

SECTION 500
WATER CONSTRUCTION STANDARDS

**SECTION 500
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500 GENERAL

This standard covers the installation of water piping systems, which are, or intended for, integration into the NMSU water distribution system. All piping and accessory materials shall be new and unused. The water line and appurtenances shall be installed as shown on the Contract Documents.

501 DEFINITIONS

See General Information Section

502 REFERENCES

The following documents, as applicable, are hereby incorporated into these Contract Documents by reference. If any referenced specification is in conflict with an NMSU specification, the specification requiring the most stringent condition shall take precedence.

MANUAL ON UNIFORM TRAFFIC CONTROL
DEVICES (MUTCD) - latest applicable edition

AMERICAN SOCIETY FOR TESTING AND
MATERIALS (ASTM) - latest applicable edition

INTERNATIONAL BUILDING CODE –
latest applicable edition

INTERNATIONAL PLUMBING CODE –
latest applicable edition

AMERICAN CONCRETE INSTITUTE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE (ACI 318) - latest applicable supplements. Herein: "ACI 318"

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) - Standard Test Methods

OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA) - Construction Industry Standards; Safety Requirements

NEW MEXICO ENVIRONMENT DEPARTMENT, all latest applicable regulations including:
Solid Waste Bureau, 20 NMAC 9.1
Air Quality Bureau, Asbestos section and all applicable regulations

CODE OF FEDERAL REGULATIONS, all latest applicable regulations including:
40 CFR part 763
29 CFR part 1926

NEW MEXICO Underground Property Damage Law, Chapter 62, Article 14, NMSA 1978, and as may be amended

SUBCONTRACTOR'S FAIR PRACTICES ACT, NMSA 1978, and as may be amended

AMERICANS WITH DISABILITIES ACT, latest applicable edition

AMERICAN WATER WORKS ASSOCIATION STANDARDS, (AWWA) the latest applicable editions of:
AWWA Manual M3, Safety Practices for Water Utilities
AWWA Manual M17, Installation...of Fire Hydrants
AWWA C600-99, Installation of Ductile Iron Water Mains...
AWWA C605-94, Underground Installation of Polyvinyl Chloride (PVC)...
AWWA C651, Disinfecting Water Mains

UNI-BELL PVC PIPE ASSOCIATION STANDARDS (UNI-BELL), as applicable, and specifically the latest editions of:
UNI-B-8, Recommended Practice for Direct Tapping of Polyvinyl Chloride...
UNI-PUB-8, Tapping Guide for PVC Pressure Pipe

503 RECEIVING, HANDLING, AND STORAGE

It is the responsibility of the Contractor to receive, handle, and store all pipe and appurtenances in such a manner as to insure delivery and placement in their final location in sound, undamaged condition as per this Standard, and AWWA Standards, and to the acceptance of the P.M. All materials, handling methods, and storage conditions at the Project location are subject to the P.M inspection. Neither inspection nor the lack of P.M., or designee, inspection shall relieve the Contractor of the responsibility to provide and install materials meeting these Standards.

Stored materials shall be kept free from damage. Interiors of pipe and appurtenances shall be kept free from dirt or other foreign matter at all times. Pipe gaskets shall be stored out of direct sunlight, away from heat sources. Factory installed gaskets shall not be removed from the joints unless damaged or subject to damage.

Damaged or otherwise unacceptable materials shall be removed from the Project site and replaced as necessary.

The interior of pipe and appurtenances shall be thoroughly cleaned of foreign matter before lowering into the trench and shall be kept clean during operations. Plugging or other means acceptable to the P.M shall be required of all pipe and appurtenances open ends at all times when work on that pipe is not in progress.

504 PIPE INSTALLATION

Trench excavations shall be made to at least four (4) inches below the pipe barrel to allow for the placement of embedment material. If the foundation of the trench is yielding, the

Contractor shall over excavate and stabilize the trench. Where running or standing water occurs in the trench bottom, the water shall be removed from the trench. The trench shall be kept free from water during installation operations by suitable means until the pipe has been installed and backfill placed and compacted to a sufficient height to prevent pipe flotation. Soil migration in the pipe zone shall be prevented by use of a geotextile material or embedment material gradation or other suitable means with prior approval of the P.M. All pipe that has the grade or joint disturbed after lying shall be taken up and re-laid. Pipe shall not be laid in water or when trench or weather conditions are unsuitable for the work, except by permission of the P.M. All unconnected ends of pipes shall have a valve, plug, or cap installed.

Embedment material shall be added for a minimum of four (4) inches in depth, uniform in cross-section and profile, and shall be compacted to a minimum of 90% Standard Proctor, AASHTO T-99 for Type III or Type IV trenches (see referenced AWWA Standards).

Bell holes at each joint shall be provided to permit the joint to be assembled and the pipe to be supported uniformly for the full length of the pipe. Pipe shall be laid to the line and/or grade as indicated in the Contract Documents.

Field cuts for PVC pipe may be made with circular saws, handsaws or similar equipment. Field cuts shall provide a smooth end at a right angle to the longitudinal axis of the pipe. Spigot ends shall be deburred, beveled, and re-marked with the insertion line. The length and angle of field bevels should match the factory bevels.

Field cuts for ductile iron pipe (DI) may be made with abrasive pipe saws, rotary wheel cutters, or similar equipment if allowed or specified by the pipe manufacturer. Cut ends and rough edges shall be ground smooth, and for push-on joints, the cut end shall be beveled as per the manufacturers' recommendations.

The sealing surface of the pipe spigot end, the pipe bell, fitting, and the elastomeric gaskets shall be cleaned

immediately before assembly. Factory installed gaskets should not be removed for cleaning. The joint shall be free of dirt, sand, grease, or foreign material. Pipe manufacturers approved lubricants shall be applied as specified to gasketed joints when assembling. Only gaskets supplied by the pipe and fittings manufacturer shall be used.

Push-on joints shall be made by insertion of the spigot end into the bell end. The installed pipe joint shall be kept straight while pushing the joint to completion at the insertion depth as specified by the manufacturer. Any deflections required by the Contract Documents shall be made after the joint is assembled. Timber headers shall be used against the pipe when mechanical equipment is used for pushing. Visual inspection of all assembled joints is required of the Contractor. Additional inspections by feeler gauge or other methods may be required by the P.M.

Mechanical joints on PVC shall be assembled in accordance with the fittings manufacturer's published recommendations. Pipe spigot ends may require shortening for use with mechanical joints or fitting joints.

Mechanical joints on DI shall have the socket and plain ends cleaned. Lubrication and additional cleaning should be provided by brushing both the gasket and plain end with soapy water or an approved pipe lubricant (per AWWA C111/A21.11) just prior to installing the gasket on the plain end. The gland and then the gasket shall be installed on the plain end. Keeping the joint straight during assembly, the pipe shall be inserted into the socket firmly and evenly around the circumference. Assemble the gland and socket components and insert the joint manufacturer's bolts and nuts and hand tighten. Any required deflections shall be made after joint assembly but before tightening the bolts. Tighten the bolts to the normal range of torque as indicated in AWWA C600-99 (75-90 ft.lb. for 4"-24" nominal diameter joints with $\frac{3}{4}$ " bolts) while maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Tightening the joint is accomplished by a process of alternately tightening bolts on opposing sides. The process is repeated until all bolts are within the required torque range.

Any restrained joints used, on PVC or DI, shall be installed as per the manufacturer's published recommendations.

PVC pressure pipe may accommodate longitudinal bending, if the Contract Documents require curvature of lines. The Contractor shall block or brace pipe joints to ensure that bending of PVC pressure pipe does not result in axial deflection in the gasketed or mechanical joints that exceeds the manufacturer's published limits. The longitudinal bending in the PVC pipe barrel shall not result in a bending radius that is less than the minimum limits established in AWWA C605-94, or latest edition. Bending of PVC pipe barrels larger than 12 inches nominal diameter is to be done only with prior approval of the Utilities Director and shall be determined by the pipe manufacturer's published axial-joint-deflection limits. PVC pressure pipe greater than 12 inches nominal diameter may be used on Projects only with the prior approval of OFS Engineering.

DI pipe may be deflected at the joints when required by the alignments specified in the Contract Documents. The amount of joint deflection shall not exceed that shown in AWWA C600-99, or latest edition. The deflections listed are maximum deflections and shall not be exceeded. For design purposes, deflection shall be limited to 80 percent of the values listed in the referenced standard. The design values are tabulated in Section 802.4 of these Standards.

Embedment material shall be provided and installed such that 90% Standard Proctor, per ASSHTO T-99, densities are achieved for the pipe zone backfill. Testing frequencies are to be one per 300 feet or fraction thereof.

Utility Soil Bedding and Backfilling shall conform to:

Utilities should be bedded in fine-grained granular material such as fine, poorly graded (uniform) sand in a fashion to avoid the development of any voids around utility lines placed.

The following gradation ranges are acceptable for pipe bedding material:

Nominal Particle Size (in.) or Sieve Number	Percent Passing for sewer, water, PE gas lines.	Percent Passing for coated, steel gas lines.
$\frac{3}{4}$	100	100
#4	70-100	100
#10	50-100	50-100
#200	0-35	0-35

All soil bedding materials used should be non-plastic. All soil bedding materials should extend a minimum of 4 inches in all directions.

All utility trenches should be backfilled with compacted soil below structural elements, including foundations, interior and exterior flat concrete work, and paved parking or drive areas. Although the backfill should be compacted, care should be taken not to damage the utility during backfilling and subsequent compaction. Testing frequencies are to be one per 300 feet or fraction thereof.

Backfill materials may be native soils, however, no material having a maximum individual particle size or agglomeration clod size greater than two and one-half ($2\frac{1}{2}$) inches shall be placed within twelve (12) inches of the utility piping installed.

Minimum Backfill Compaction Requirements

Utility Construction	Percent of Modified Proctor Density (ASTM D-1557)		
	Existing Surface Preparation	Fill or Backfill Placement	Maximum Finished Lift Thickness (in.)
In Roadway: Shallower than 36 " of Grade	N/A	95	6
In Roadway: Deeper than 36 " of Grade	N/A	95	12
Outside Roadway: Shallower than 36 " of Grade	N/A	90	12
Outside Roadway: Deeper than 36 " of Grade	N/A	90	18

Thrust restraints shall be provided for each dead end, valve, bend, tee, and any unrestrained hydrant, at reducers or fittings otherwise unrestrained, and where changes in pipe diameters or directions occur.

Utility system piping thrust is to be restrained by the use of restrained joint fittings. Concrete thrust blocking shall be utilized only where Project site conditions are not applicable to the use of restrained joint fittings. The P.M., or designee, shall approve of the use of concrete thrust blocking where applicable. The size and shape of concrete thrust blocks shall be as indicated within the NMSU design guidelines. The concrete shall be placed such that no concrete is in contact with any bolts or nuts on the piping system. The lengths of restrained joint piping and details of joint restraint glands, clamps, friction slabs or anchors shall be as indicated within these Standards and in conformance with the manufacturer's published recommendations.

Fittings and valves shall be provided and installed as indicated within the Project Documents and these Standards. All valves shall be placed with operating stems vertical, excepting butterfly valve operating stems, which shall be horizontal. The full weight of valves and fittings shall not be carried by the

pipe. Thrust blocking or restraint shall be provided for fittings and valves as indicated within these Standards.

Hydrants shall be installed as per these Standards and AWWA Manual M17 and NMSU Design Guidelines

Saddle tapping of water mains shall be as per AWWA Manual M23, and UNI-BELL UNI-PUB-8. Direct tapping of corporation stops into water mains is not allowed. No hand held drills, twist drills, or auger bits shall be allowed in tapping PVC or Ductile Iron. Shell type cutters, which retain the cut coupon, shall be used in the tapping machines. Taps shall be made at 10 and 2 o'clock around the circumference of the main. Two spiral wraps of three-mil PTFE (Teflon) tape shall be applied clockwise to the inlet threads on the closed corporation stop. Liquid sealants or other thread lubricants shall not be used. The maximum outlet size by use of a corporation stop or service saddle shall be 2 inch. If larger taps are required, a tapping sleeve and valve or other applicable fitting shall be used.

Service lines shall be installed at not less than the minimum depth indicated. The Contractor shall leave the water turned on or off as it was found prior to meter transfers in order to obviate inconvenience to the customer in the first case or damage in the second. Water service lines, including the piping, meter, and the meter box, shall lie in a line perpendicular to the street's centerline.

505 WARNING TAPE & TRACING WIRE

TAPE: During the backfilling process, all PVC and Ductile Iron water mains, service lines and system appurtenances shall have a continuous warning tape placed immediately above them and throughout their length at a depth of eighteen (18) inches above the utility line surface. The tape shall be six (6) inches wide. Tape material shall be formulated from 100 percent virgin polyolefin resins. Resins shall be pigmental for chemical stability and resistance to sulfide staining (color fastness).

Tape shall be constructed by the mechanical (non-adhesive) lamination of two plies of three layer blown film in such a

manner as to produce a bi-axially oriented structure. The tape shall be able to provide a 700 percent elongation prior to rupture as per ASTM-D882.

The tape shall meet or exceed the standards provided in the Materials Specification List, included in these Standards.

The warning tape shall be manufactured with a permanent APWA water line blue pigment at a maximum of every thirty (30) inches along its length, be imprinted with a continuous warning message as follows:

CAUTION WATER LINE BURIED BELOW

At tees, tape ends, etc., the warning tape shall be tied together (spliced) with knot to create a continuous warning tape throughout the length of the pipeline and associated branch lines, appurtenances, etc.

TRACING WIRE: In addition to the installation of warning tape, copper tracing wire is to be installed with all water mains. This includes all mains, and individual hydrants. The tracing wire shall be taped, using electrical tape, on top of the pipe at ten (10) foot centers, for the total length of the pipe.

The tracing wire shall be 12 AWG (average wire gauge), solid core, copper wire (solid core meaning one (1) single continuous strand of copper wire). In addition, the wire insulating coating (jacket) shall be blue in color and shall have 45 mils of polyethylene insulation thickness and high molecular weight. Also the tracing wire shall be HMW – PE and rated for UL 600V construction. The wire shall be suitable for wet or dry applications. The wire size (gauge) shall be continuously affixed (printed on) the entire length of all tracing wire coating and shall be easily read.

Where a splice is required, or when a three (3) way splice is necessary, the wires shall be joined together with an appropriate size (blue) wire nut which shall then be placed inside a 3M brand Direct Bury Splice kit (DBR), or approved equal, of appropriate size. No bare wire shall be left exposed anywhere. All wires shall be spliced to all other wires for a continuous tracing wire system.

On all hydrants the tracing wire shall be run up and wrapped around the hydrant, see detailed drawings herein, by use of a tee splice. This wire end shall not be bare, but shall have the coating jacket intact. Location and frequency of test boxes shall be as directed by P.M., or designee. Test boxes, connected onto tracing wire system as per detailed drawings herein, shall be required where hydrants are not used or where hydrant spacing exceeds 500 feet.

No electrical connections of the tracing wire to any metal pipes or metal service lines will be allowed and care shall be taken to ensure that the tracing wire is not damaged during installation. The tracing wire will be tested for continuous signal (continuity test) and shorts to ground across all main and service lines before asphalt is installed, and prior to sub grade preparation. Tracing wire must be able to conduct a continuous signal before pipe is accepted.

506 INSPECTION & TESTING

Lines shall be filled slowly with potable water while venting all air. Precautions shall be taken to prevent entrapping air in the lines. After filling, lines shall be flushed at blow offs and dead ends at a high velocity. Valves shall be closed slowly to prevent excessive surges while maintaining positive pressure at all times throughout the new line. Flushing water shall be discharged without causing erosion damage, nuisance, or interruption of traffic. Disposal of flushing water shall be as indicated in the Contract Documents or as directed by the P.M.

The Contractor is required to hydrostatic test all water mains, laterals, dead ends, service lines and appurtenances in accordance with AWWA C600-99 (for Ductile Iron lines), or AWWA C605-94 (for PVC lines). The test shall be conducted in the presence of the P.M. The test shall be conducted without being connected to the existing NMSU utility system. If connection to the existing NMSU system is approved, the Contractor shall assume any and all responsibility in case of damage or failure of the existing system. Leakage through connections to the existing system,

leaks in the existing lines, or leaking existing valves under the test pressure will invalidate the test. The Contractor shall provide all taps, gauges, and necessary equipment and personnel for conducting the tests. All such equipment shall be subject to the approval of the P.M. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the P.M. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be examined for leakage. All visible leaks shall be corrected. All defective elements shall be repaired or removed and replaced and the test repeated until the allowable leakage requirements have been met.

The Contractor may perform simultaneous pressure and leakage tests or perform separate pressure and leakage tests on the installed system at test durations and pressures specified. The Contractor is responsible for the costs of all testing.

The duration of the pressure test shall be one hour, continuous. The applied pressure shall be one hundred fifty (150) pounds per square inch (psi) or 1.5 times the normal working pressure of the line, whichever is greater.

The leakage test shall be maintained for a period of two continuous hours. A leakage test pressure of one hundred fifty (150) psi, or 1.5 times the normal working pressure of the line, shall be applied to all lines.

The simultaneous pressure and leakage test shall be of two (2) hour duration, at an applied pressure of 150 psi, or 1.5 times the normal working pressure of the line, whichever is greater.

For any and all of the above tests, accurate measurements shall be made of the volume of water required to maintain the test pressure, the variation in test pressure, and starting and ending test times.

The testing allowance is defined as the quantity of makeup water that must be supplied into the newly installed piping, or any valved section thereof, in order to maintain pressure within 5 psi (plus or minus) of the specified test pressure after the pipe has been filled and the air expelled. Testing allowance is not measured by a drop in pressure in a test section over a period of time. No pipe installation will be acceptable if the amount of makeup water is greater than that which is determined by the following formulas:

PVC Piping Systems –

$$L = \frac{N \times D \times \bar{P}}{7,500}$$

Ductile Iron Systems –

$$L = \frac{S \times D \times \bar{P}}{133,200}$$

Where:

L = testing allowance (makeup water), gallons per hour

N = number of joints in the length of pipeline tested

S = length of pipe tested, feet

D = nominal diameter of the pipe, inches

P = average test pressure during hydrostatic test,
pounds per square inch (gauge)

507 DISINFECTION

The Contractor is required to disinfect all new potable water mains, and their appurtenances, and all existing water system portions that have undergone repairs or reconfigurations as part of the Project Documents. The disinfection procedures and requirements shall be in accordance with AWWA C651-99, or applicable revisions.

The sanitary handling of materials, the practices during construction, and the continual inspection of the work are the primary means for ensuring the sanitary condition of the water main. Three methods of disinfecting newly constructed water mains are typically utilized, depending on the circumstances involved.

The tablet method consists of adding dry calcium hypochlorite, conforming to AWWA B300-92 or latest revision, in granular form or in 5-gram (g) tablets containing approximately 65% available chlorine by weight. This method may be used only if the pipe and appurtenances are kept clean and dry during construction. The method gives an average chlorine dose of approximately 25 mg/L over a required contact time of 24 hours. The granules are placed in the upstream end of the first section of pipe, at the upstream end of each branch main, and at 300-foot intervals. If tablets are used, they are attached by a food grade adhesive (such as Permatex clear RTV Silicone Adhesive Sealant by Loctite Corp.) on the inside, top of the main and equally distributed at each end of the pipe joint. The number of tablets required per joint of pipe are given below, with one tablet being required to be placed in each hydrant, hydrant branch, and other appurtenances:

Number of 5-g. calcium hypochlorite tablets required (25 mg/L dose).

<u>Nominal Pipe Diameter (in.)</u>	<u>Length of Pipe Joint (ft.)</u>				
	<u>13 or less</u>	<u>18</u>	<u>20</u>	<u>30</u>	<u>40</u>
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

The amount of granular calcium hypochlorite to be at the beginning of the main and at each 300-foot interval, if granules are used shall be as follows:

Ounces of Calcium Hypochlorite granules per 300-foot interval

<u>Nominal Pipe Diameter</u>	<u>Calcium Hypochlorite granules</u>
4 in.	1.7
6 in.	3.8
8 in.	6.7
10 in.	10.5
12 in.	15.1
14 in. and larger	D x D x 15.1

(Where D is the inside pipe diameter in feet.)

The tablet method precludes preliminary flushing of the main. When the installation is complete, the main shall be filled slowly and all air pockets eliminated. This water shall remain in the piping for at least 24 hours. Detectable chlorine residuals should be found at each sampling point after the 24-hour period. The residuals must be reported to the P.M.

The continuous feed method consists of placing calcium hypochlorite granules in the main during construction (optional). The main is then flushed to remove all particulates and re-filled with chlorinated potable water. The chlorinated water shall be feed into the new system at a measured rate. Within 10 feet of the feed point, a constant rate of chlorine injection shall be fed into the system such that the water will have not less than 25 mg/L of free chlorine. Chlorination shall not cease until the new system is fully filled with the heavily chlorinated water. This water shall be chlorinated so that after a 24 hour holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

The slug method may also be used in disinfecting large diameter mains where continuous feed methods are impractical. This method consists of placing calcium hypochlorite granules as per the above method, flushing the main, then chlorinating the main by slowly flowing through the main a slug of water dosed with chlorine to a concentration of

100 mg/L. The slow rate of flow shall completely fill the main and its appurtenances and will expose them to the chlorinated water for a period of not less than 3 hours.

Flushing of the pipeline and appurtenances shall occur after the applicable retention period, and at other points depending on the method of chlorination. This flushing shall be into an area subject to the approval of the P.M. Flushing velocities in the main lines shall be a minimum of 2.5 feet per second.

Water samples shall then be taken from the newly installed piping system by the Contractor. The sampling process shall be witnessed by the P.M. The P.M. shall, at the time of sampling and from the same sampling port, test the discharge for residual chlorine. Residual chlorine values shall be below 0.5 parts per million (ppm). Higher residual chlorine values shall require the Contractor to re-flush the new piping system prior to re-sampling. When residual values are in the acceptable range, the Contractor shall take two consecutive sets of acceptable samples, taken at least 24 hours apart. At least one set of samples shall be collected from every 1,200 feet of the new water main, plus one set from the end of the line, and one set from each branch. The Contractor shall submit the samples to the P.M., along with directions to the local New Mexico Environment Department certified laboratory of the Contractor's choice. The P.M. shall properly store and deliver the samples to that laboratory for testing. Testing shall be for the absence of coliform and the presence of chlorine residual. Testing results shall be forwarded to the Contractor and the P.M., before acceptance of the tested system or portion. Testing costs shall be the responsibility of the Contractor.

If trench water or excessive debris has entered the new main during construction, the samples shall be taken at intervals of approximately 200 feet. These samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing.

Failure to produce satisfactory bacteriological results shall be cause for the new main to be reflushed and resampled. If these check samples also fail to produce acceptable results,

the main shall be re-chlorinated by the continuous feed or slug method until satisfactory results are obtained. In no case shall an existing service be transferred to a new line or a new service connected to a meter until the bacteriological analyses are satisfactory.

When small installations are constructed without the extensions of mains, such as main line taps only, chlorination of trench and equipment used, and materials (tapping valves, fittings) is required. See AWWA C651-99, or latest edition, for further details.

508 ASBESTOS CONTAINING MATERIALS

All asbestos containing materials encountered in the process of accomplishing the Project shall be dealt with in strict conformance to the cited references contained herein, see previous Sections and Section 502.

It is the Contractor's responsibility to follow all EPA, OSHA, NM Solid Waste Management Regulations, and all other regulations when working with asbestos-cement pipe. Cutting of AC pipe shall not be allowed. At the point of tie-in to existing AC lines, the Contractor shall excavate to the nearest joints and remove the section of pipe in one piece. The AC pipe must remain wet and encapsulated with 6 ml or thicker plastic bag per NM Solid Waste Management Regulations until the pipe is delivered to the Special Waste Facility. Existing AC water line pipe shall remain abandoned in place wherever possible.