEO and Southwest agree that allowing agencies to spend up to 25 percent of the annual budget on Health and Safety measures without prior approval will simplify the process, while continuing to keep the overall program cost-effective.

Economic Protocol

Installed conservation measures must be cost-effective. The contracted agencies use the AEO Guidelines to determine which cost-effective measure(s) may be installed in individual households.

Program Evaluation and Reporting

The details of the evaluation and reporting system for this program will be determined in agreement with the Arizona Corporation Commission (ACC) Staff. This information will be included in the semiannual report to the ACC.

Program Budget

The AEO and SWG recognize the need to further assist low-income customers as energy costs have risen significantly. Therefore, Southwest is seeking approval to increase its budget to \$350,000 annually for the continuation of the statewide Low Income Energy Conservation (LIEC) program from July 2001 through June 2004. In order to raise the current LIEC budget to \$350,000, Southwest is requesting the DSM Cap be increased to \$1,250,000 annually. (The current cap of \$1,125,000 was established in Decision No. 60967)

In Decision No. 60352 it was ordered that Southwest "shall commit no more than 23.6 percent of its residential Demand Side Management programs to low-income customers." Therefore, ACC action to remove this limitation is also required to permit an increase in the annual LIEC budget to \$350,000.

Program Funding

The AEO will survey all agencies in February prior to the start of a new program year to review their need and ability to use funds in the new year. The preliminary amount of funds awarded to each agency annually will be based on the historical use of SWG funds, the percentage of potential Southwest Low Income customers in each area and the upcoming program year needs of the agencies. Fifteen percent of the preliminary amount may go toward administrative costs. Five percent will go directly to the AEO for administering the statewide

program, and up to ten percent may be used by the agencies for their local administrative costs. The remaining non-administrative funds will cover ALL costs (supplies and materials, other labor, etc.) incurred while performing the eligible activities listed above, not to exceed \$1,500 per household. (See Table 2)

Program Recommendation

Considering the merits of the current low-income weatherization program administered through the AEO and the benefits of an additional funding source, Southwest recommends a three-year (July 1, 2001 through June 30, 2004) continuation of the LIEC program.

TABLE 1
SOUTHWEST GAS CORPORATION
LOW INCOME ENERGY CONSERVATION PROGRAM
ALLOWABLE MEASURES

Cost Effective Measures	Code
Replacement of broken or missing window glass	YES
Repair/replace of leaking hot water (controlling) valves (kitchen or bath)	YES
Complete replacement of deteriorated/worn out duct systems	YES
Installation of "Low flow" shower heads	YES
Replacement heating system thermostats or relocation thereof	YES
Building Shell (wall, floor, ceiling) Thermal Envelope Insulation	CE
Insider (rigid) Plastic Storm Windows	CE
Repair/replace OPERABLE SEER < 7.0 A/C - "GAS PAC" with new SEER 12.0 "GAS PAC"	CE
"Pressure Envelope" patching & sealing repair materials	CE
Repair inoperable forced air natural gas (FANG) heating system **	CE
Repair inoperable natural gas, wall, floor, or free standing space heater **	CE
Repair inoperable A/C - "GAS PAC" with new SEER 12.0 "GAS PAC" **	CE
Solar shade screens for houses with refrigeration cooling	GAS-PAC
Replacement forced air system filters and filter racks	FANG
Replacement evap cooler "roof Jacks" with damper system	FANG
Health and Safety Measures	Code
Replace inoperable forced air natural gas (FANG) heating system **	H&S
Replace inoperable natural gas, wall, floor, or free standing space heater **	H&S
Replace inoperable A/C - "GAS PAC" with new SEER 12.0 "GAS PAC" **	H&S
Replacement of worn out domestic water heater tank (DHW)	H&S
Replacement kitchen stoves	H&S
Battery powered smoke alarms	H&S

Codes: Yes = Always Allowable CE = Must be Cost Effective

GAS-PAC = Only allowable if a gas furnace/electric AC combo-unit is present

FANG = Only allowable if a Forced Air Natural Gas heating system is present.

H&S = AEO may allow up to 25% of the funds be spent on Health and Safety Measures

** = Unit must be repaired if it is cost-effective. If not cost effective, it may be replaced if the unit is causing an unhealthy or unsafe environment.

See Appendix B for an example of the analysis completed on a typical home.

TABLE 2
SOUTHWEST GAS CORPORATION - ARIZONA
LOW INCOME ENERGY CONSERVATION PROGRAM
ANNUAL FUNDING BY COUNTY 2

<u>Counties</u> Agencies	Administration (15% of funding) (5% AEO & 10% Agencies)		Annual ¹ Program Dollars	Total ² Annual Funding
	AEO	Agencies		
<u>Maricopa</u>				
City of Phoenix	\$6,500	\$13,000	\$110,500	\$130,000
Mesa	\$250	\$500	\$4,250	\$5,000
MHRD	\$6,250	\$12,500	\$106,250	\$125,000
<u>Pima</u>				
TUL	\$1,200	\$2,400	\$20,400	\$24,000
Pima County	\$300	\$600	\$5,100	\$6,000
<u>Cochise, Graham, & Greenlee</u>				
SEAHRC	\$525	\$1,050	\$8,925	\$10,500
<u>Pinal</u>				
CAHRA	\$600	\$1,200	\$10,200	\$12,000
<u>La Paz, Mohave, & Yuma</u>				
WACOG	\$675	\$1,350	\$11,475	\$13,500
<u>Gila</u>				
Gila County	\$1,200	\$2,400	\$20,400	\$24,000
Total	\$17,500	\$35,000	\$297,500	\$350,000

¹ Allocated program dollars are for supplies and materials, other labor, per diem, inspections, etc... (i.e. non-administrative costs)

² The annual distribution of total funds will be determined according to the percentage of Low customers, prior year spending, and the agencies' projected needs and ability to complete jobs.

**APPENDIX A
ARIZONA DEPARTMENT OF COMMERCE
ENERGY OFFICE
WEATHERIZATION PROCEDURES**

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Energy Audit Procedures

The WAP Energy Audit Procedures are to be used by all sub-grantees to gather, record and analyze data on structures. This data is to be used to deliver weatherization materials/measures in a fashion that protects the health and safety of the client, increased the durability of the structure, increases the comfort of the client and reduces the energy cost to the client in a cost effective manner.

The following audit activities must be completed on all homes utilizing WAP funds.

- A site audit is to be completed that records all of the relevant data on the structures that is needed to perform a cost effectiveness test.
- The Cost-Effectiveness Procedure must be followed to determine cost-effectiveness of potential weatherization materials/measures. (see Cost Effectiveness Procedure)
- The Pressure Diagnostic Procedures must be completed and the finding recorded on the Pressure Diagnostic Report. (see Pressure Diagnostic Procedure)
- A health and safety audit of the structures must be completed and the findings recorded on the Combustion Safety Report. (see Health and Safety Policy)

Cost Effectiveness Procedure

WAP has incorporating performance based energy audit procedure that focuses on optimizing investment in energy efficiency through a systems approach. To enable the WAP program to optimize the investment in energy efficiency, the following requirements have been established for the audit procedure:

- The energy audit procedure must determine that each weatherization material/measure is cost effective by ensuring the discounted savings-to-investment ratio (SIR) is greater or equal to one.
- The energy audit procedure must assign priorities among weatherization materials/measures in descending order of SIR and must account for interactions between architectural and mechanical measures.
- The energy audit procedure must ensure that the overall SIR for the entire package of materials/measures, including the cost of incidental repairs and comfort related items, is greater or equal to one.
- Funds spent to abated health and safety hazards do not need to be included in the preceding requirements. Health and safety is the first priority. Once addressed, the remaining funds are to be applied to weatherization materials/measures utilizing the Cost Effectiveness Procedure.

To determine the cost effectiveness of weatherization materials/measures, the contractor must use a computer audit approved by Commerce or an appropriate Priority List for homes that meet the criteria contained in the list.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 1

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 1 (see Climate Zone map). The Priority List is comprised of two housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Homes With Gas Heating.

- Existing ceiling insulation of R-19 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

Housing Type Two: Homes With Electric Resistance Heating.

- Existing ceiling insulation of R-19 or less upgraded to a R-38.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 2

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 2 (see Climate Zone map). The Priority List is comprised of three housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Homes With Refrigeration Cooling (AC or Heat Pump)

- Existing ceiling insulation of R-15 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Existing ceiling insulation of R-5 or less upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Gas Heating

- Uninsulated ceiling upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 3

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 3 (see Climate Zone map). The Priority List is comprised of four housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Home With Refrigeration Cooling and Electric Heating (Heat Pump or Electric Resistance.

- Existing ceiling insulation of R-19 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Home With Refrigeration Cooling and Gas Heating.

- Existing ceiling insulation of R-15 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Existing ceiling insulation of R-19 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

Housing Type Four: Homes With Evaporative Cooling Only and Gas Heating

- Existing ceiling insulation of R-5 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 4

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 4 (see Climate Zone map). The Priority List is comprised of three housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Homes With Refrigeration Cooling (AC or Heat Pump)

- Existing ceiling insulation of R-11 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Existing ceiling insulation of R-5 or less upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Gas Heating

- Uninsulated ceiling upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 5

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 5 (see Climate Zone map). The Priority List is comprised of four housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Home With Refrigeration Cooling and Electric Heating (Heat Pump or Electric Resistance.

- Existing ceiling insulation of R-19 or less upgraded to a R-38.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Home With Refrigeration Cooling and Gas Heating.

- Existing ceiling insulation of R-19 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Existing ceiling insulation of R-19 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

Housing Type Four: Homes With Evaporative Cooling Only and Gas Heating

- Existing ceiling insulation of R-11 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

COST EFFECTIVENESS PRIORITY LIST CLIMATE ZONE 6

The Priority List can be used to determine cost effective weatherization materials/measures for homes located in Climate Zone 6 (see Climate Zone map). The Priority List is comprised of three housing types with a listing of cost effective upgrades.

A computer audit is required if:

- There are potential cost effective energy upgrades to the house that are not listed on the priority list.
- There are not sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs.

Housing Type One: Homes With Refrigeration Cooling (AC or Heat Pump)

- Existing ceiling insulation of R-15 or less upgraded to a R-30.
- Uninsulated frame walls upgraded with blown insulation.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Existing ceiling insulation of R-5 or less upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Gas Heating

- Uninsulated ceiling upgraded to a R-19.
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 1**

The Priority List can be used to determine cost effective weatherization materials/measures for mobile homes located in climate zone 1 (see climate zone maps). The Priority List is comprised of one housing type with a listing of cost effective upgrades.

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures and other general repairs

Priority List for Mobile Homes.

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 2**

The Priority List can be used to determine cost effective weatherization materials/measures for mobile homes located in climate zone 2 (see climate zone maps). The Priority List is comprised of three housing types with a listing of cost effective upgrades.

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs

Housing Type One: Homes With Refrigeration Cooling (AC or Heat Pump)

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Mobile Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only.

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 3**

The Priority List can be used to determine cost effective weatherization materials/measures for mobile homes located in climate zone 3 (see climate zone maps). The Priority List is comprised of four housing types with a listing of cost effective upgrades.

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures and other general repairs

Housing Type One: Mobile Homes With Refrigeration Cooling

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Mobile Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Fossil Fuel Heating

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 3**

The Priority List can be used to determine cost effective weatherization materials/measures for mobile homes located in climate zone 3 (see climate zone maps). The Priority List is comprised of four housing types with a listing of cost effective upgrades.

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures and other general repairs

Housing Type One: Mobile Homes With Refrigeration Cooling

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Shade screens on all sun struck South, East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Mobile Homes With Evaporative Cooling Only and Electric Resistance Heating.

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Water heater wrap (where allowed).

Housing Type Three: Homes With Evaporative Cooling Only and Fossil Fuel Heating

- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 5**

The Priority List can be use to determine cost effective weatherization materials/measures for mobile homes located in climate zone 5 (see climate zone maps). The Priority List is comprised of two housing types with a listing of cost effective upgrades.

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures and other general repairs

Housing Type One: Mobile Homes With Refrigeration Cooling

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Shade screens on all sun struck East and West windows and glass doors.
- Water heater wrap (where allowed).

Housing Type Two: Mobile Homes With Evaporative Cooling Only

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

**COST EFFECTIVENESS PRIORITY LIST
MOBILE HOMES
CLIMATE ZONE 6**

The Priority List can be used to determine cost effective weatherization materials/measures for mobile homes located in climate zone 6 (see climate zone maps).

A computer audit is required when the following two criteria are not met.

- All possible energy upgrades to the house are listed as cost effective for the housing type in question.
- There are sufficient funds to complete all the measures, including health and safety measures, comfort related measures and other general repairs

Housing Type One: Mobile Homes With Refrigeration Cooling (AC or Heat Pump)

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Shade screens or awning on all sun struck South, East and West windows and glass doors.
- Storm windows on single pane windows (installed cost of under \$3 per square foot).
- Water heater wrap (where allowed).

Housing Type Two: Mobile Homes With Evaporative Cooling Only

- Reflective roof coating
- Pressure diagnostics and repair following the pressure diagnostic procedure established by the WAP program.
- Upgrade of evaporative cooler motor with higher efficiency two speed motor.
- Water heater wrap (where allowed).

In cases where there are potential cost effective energy upgrades not listed or sufficient funds are not available to complete all (energy, health and safety, comfort related measures and general repairs) possible upgrades, a computerized audit must be completed to develop a ranking of the energy upgrades, based on their savings to investment ratio (SIR). Only those measures with a SIR of 1 or greater can be completed. If sufficient funds are not available to complete all possible upgrades, those upgrade with the highest SIR must be completed first.

PRESSURE DIAGNOSTIC PROCEDURES

The pressure diagnostic procedures are to be followed when performing air leakage diagnostics and repair. These procedures provide crews with immediate feedback on the effectiveness of their air sealing work, insure that the repairs will provide long-term energy benefit in a safe manner and provide essential management information needed to monitor the cost effectiveness of the air sealing programs.

Pressure Diagnostic Decision Tree

The pressure diagnostic decision tree provides assistance to agency personnel in identifying the minimum level of pressure testing that needs to be performed to meet the Weatherization Program requirements. The decision tree is comprised of two levels of housing characteristics with corresponding test requirements. In all cases, air sealing can only be performed in conjunction with pressure diagnostics.

Level One: Homes With Central Forced Air Heating or Cooling.

- The complete pressure diagnostic process must be followed in all cases on homes with a central forced air heating or cooling system. (Evaporative cooling is not considered a forced air system in this case.)

Level Two: Homes With No Central Forced Air Heating or Cooling

- The use of pressure diagnostic process is optional in homes that do not have a central forced air heating or cooling system and that do not contain the characteristics listed below.
 - Electric resistance heating: A Whole House CFM50 Test must be performed on homes with electric resistance heating.
 - An exhaust fan and a combustion appliance in the same zone: The Worst Case Pressure Test must be performed in zones that contain an exhaust fan and a combustion appliance.

NOTE: A Pressure Diagnostic Report must be completed for each home detailing the test results or the characteristics of the home if the tests were not performed.

Testing Procedure

When performing pressure diagnostic, crews are required to use the following procedures **IN SEQUENCE**. Test results are to be recorded on the Pressure Diagnostic Report. If a test is not performed, document the reason on Pressure Diagnostic Report.

1. Initial air leakage tests
2. Duct repair
3. Envelope sealing
4. Room pressure balancing

1. Initial air leakage and room pressure tests: These initial tests will provide reference information on the existing condition of the home. This information will be used to determine what retrofit measures are to be completed and their effectiveness.

- A. Perform a complete energy audit and combustion safety test of the house.
- B. Perform initial Whole House CFM50 Test (ducts open) and record the results (1A).
- C. Evaluate and note location of envelope and duct leaks (1B).
- D. Perform Room Pressure Tests (dominant duct leakage test, room pressure test and worst case test) and record pressures and combustion appliances located in rooms tested (1C).
- E. Perform a duct leakage test.
 - 1. Blower Door Subtraction Method: Tape off all supply and return registers (Do not tape off other exhaust fans) and repeat CFM50 Test to determine Envelop Only CFM50 (1D) and duct leakage (1A minus 1D). Determine house to duct pressure to establish Subtraction Correction Factor (see page 3) and adjusted duct leakage estimate.
OR
 - 2. Pressure Pan Method: Establish a 50 Pa pressure difference between the house and exterior. over each register (one at a time) with pressure pan and record initial pressure difference (1E).
- F. Based on the results of the energy audit, combustion safety test and pressure tests, determine extent of work to be completed.

2. Duct Repair Procedure:

- A. Duct repair can only be performed under the supervision of a trained technician.
- B. The Health and Safety Policy must be followed at all times.
- C. Perform duct repair using approved products (see product guidelines) and repair techniques (see duct repair techniques).
- D. After initial duct repair is performed, evaluate if additional duct repair is possible.
- E. Once all attainable duct leakage is repaired, perform post duct repair Whole House CFM50 Test (2A) and pressure pan readings (2E). The difference between the initial Whole House CFM50 Test and the post duct repair Whole House CFM50 Test will provide the CFM reduction in duct leakage (1A minus 2A).

3. Envelope Air Sealing Procedure:

- A. All duct repair must be completed before envelope air sealing.
- B. Envelope air sealing can only be performed under the supervision of a trained technician.
- C. The Health and Safety Policy must be followed at all times.
- D. Perform air sealing with high-quality products. Weatherization products must be permanent and guaranteed for at least 15 years.
- E. Repeat Whole House CFM50 Test after air sealing work is performed and evaluate if additional air sealing is possible (see Health and Safety Policy for CFM ventilation requirements).
- F. Once air sealing is completed, perform final Whole House CFM50 Test and record results (3C).

4. Room Pressure Balancing

- A. All duct repair and air sealing must be completed before room pressure balancing.
- B. Room pressure balancing can only be performed under the supervision of a trained technician.
- C. The Health and Safety Policy must be followed at all times.
- D. Perform post air sealing room pressure tests (dominant duct leakage test, room pressure test and worst case test) and record room pressures (4A).
- E. Review options to remedy pressure imbalances with the client. If pressure balancing is not performed, record reasons in the work summary.
- F. Repeat room pressure tests after initial pressure balancing measures are installed and evaluate if addition pressure balancing is needed.
- G. Once pressure balancing is completed, repeat room pressure tests and record results (4B).

Note: Return house to pre-test condition and ensure that mechanical equipment is returned to operable condition.

Economics

The cost effectiveness of pressure diagnostic and repair is to be based on a comparison of the present value of the reduced air leakage and the cost (labor and materials) to achieve the reduction. The values in the follow tables are designed to provide general guidance on the present value of air leakage control.

Infiltration

The following table gives the present value of reducing the infiltration rate by 100 CFM50 for a typical weatherized home.

Present value of 100 CFM50 reduction	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6
	\$80	\$20	\$45	\$20	\$45	\$20

Duct leakage

The following table gives the present value of reducing duct leakage by 100 CFM50 for a typical weatherized home.

Present Value of 100 CFM reduction	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 5	Climate Zone 6
Heating	\$570	\$65	\$250	\$70	\$280	\$35
Cooling*	\$10	\$450	\$80	\$300	\$100	\$870

*If a home has only evaporative cooling, only the heating values will be realized in duct repair.

Correction Factors for Blower Door Subtraction Test

House To Duct Pressure (ducts sealed)	Subtraction Correction Factor	House To Duct Pressure (ducts sealed)	Subtraction Correction Factor
50	1.00	35	1.84
49	1.09	34	1.91
48	1.14	33	1.98
47	1.19	32	2.06
46	1.24	31	2.14
45	1.29	30	2.23
44	1.34	29	2.32
43	1.39	28	2.42
42	1.44	27	2.52
41	1.49	26	2.64
40	1.54	25	2.76
39	1.60	24	2.89
38	1.65	23	3.03
37	1.71	22	3.18
36	1.78	21	3.35

House to duct pressure Example:

Whole house CFM50 = 2800
 Envelope only CFM50 = 2600
 Initial duct leakage estimate of 200 CFM (2800 - 2600)
 House to duct pressure (ducts sealed) of 40 Pa
 From the correction table above, the correction factor for 40 Pa is 1.54
 Modified duct leakage estimate equals 308 CFM50 (200 CFM50 x 1.54)

HEALTH AND SAFETY POLICY

The following policy must be strictly adhered to when performing air tightening and duct repair. If any house fails these program safety standards and the problem cannot be remedied, the homeowner must be notified in writing (Health and Safety Waiver) and a copy placed in the client's file. Note any problems on the Combustion Safety Report.

- Perform air tightening and duct repair **only** in conjunction with pressure diagnostics to ensure that sufficient ventilation and draft rates are maintained in the home.
- Research and follow the local health and safety codes and standards dealing with residential ventilation requirements for occupants and combustion equipment.
- No air tightening (including duct repair) should be done if there is a high pollution source, such as a non-vent combustion heater, that can't be removed.
- No air tightening (including duct repair) should be done if there are existing health and safety problems in the home.
- No air tightening (including duct repair) should be done if there is Carbon Monoxide (CO) present in the flue gases higher than 100 ppm.
- No air tightening (including duct repair) should be done if there is CO production is greater than 50ppm for any part of a cook stove.
- No air tightening (including duct repair) should be done if there is a possible of gas leak.
- No air tightening (including duct repair) should be done if CO is greater than 9 ppm in the living space.
- If CFM50 is less than 1500 CFM for the home or 300 CFM per person (whichever is greater), the homeowner must be advised of the tightness of the home. Any further air tightening (including duct repair) may require that an active ventilation strategy be employed.
- There must be pressure relief provided (with homeowners approval) if a negative pressure exists or is produced by duct repair in a zone with a gas water heater or if the negative pressure is greater than 3 pascals in a zone with a fireplace that draws its combustion air from the conditioned space. These tests will be done with the air handler operating, all venting appliances (dryer, kitchen and bathroom exhaust fans) operating, and all bedroom doors closed.
- Flame change is an indication of a cracked heat exchanger - **NO AIR TIGHTENING** (including duct repair) should be done until the problem is fixed.
- If spillage of flue gases occurs for more than one minute - **NO AIR TIGHTENING** (including duct repair) should be done until the problem is fixed.
- If draft is low, it must be fixed before air tightening (including duct repair) is done unless duct leakage is the only cause. Draft pressure is the pressure difference between the flue and the combustion appliance room or area containing the combustion equipment. If the room is too small for you to take draft pressure, then sampling tubes must be run from the combustion appliance room and the flue pipe sampling port. To determine if low draft is caused by duct leakage only, turn off all exhaust fans and open all interior bedroom and bathroom doors. If draft

is still low open an exterior door; then if draft becomes acceptable, the low draft was caused by duct leakage.

Minimum draft pressures required as follows:

- Outside temperature below 20° F, -5.0 pascals draft
- Outside temperature 20° to 40° F, -4.0 pascals draft
- Outside temperature 40° F to 60° F, -3.0 pascals draft
- Outside temperature 60° F to 80° F, -2.0 pascals draft
- Outside temperature above 80° F, -1.0 pascals draft

• **IF THE CONDITIONS DESCRIBED BELOW CONCERNING COMBUSTION AIR ARE NOT MET, NO AIR TIGHTENING (INCLUDING DUCT REPAIR) SHOULD BE DONE:**

- In homes of ordinary tightness insofar as infiltration is concerned, all or a portion of the air for fuel-burning appliances may be obtained from infiltration when the requirements for 50 cubic feet per 1000 Btu/hr input is met. Two openings are required and one shall be within 12 inches of the bottom of the space containing the combustion equipment. Openings shall allow space to communicate with the rest of the house. A minimum free area of one square inch per 1000 Btu per hour (or 100 square inches, which ever is greater) of the total input rating of all gas utilization equipment in the space, shall be provided.
- In all cases where combustion air is from inside the home, the homeowner must be made aware of this and sign the Health and Safety Waiver before any airtighting or duct repair is completed.

(Note: If this method is used, special attention must be given to zonal and draft pressures. In buildings of unusually tight construction, combustion air shall be obtained from outside.)

- In homes that receive combustion air from outside the conditioned space, two openings are required. One shall be within 12 inches of the top and one within 12 inches of the bottom of the space containing the combustion equipment. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that communicate with the outdoors.
- The following guidelines must be met when determining the minimum free area for combustion air openings:
 - Openings directly communicating with the outdoors shall provide one square inch per 4000 Btu per hour of the total input of all gas utilization equipment in the space.
 - Openings communicating to outdoors with vertical ducts shall provide one square inch per 4000 Btu per hour of the total input of all gas utilization equipment in the space.
 - Opening communicating to outdoors with horizontal ducts shall provide one square inch per 2000 Btu per hour of the total input of all gas utilization equipment in the space.

(NOTE: If the free area is not known because of louvers or screens, double the required opening size. **IF THESE NFPA 54 NATIONAL FUEL GAS CODE REQUIREMENTS ON**

COMBUSTION AIR ARE NOT MET, THEN NO AIR TIGHTENING (INCLUDING DUCT REPAIR) SHOULD BE DONE UNTIL THESE CONDITIONS ARE MET.)

DUCT INSTALLATION /REPAIR POLICY

The following policy must be strictly adhered to when installing or repairing the duct work on a forced air heating or cooling system.

Installation of New Duct Systems

All new duct work must be installed according to the Duct Installation/Repair Techniques and Product Guidelines. All duct systems must be pressure tested and the CFM leakage rate can not exceed 3% of the systems air handler capacity.

Repair of Existing Systems

All duct work must be repaired according to the Duct Installation/Repair Techniques and Product Guidelines.

Evaporative Cooler Installation

It is strictly prohibited to install an evaporative cooler on to the duct work of a forced air heating or cooling system. Retrofit evaporative coolers and forced air heating or cooling system sharing a common duct system with a damper that is appropriate for the current residents.

Duct Installation/Repair Techniques

A. Flex ducts

- Seal the start collar to the plenum using mastic reinforced with mesh around the entire circumference.
- At all connections (triangles, junction boxes, etc.), fasten the inner liner to the start collar using a mechanically tightened draw band for mechanical strength.
- Seal the inner liner using an approved mastic reinforced with fiberglass mesh and overlaid with another layer of mastic sufficient to cover all of the pattern in the mesh.
- Fasten the outer liner well over the start collar using a mechanically tightened draw band.
- Seal all boots to the sheetrock using mastic or silicone caulk applied at the point where the air barrier (metal or exterior foil backing) meets the sheetrock.

B. Duct board

- Staple all duct board joints with appropriate staples every two inches.
- Apply a layer of mastic, embed reinforcing mesh and overcoat with another layer of mastic sufficiently thick to hide the pattern in the tape.
- Allow for proper curing (manufacturer's specifications) before starting the system. This is critical.
- Seal all boots to the sheetrock at the point where the foil backing meets the sheetrock.

C. Metal

- Seal all points where components join together using a mastic. Special attention must be given to any area where tabs provide the method of securing the joint.
- Seal all boots to the sheetrock at the point where the metal meets the sheetrock.
- Join all components with screws or other mechanical fastening devices as required in listings or code.

D. Building Cavities Used as Returns

- If the cavity is lined with sheetrock, seal all joints with mastic. All gaps over 1/4 inch must be reinforced with embedded mesh tape.
- If the cavity is lined with duct board with the fiberglass side facing inside, you must create a positive air barrier in the plenum by covering the fiberglass with a material such as sheetrock, duct board with the foil facing inside, or coat the fiberglass with mastic, etc., and seal all remaining joints in the plenum.
- If the cavity is unlined (exposed studs) and it is impossible to line the plenum, seal all joints, holes and penetrations using mastic applied with a brush attached to a handle or other extension. It may be easier and more effective to simply create a ducted plenum or chase and avoid the problems associated with using a building cavity to convey conditioned air.
- It may be necessary to cut a hole in the plenum in order to gain access and seal the interior adequately.

E. Air Handler

- Seal all penetrations and gaps between materials using mastic or silicone. If the gap is over 1/4", reinforce with fiberglass mesh.
- Seal the areas where the air handler meets the supply/return plenums using mastic reinforced with fiberglass mesh or other approved methods.
- Seal any panels that will require frequent access by the owner (such as the filter area), using a quality temporary tape (duct tape).
- The air handler must not have any noticeable leaks.

F. Wall Penetrations

(The most common wall penetration problem is where the opening for the return grille is cut through the wall. In such an installation, even in a lined plenum, the wall cavity is open into the plenum.)

- Where an un-ducted section of the air distribution system penetrates a wall cavity, the wall cavity must be sealed.
- The cavity will first be blocked using a rigid air barrier such as sheetrock or duct board with the foil facing the air flow.
- All seams, cracks, crevices and openings will then be sealed air-tight using an approved mastic.

Products Guidelines

- All new duct work will be a minimum of R-6.
- Duct sealing materials shall have both excellent cohesive and adhesive qualities.
- Water-based Latex mastic with at least 50% solids reinforced with fiberglass mesh at all duct connections, joints and seams shall be used. "Hardcast" type mastic with reinforcing mesh is also acceptable.
- The ducts shall be further attached as per manufacturer's specification, using a draw tie, plumbing strap or screws, as appropriate for a strong mechanical connection. The mechanical connection does not replace air sealing.
- Foil tapes, including UL 181 AP-type tapes, when used alone will not be accepted. If tape is used to temporarily hold a seam, it must be overlaid with a coating of mastic that extends at least one inch (1") past the tape on all sides, and is thick enough to hide the tape completely.
- Do not use materials which are potentially damaging or have harmful effects, such as toxic vapors or carcinogenic substances which may be harmful to the occupants of the home or the installer. Agencies are required to obtain and maintain the Material Safety Data Sheets (MSDS) for all materials used on the job. You may be asked to provide the data sheets when a question arises. This procedure is required by federal law; further information is available locally from the vendor.
- Materials must meet all current codes and manufacturer's specifications.

Combustion Safety Report

(4/15/97)

Client Information:

Agency Information:

Name: _____

Name: _____

Address: _____

Auditor: _____

City: _____

Crew: _____

Phone: _____

Check for gas leaks

___ None found

___ Problems found: _____

Check to ensure that combustion appliance meet combustion air requirements (see health and safety guidelines).

___ Supply air sufficient from: _____ Interior source _____ Exterior source

___ Problems found: _____

Check each heat exchanger for cracks with a mirror and strong light.

___ None found

___ Problems found: _____

Observe burner flame pattern and color. Note presence of large yellow or soft lazy flame or other abnormalities.

___ None found

___ Problems found: _____

When blower comes on is there a change in the flame pattern or color.

___ None found

___ Problems found: _____

Measure carbon monoxide levels in undiluted flue of all combustion appliances (if levels exceed 100 ppm after 3 minutes of appliance operation, air leakage control measures shall not be installed until the appliance has been serviced and declared safe by a qualified technician).

Furnace or space heater flue: _____ ppm (requires servicing prior to any air tightening: _____)

Water heater flue: _____ ppm (requires servicing prior to any air tightening: _____)

Oven vent: _____ ppm (requires servicing prior to any air tightening: _____)

Other: _____ ppm (requires servicing prior to any air tightening: _____)

Measure carbon monoxide levels in indoor air during appliance operation (if levels exceed 9 ppm, air leakage control measures shall not be installed until the problem has been corrected).

Furnace or space heater room: _____ ppm (exceeds 9 ppm standard: ___Y___N)

Water heater room: _____ ppm (exceeds 9 ppm standard: ___Y___N)

In kitchen after 5 mins oven operation: _____ ppm (exceeds 9 ppm standard: ___Y___N)

Near supply air registers: _____ ppm (exceeds 9 ppm standard: ___Y___N)

Perform chimney smoke test under worst case depressurization.

___ Smoke rises up the chimney within 30 seconds.

___ Smoke takes longer than 30 seconds to rise.

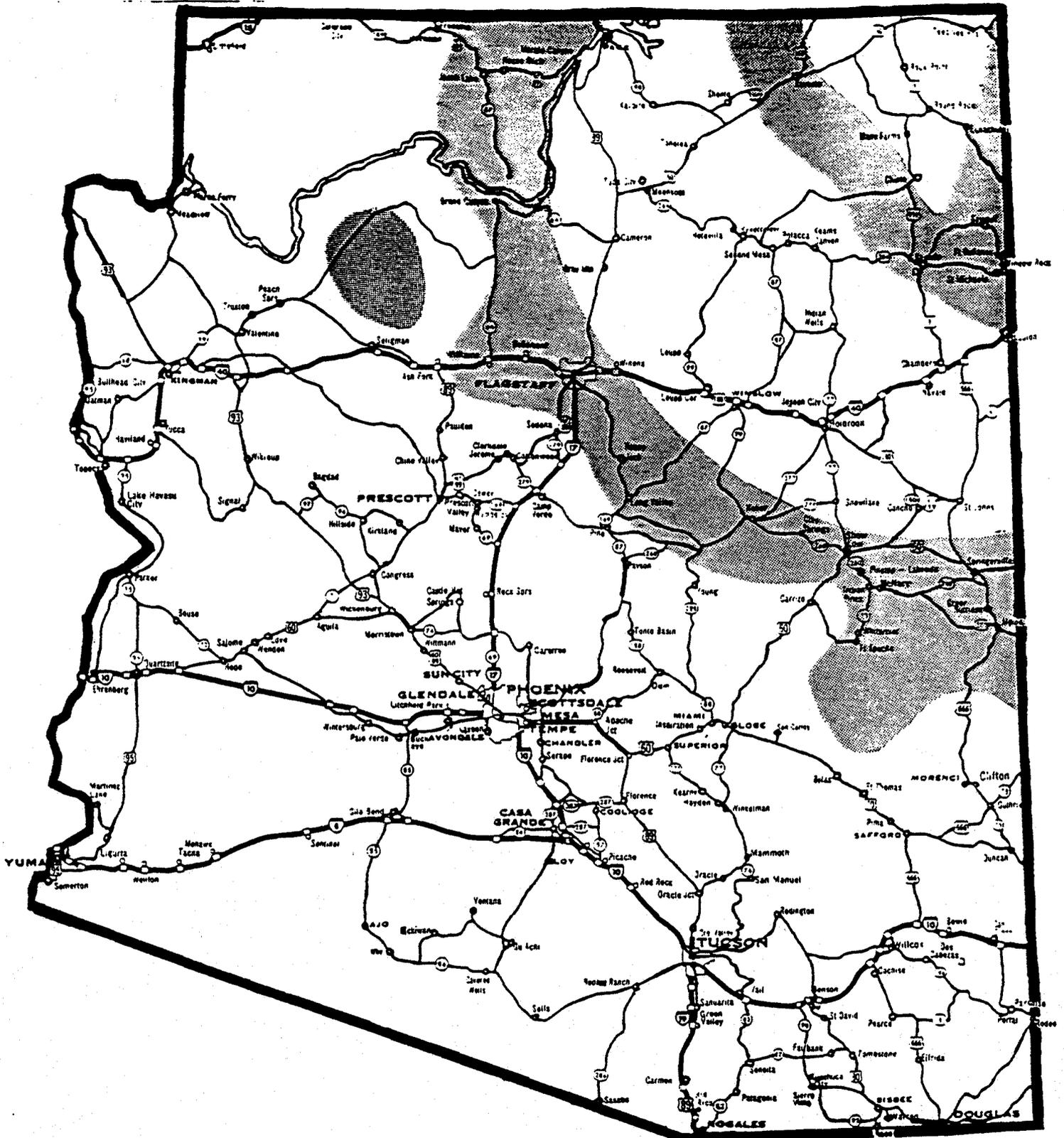
___ Smoke does not rise.

Measure chimney draft pressure under worst case depressurization.

Furnace _____ Pa

Water heater _____ Pa

Other: _____ Pa

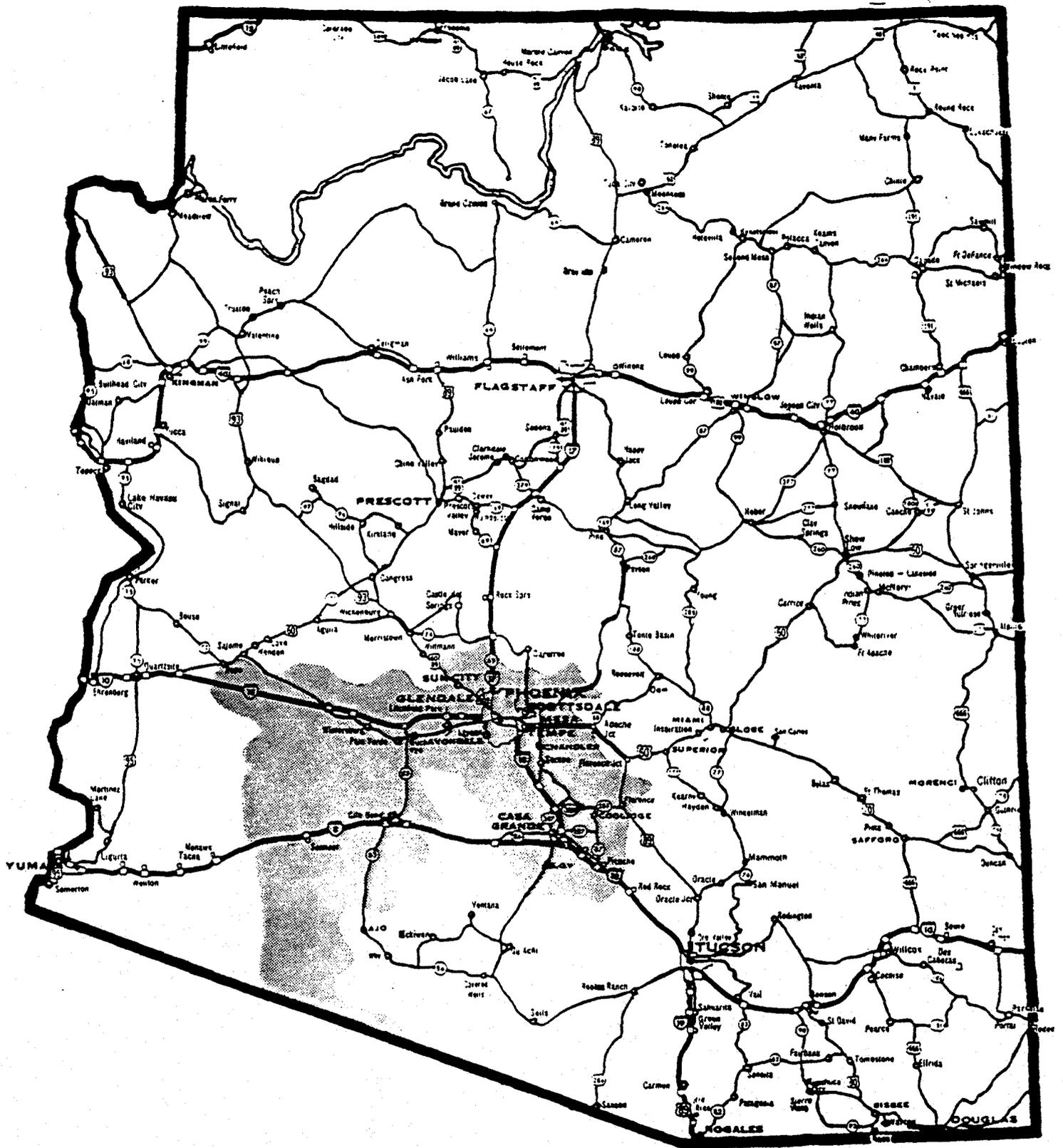


Climature Zone 1 Locations

Flagstaff
 Fort Defiance
 Grand Canyon
 Happy Jack
 Heber

Kayenta
 McNary
 Nutrioso
 Pinetop-Lakeside
 Show Low

Springerville
 Whiteriver
 Williams
 Window Rock

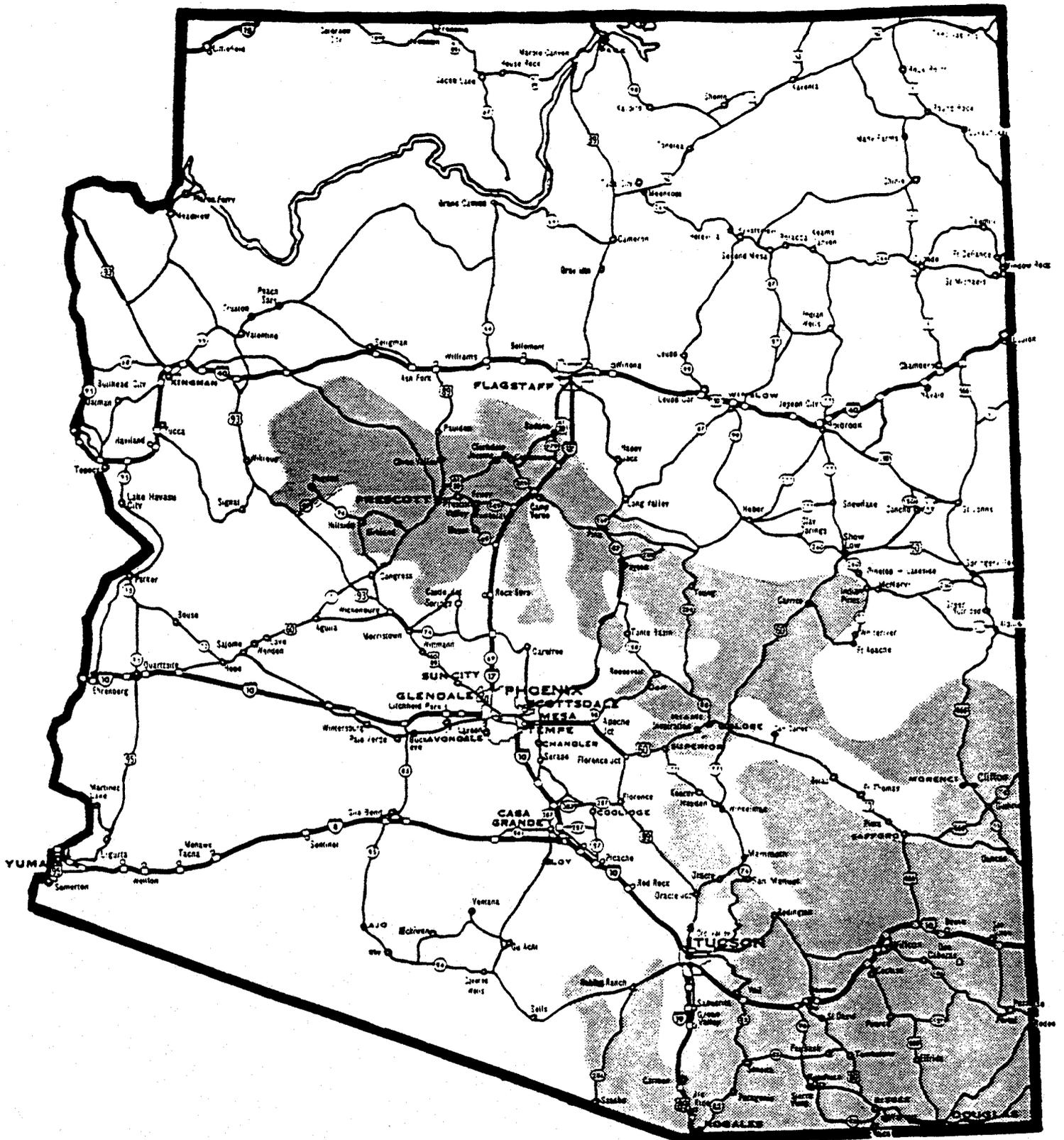


Climate Zone 2 Locations

Apache Junction
 Avondale
 Buckeye
 Casa Grande
 Chandler
 Coolidge

Eloy
 Florence
 Gila Bend
 Glendale
 Litchfield Park
 Mesa

Phoenix Area
 Picacho
 Scottsdale
 Sun City
 Tempe

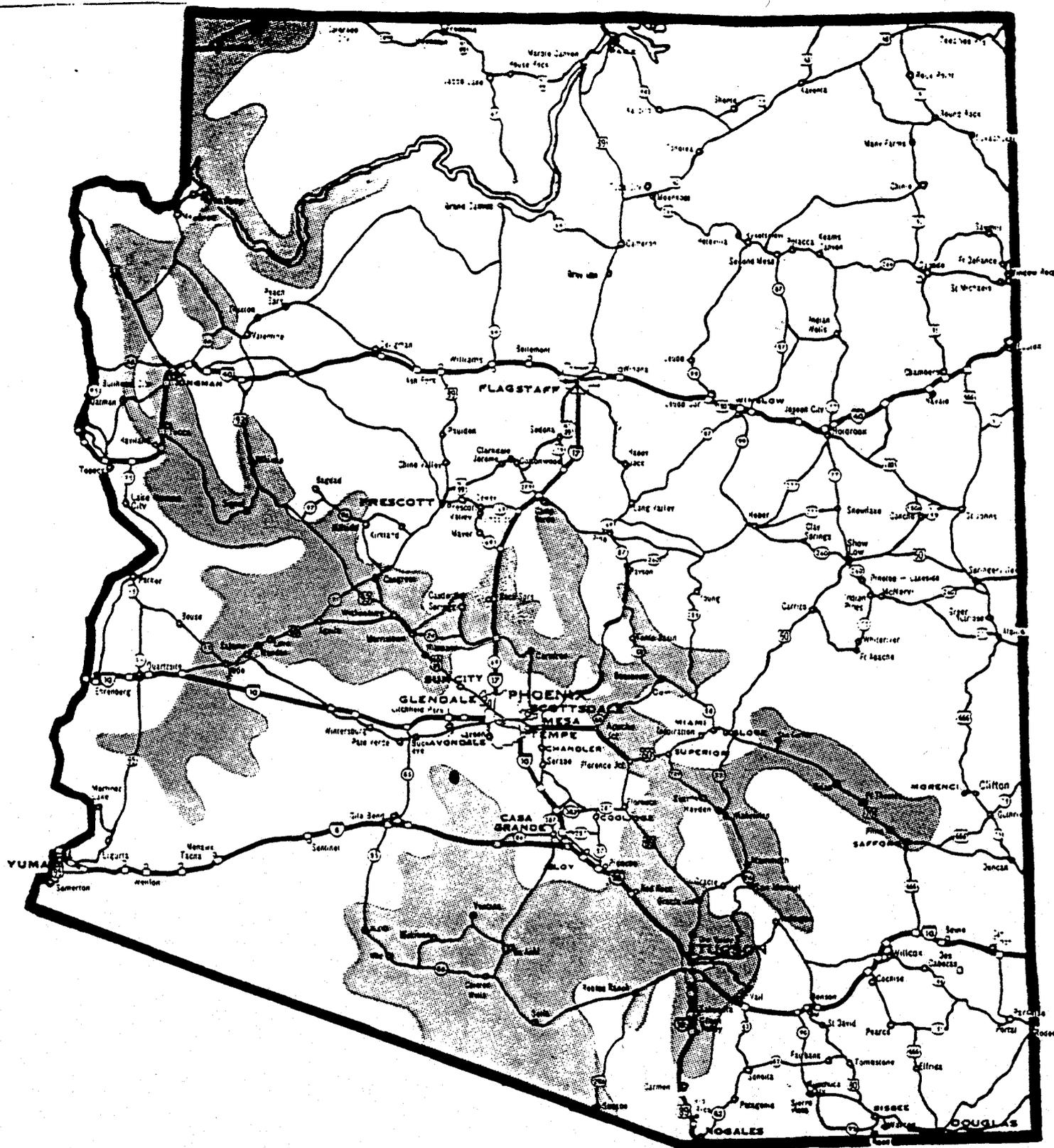


Climate Zone 3 Locations

Bagdad
 Bisbee
 Campe Verde
 Chino Valley
 Clifton
 Cottonwood

Douglas
 Duncan
 Globe
 Mayer
 Miami
 Nogales

Oracle
 Patagonia
 Payson
 Prescott
 Sedona
 Willcox

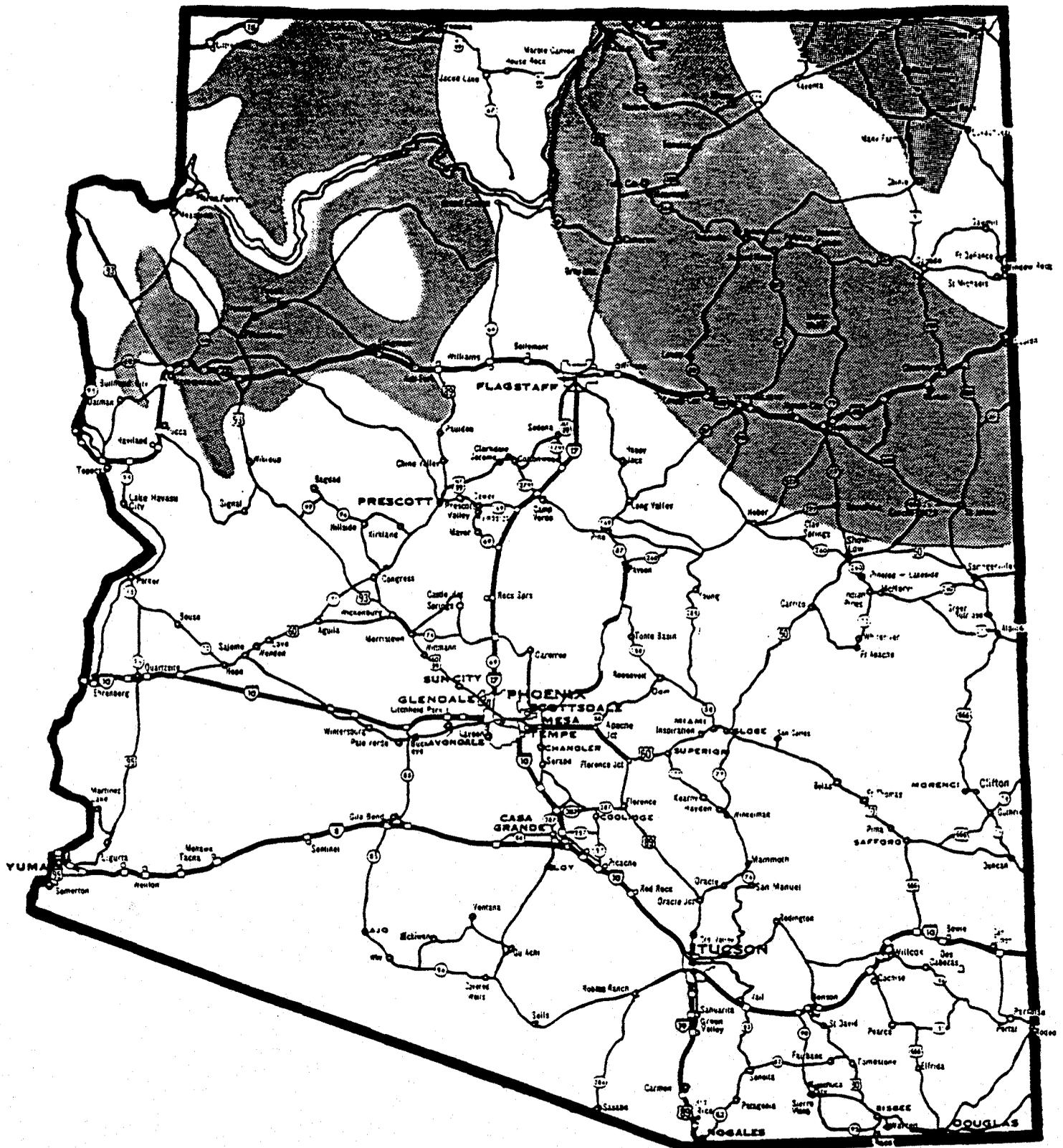


Climate Zone 4 Locations

Aguila
 Ajo
 Carefree
 Fort Thomas
 Green Valley
 Gu Achi

Hayden
 Kearney
 Kingman
 Morristown
 Pima
 Safford

Salome
 San Carlos
 Sells
 South Tucson
 Superior
 Tucson

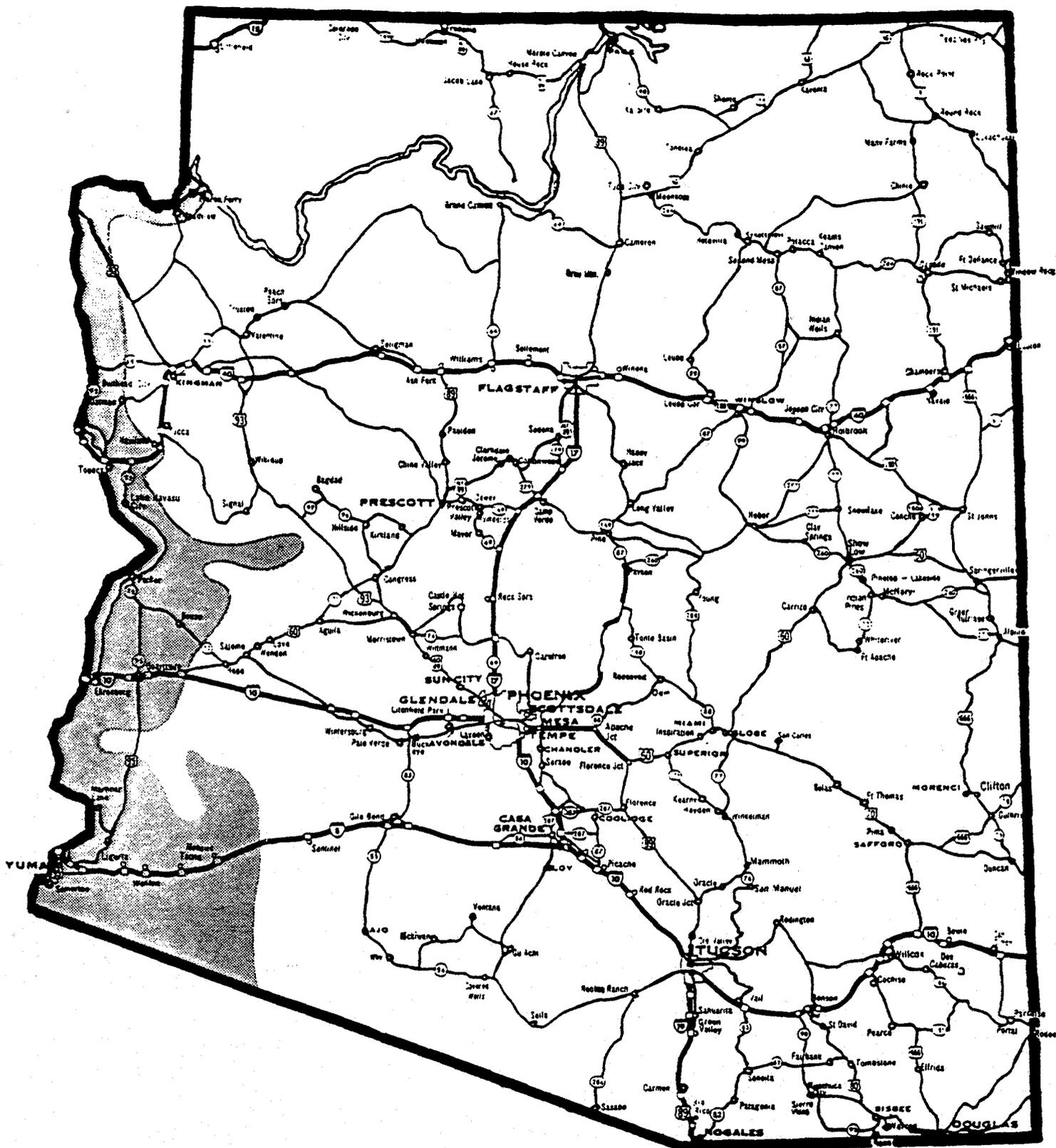


Climate Zone 5 Locations

Ash Fork
 Colorado City
 Fredonia
 Holbrook
 Joseph City
 Keams Canyon

Mocassin
 Moenkopi
 Page
 Peach Spring
 Polacca
 Saint John

Seligman
 Snowflake
 Tuba City
 Winslow



Climate Zone 6 Locations

Bullhead City
 Ehrenberg
 Lake Havasu City

Parker
 Quartzsite
 Somerton

Wellton
 Yuma

PRESSURE DIAGNOSTIC REPORT

(9/97)

Client Information:

Agency Information:

Name: _____

Name: _____

Address: _____

Auditor: _____

City: _____ Phone: _____

Crew: _____

Test Data:

Conditioned Area (sf): _____

Volume (cf): _____

Is Test Feasible? Yes No: Why not? _____

Whole House CFM 50 Test

Put house in test condition: (normal heating and cooling configuration)

Adjustable openings:

- Close all doors, windows and other hatches between the conditioned and unconditioned spaces.
- Open all interior doors to rooms that are heated or cooled.
- Check and close evaporative cooler baffle.

Combustion appliance/Exhaust devices:

- Adjust any combustion appliance so they do not turn on during the test. Turn off the gas to the appliance.
- Check to insure that any fireplaces or wood stoves are not in use and dampers and doors are closed.
- Turn off any exhaust fans, vented dryers, air conditioners and HVAC fans.

Blower Door Test Results

Test	House pressure (Pa)	Flow (CFM)	Flow (CFM50)*	ACH natural**	Time spent to achieve reduction
Whole house CFM 50 (1A)					
Post duct repair CFM 50 (2A) ***					
Post air sealing CFM 50(3C)					

*If you are unable to generate 50 Pa of house pressure, see users manual for "Can't Reach Fifty (CRF) Factor".

**ACH natural = CFM50 X 3/volume (CFM50 X 60 X .05/volume).

***All duct repair must be completed before envelope sealing is started. Once duct repair is complete, test house to establish post duct repair flow and ACH.

Duct Leakage Tests

Blower Door Subtraction Method

- Tape off all supply and return registers (Do not tape off other exhaust fans).
- Establish a 50 Pa pressure difference between the house and exterior.
- Check and record house to duct pressure. Record Subtraction Correction Factor.
- Record envelope CFM50 and calculate duct leakage CFM (Whole house CFM - Envelope CFM). Adjust CFM using Subtraction Correction Factor.

Test	Blower door CFM 50	Time spent to achieve CFM reduction
Whole house CFM 50 (1A)		
Envelope CFM 50 (1D)		
Initial duct leakage CFM 50 (1A-1D)		
Post duct repairs whole house CFM 50 (2A)		
Duct leakage reduction (1A-2A)		

House to duct pressure _____ Subtraction Correction Factor _____ Adjusted Duct Leakage _____

Pressure Pan Method

- ___ Establish a 50 Pa pressure difference between the house and exterior.
- ___ Cover each register (one at a time) with pressure pan and record initial pressure difference.
- ___ Repeat test after duct repairs are completed and record post-repair pressure difference.

Register location	Initial pressure (1E)	Post-repair pressure (2E)	Register location	Initial pressure (1E)	Post-repair pressure (2E)	Register location	Initial pressure (1E)	Post-repair pressure (2E)

Room Pressure Tests

- ___ Put house in test condition (normal heating and cooling configuration) and seal off blower door fan.

Dominant Duct Leakage Test

- ___ Turn on air handler and open all interior doors.
- ___ Measure and record pressure created in the main body of house relative to the exterior (1C).

Room Pressures

- ___ Turn on air handler and close interior doors (one at a time).
- ___ Measure and record pressure created in rooms with supply registers relative to main body of house (1C).

Worst Case Test

- ___ With air handler on, turn all other exhaust fans on and close all interior doors.
- ___ Measure and record pressure created in rooms with combustion appliances relative to the exterior (1C).

Post Air Sealing

- ___ Repeat above tests and record post air sealing balancing results (4A).

Pressure Balancing (post duct repair and air sealing)

- ___ Discuss pressure balancing options with the client.
- ___ If client refuses pressure balancing work, record reason in work summary.
- ___ Perform pressure balancing.
- ___ Repeat above tests and record post pressure balancing results (4B).

Test	Room tested	Initial room pressures (1C)	Post air sealing pressures (4A)	Post pressure balancing (4B)	Combustion appliances in pressure zone (1C)
Dominant duct leakage					
Room pressure					
Room pressure					
Room pressure					
Room pressure					
Room pressure					
Room pressure					
Worst case test					

- ___ Put house back in original condition

Summary of test results and work completed (1B): _____

HOUSEHOLD REPORTING FORM

Agency name: _____ Contact person: _____ Agreement # _____
 Address: _____ Phone/Fax: _____ Location: _____
 Client name: _____ Age of home: _____ Owned: _____ Rented: _____
 Address: _____ City: _____ Zip: _____
 Housing Type: Single family/detached _____ Mobile home _____ Multi-family _____
 Electric Co./Acct #: _____ Gas Co./Acct #: _____
 # in Household: _____ Adult: _____ Children: _____ Any changes in # in the past 12 months: _____
 Heating Type: El Res ___ HP ___ Gas ___ Other _____ Cooling Type: AC ___ HP ___ Evap ___ Dual cooling ___
 Water Heating Type: El Res ___ Gas ___ Other _____ List inoperable equipment: _____

FEATURE existing characteristics/problems	WORK COMPLETED	COST material and labor	FUNDING SOURCE
Health and safety			
Infiltration			
Duct work			
HVAC			
Evaporative cooler			
Attic			

Walls			
Windows			
Doors			
Water heater			
General repairs			
Other: (Audit, travel, energy education, etc)			

Funding Source

Funding code	Funding Source	Materials cost	Labor cost	total cost	Funding code	Funding Source	Materials cost	Labor cost	total cost.
1	WAP				6	CDBG			
2	LIHEAP				7	HTF			
3	APS				8				
4	URRD				9				
5	AAA				10				

Total Job Cost: **Materials** **Labor** **Total**
 \$ _____ \$ _____ \$ _____

Completed work inspected by: _____ Comments: _____

