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A CONTINUOUS FLOW MOBILE BIOASSAY LABORATORY

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Army Medical Environmental Engineering Research Unit
Edgewood Arsenal, Maryland

March 1973

AD

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BY

CPT W. R. MURA, MSC

MARCH 1973

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U.S. ARMY
MEDICAL ENVIRONMENTAL
ENGINEERING RESEARCH UNIT
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13. ABSTRACT

A specification has been developed describing the design of a continuous flow mobile bioassay and general purpose field laboratory for use by the US Army Environmental Hygiene Agency (USAEHA). The specification is complete with drawings and is suitable for inclusion with a purchase request for procurement of the mobile unit. It outlines the requirements for the laboratory vehicle construction, safety features, equipment load, utilities, and testing requirements. Those consulted during the development of the specification include USAEHA personnel, manufacturers, and users of mobile laboratories, Government regulatory agencies, and others.

A number of alternative concepts, methods, and equipment items were considered for the major design features. These alternatives are presented along with the reasons for selection. The laboratory was designed to meet the specialized needs of the Water Quality Engineering Division, USAEHA, in the areas of bioassay and wastewater treatability studies and sample preservation and transportation, while also incorporating features to meet the general field laboratory requirements of other divisions of USAEHA. In the specification a semitrailer unit is described which contains trailer mounted bioassay facilities, space and utility connections for user-procured treatability equipment, sample preservation equipment, work space, and storage facilities. A cost estimate is included.

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INTRODUCTION

This project was originally envisioned as providing a field capability for the conduct of continuous flow bioassay studies only. However, in the early development stages of the project, it was determined that additional field laboratory capability was required by the Water Quality Engineering Division (WQED) and other Divisions of the US Army Environmental Hygiene Agency (USAEHA), which could be attained by a more flexible design of a single mobile unit. Personnel at USAEHA identified field capability requirements in the following areas:

1. Bioassay studies (continuous and static)

2. Wastewater treatability studies

3. Sample preservation and transportation facilities

4. General laboratory and desk space

In response to these needs, alternative designs for a mobile unit were investigated.

OBJECTIVES

1. To develop design criteria, including the capability, optimal configuration and equipment load of a continuous flow mobile bioassay and general purpose field laboratory for use by USAEHA.

2. To develop plans and specifications to be used by USAEHA for procurement of this laboratory.

APPROACH

Considerable experience in the design and desired qualities of a mobile laboratory is available from personnel both within and outside the Government. In order to best utilize this experience, technical advice and assistance were obtained from many sources including the following: USAEHA personnel; Government and private organizations which operate mobile water quality laboratory facilities; manufacturers of customized mobile laboratories; manufacturers and vendors of accessory equipment; various Government regulatory agencies; and various Army technical and procurement personnel.

Following preliminary discussions with these individuals and organizations, alternatives were considered for various functional requirements of the mobile laboratory. The concept employed in satisfying the diverse requirements for this unit and in implementing

selected alternatives was to utilize a minimum of permanently installed equipment and to arrange the interior of the mobile laboratory so that non-fixed equipment could be easily installed and removed. Where equipment may be removed from the mobile laboratory, permanent wall shelf brackets would have to be mounted to provide ease of conversion for other functions. Details of the design were based on the specialized requirements of WQED, while incorporating the flexibility needed for the other operations.

RESULTS

A number of alternative concepts, methods, and equipment items were considered for the major design features of the mobile unit. To a large degree the resolution and selection of the most desirable alternatives dictated many of the design details. The major conceptual and design alternatives are summarized as follows:

1. Vehicle style and size. The mode of operation of the mobile laboratory and the size required to accommodate equipment and work space dictated the use of a semi-trailer as opposed to a self-propelled vehicle or a house trailer-type unit. The size and weight limitations on semi-trailers are detailed in section 2b(1), Appendix A.

2. Bioassay facilities.

a. Continuous flow bioassay studies could be carried out in the mobile laboratory by using dilution panels which would be constructed by user personnel. Either raw or treated water may be used in this system. The water flow pattern is shown on Figure 5, Appendix A. A 200 gallon storage tank and four 50 gallon fish colonization tanks are required as part of the system. Other internal support facilities include the bioassay work area with sink, utilities, and accessory equipment.

b. An alternative proposal was to use the mobile laboratory as a field support facility and to conduct the bioassays in small buildings, or field modules, located at selected sites near streams of interest. The mobile laboratory could contain water treatment and storage equipment and fish colonization tanks. The field modules (approximately 6 ft. x 6 ft. x 8 ft. tall) would contain a bioassay panel and associated equipment. These buildings would be portable, collapsible structures, made of prefabricated insulated panels. Power could be

supplied by gasoline engine-driven generators, batteries, or by tapping electrical transmission lines. Battery power sources were physically unwieldy and economically impractical. This alternative was rejected since considerably more personnel and logistic support would be required for the conduct of aquatic bioassays.

3. Treatability facilities.

a. New Brunswick Scientific Company Fermenters, Model MF 114, were selected for the conduct of field treatability studies by USAEHA personnel. Their installation is planned for the treatability area as shown on Figure 1, Appendix A. Support facilities include the refrigerator/freezer, utilities, and bench space

b. An alternative proposal was to utilize owner fabricated, removable panels with attached commercial bench scale reactors such as the Fabco-Busch Apparatus or the Eckenfelder Unit (Ref. D.L. Ford *et al*, "Development of Biological Treatment Data for Chemical Wastes", Proc. 22nd Industrial Waste Conf., Purdue Univ., 1967, p. 292). Four panels could be used in sets of two, with panels facing each other to form two bays. Panels would be mounted perpendicular to the side walls of the trailer and their positions would be adjustable. This approach is less expensive than the commercial fermenter units, although it does not provide the same degree of control over some physical parameters involved in treatability studies. It would, however, result in an appreciable reduction in mobile laboratory power requirements.

4. Sample preservation. The capability for preserving samples for analysis at or near freezing temperatures during shipment back to the base laboratory was considered desirable. Two possible alternatives were evaluated.

a. A freezer could be provided in the mobile laboratory where water samples could be maintained in the frozen state during shipment to the base laboratory at Aberdeen Proving Ground. However, this would require a trailer mounted generator, capable of providing a continuous power supply during transit.

b. A second choice consisted of providing a freezer of sufficient size to permit the packing of pre-frozen samples in dry ice during the transit period. In order to evaluate the ability of this concept to maintain temperatures at or near freezing, an experiment was conducted in which a one gallon plastic container of water was frozen, packed in dry ice in a cardboard box, and placed in a refrigerator. Power to the

refrigerator was cut off and the sample remained in the unopened refrigerator for 4 days. (Four days was the estimated time for a long distance return trip from the field site to Aberdeen Proving Ground). At the end of this period, approximately 10% of the water sample was still frozen and the water temperature was 5 - 6°C. This alternative was considered acceptable to satisfy the sample preservation requirement.

5. Floor covering. Poured or sprayed seamless epoxy was selected for the floor covering because of its excellent durability and its chemical resistant properties. Vinyl tile is used in the existing USAEHA mobile laboratories, but it has not provided satisfactory durability. Indoor-outdoor nylon carpeting was considered because of its accoustical properities, stain and chemical resistance, and ease of maintenance. However, it was felt that the heavy foot traffic and the moving of equipment in and out of the mobile laboratory would wear through or rip this type of covering.

6. Specifications. The basic requirements for this mobile laboratory, along with a thorough evaluation of the major alternatives described above, resulted in the development of a set of specifications and drawings (Appendix A).

7. Estimated Procurement Cost. Considering the wide variation in bids received for the existing USAEHA mobile laboratories, it is difficult to provide a meaningful cost estimate for the new facility. However, based on current costs for semi-trailers of similar size and application, utility requirements and the specialized nature of some contractor supplied equipment, an acceptable bid should not exceed $75,000.

CONCLUSIONS

1. A semi-trailer type mobile laboratory was chosen because of required equipment transport capability, work space, weight constraints, and operational demands.

2. Mobile laboratory mounted bioassay facilities were employed because of the excessively complicated logistic requirements to support independent field modules.

3. Sample preservation requirements during mobile laboratory transit can be achieved by employing the dry ice packing concept.

4. Epoxy seamless floor covering was chosen because of its durability and chemical resistant properties.

5. The specifications and drawings (Appendix A) are complete and are suitable for attachment to a purchase request for procurement purposes.

6. Procurement cost for the mobile bioassay laboratory should not exceed $75,000.

Appendix A

SPECIFICATION FOR MOBILE BIOASSAY LABORATORY

1. Scope

a. General

(1) This specification covers a mobile laboratory, semi-trailer mounted, complete with the various accessories listed herein. The unit shall be furnished complete and operational, requiring only connection to standard 110/220 VAC electrical power, a pressurized potable water system, and liquid waste drainage provisions for operation. All installed equipment shall be connected to the proper utilities and ready to operate.

(2) This unit will be operated in all parts of the continental United States in all seasons of the year. It will be staffed by 3-5 persons. Facilities in and on the semi-trailer will permit the following tasks to be performed:

(a) Bioassay studies

(b) BOD determinations

(c) Field treatability studies

(d) Limited workshop and desk-work activities

(e) Preservation of samples

(f) Chemistry lab functions as required

b. References and Specifications

(1) Each component of the unit shall meet all federal and state Department of Transportation (DOT) regulations, latest issue, where applicable. Other references and specifications which must be complied with will be cited in later paragraphs.

(2) Contractor shall submit drawings of the unit as required by DD Form 1423. Updated drawings as required by DD Form 1423 shall also be submitted by the contractor as therein indicated.

2. Construction

a. General. The contractor shall procure a semi-trailer platform chassis of appropriate rated capacity and construct and assemble the remainder of the trailer to include the features described in this specification.

b. Exterior

(1) Dimensions and Clearances. The dimensions described herein shall be measured with the semi-trailer uncoupled from the towing vehicle, resting level on the landing gear on a level surface, and loaded with the specified payload. The overall exterior dimensions shall be such that the unit will not be considered oversize in any state or district in the continental United States and such that no oversize permits will be required for transit to or through any state or district. (Ref. American Trucking Associations, Inc., Summary of Size and Weight Limits and Reciprocity Authority, 1 August 1972):

Maximum exterior dimensions of the trailer shall be: 12 ft. 6 in. in height (ground to roof), 35 ft. in length, and 96 in. in width

Minimum exterior dimensions of the trailer shall be: 12 ft. in height (ground to roof), 34 ft. in length, and 90 in. in width

Minimum interior dimensions of the trailer shall be: 90 in. in height (floor to ceiling), 33 ft. in length, and 84 in. in width

In addition, adequate clearance shall be maintained beneath the trailer to allow easy access to utility compartments and connections.

(2) Weights and Loads

(a) Curb weight. The curb weight of the unit shall include the weight of the trailer body with all attachments, accessories, and equipment, except those items listed in Sections 4 and 5.

(b) Payload. The rated payload capacity shall cover the weight of equipment listed in Sections 4 and 5, and of other supplies necessary to accomplish the mission. Payload is estimated at 9000 lbs.

(c) Gross weight. The gross weight shall be the combined curb weight and payload weight. The contractor will ensure that the gross weight of the unit does not exceed any state or district limitations, and that no overweight permits will be required for transit to or through any state or district.

(3) Framework. The structural framing for the semi-trailer shall be of unitized, all welded construction using steel sections (approximately 2 square inches in cross section) on 12 to 16 inch centers.

(4) External skin shall be of 0.050 inch natural aluminum, corrugated on 2 inch centers, cleaned and waxed.

(5) Suspension and axle system. The trailer shall be fully air-suspended, both at rear axle(s) and at the king pin. Clearances shall preclude interference between wheels and with any other part of the semi-trailer under the operating conditions specified herein. The suspension system shall be rated at a minimum of 20,000 lbs. Either a one or two axle configuration is acceptable provided the rating criterion is met.

(6) Tires, wheels, and rims shall be provided by the manufacturer according to the recommendations of the Tire and Rim Association.

(7) Brakes. Brakes shall be of the full air, internal expanding, two shoe, cam action type and shall conform to Federal DOT Motor Carrier Safety Regulations 393.40 through 393.43, 393.45 through 393.51, and as specified herein. The braking system shall include at least standard breakaway features, relay emergency valve, air reservoir and filters, slack adjusters, piping, hose connections, glad hands, dummy couplings, and all other components required for a complete system. Air hose connections and hose couplings (glad hands) shall comply with SAE Recommended Practice for Semi-trailer Brake Connection Locations. Parking brakes will be provided and will be "piggyback" type, air powered so as to be fully operational when the trailer is disconnected from the tractor. Parking brakes shall adhere to Federal DOT Safety Regulations, Part 393.41. The braking system shall be installed in a manner which provides road clearance for travel over uneven terrain and protection against damage caused by objects striking components. No part of the braking system shall extend below the bottom of wheel rims.

(8) Landing gear

(a) Retractable landing gear, of the vertical two speed type, with steel landing pads shall be furnished to support the front of the trailer on both the street and curb sides, and shall be of adequate capacity to support its portion of the fully loaded semi-trailer. The minimum size of the landing pads shall be 12 in. x 12 in.

(b) Proper and effective means shall be provided for adjusting the extended length of the landing gear. The adjustments to the landing gear shall be sufficient to, under ordinary conditions, permit the

coupling and uncoupling of the fully loaded semi-trailer to and from the truck tractor without resorting to other means. Landing gear shall be manually operated from the curbside of the semi-trailer by means of a crank handle and shall be so constructed or inclosed as to preclude entry of foreign matter which would impair its mechanical efficiency.

(9) Coupling devices and towing methods, including fifth wheel and kingpin, shall conform to Section 393.70 of the Federal DOT Motor Carrier Safety Regulations.

(10) Rear end protection (bumpers or other devices) conforming to DOT 393.86 shall be installed in such a manner as to not interfere with the operation of the rear doors.

(11) Semi-trailer shall be undercoated in accordance with requirement of Standard MIL-STD-1223.

(12) Drip moulding shall be furnished along each side (street side and curb side) at the top, and over the rear and side doors.

(13) Rub rail. Each side of body shall be protected by an all steel rub rail installed at base of exterior panels. Rail shall be at least 7 gauge pressed steel angle (approximately 1 1/2 in. x 2 1/2 in) and mounted to allow 1/8 in. opening between rub rail and body panel for quick moisture evaporation and longer panel life.

(14) Body waterproofing. Panel joints and closed windows and doors shall be leakproof to preclude entrance of water due to rain, snow, and road splash during inclement weather.

(15) External doors

(a) The trailer shall be provided with one access door on the curb side of the trailer, providing a clear opening at least 78 in. high and 32 in. wide. It shall open outwardly and shall be provided with a latching mechanism to hold it at full open. In addition, it shall be equipped with a latching mechnaism at top and bottom which is operated by a single, recessed handle capable of being locked with a key from the outside, but openable from the inside without a key when locked from the outside. An automotive-type roll-down window with hand-crank regulator will be installed in the top half of the door. The window will be of safety glass and will come complete with inside-mounted, replacable screen and double-thermopane storm window. It will be of the largest size which will fit into the top half of the door.

(b) Rear of trailer shall be provided with double doors which shall open across the full width of the trailer.

(c) All doors shall be approximately 1 3/4 in. thick and of full, flush design. They will be suitably reinforced and insulated, with a durable aluminum exterior surface. Doors and frames will be trimmed with metal weather stripping to prevent entrance of dust and water.

(16) Access steps and platforms

(a) Each door will be provided with an entrance platform which extends horizontally at least 30 in. outward from the side of the trailer, and with access steps reaching from the ground to the platform. Platforms and steps are shown in Figure 2.

(b) Both platforms and steps shall be of aluminum construction, self cleaning, with a ribbed or abrasive surface to prevent slipping.

(c) Rear platform will be at least as wide as rear doorway. Side platform will be at least 1 ft. wider than doorway, with extra width being allowed on side of entrance away from hinges. Platforms will be stored for transportation by sliding under the trailer or by swinging up against the rear of the trailer and being secured in place.

(d) Both sets of access steps will be at least 24 in. wide and will be of one piece, rigid construction. The steps will be removable from the platforms and provision will be made to attach the steps to the platform both straight-on toward door and on one side (curb side for rear steps). Provision shall be made that side door opens away from side mounted steps and that street side rear door may be opened without opening the curb side rear door. Steps shall have self-leveling feet. The steps will be stored for transportation either in or under the trailer.

(e) Removable hand rails will be provided for both steps and platforms. Hand rails will have capability for attachment to either side or outward end of platforms and to side of steps away from trailer when side mounted. Hand rails will be stored for transportation in or under the trailer.

(17) Roof. The roof will be of one-piece construction using 0.040 in. thick aluminum. It will be tape-sealed on the perimeter and secured by a double row of pressure-applied rivets of 2 in. centers. The roof will have a minimum 1 1/2 in. rise at the center.

(18) Exterior hardware. All screws, rivets, hinges, and other fixtures used on the body exterior shall be corrosion resistant.

(19) Exterior lighting

(a) A 12 volt DC exterior lighting system conforming to applicable DOT regulations, Part 393, will be provided.

(b) System will include lights above outside doors to illuminate access steps.

(c) All lights and reflectors shall be mounted in recessed settings or in guarded locations to provide protection from operational hazards. All wiring shall be properly routed and anchored to protect against snagging or tearing away. Lights and reflectors shall not be mounted on rub rails or on vehicle bumpers.

(d) An illuminated rear license plate holder shall be provided.

(20) Storage compartments will be mounted under the entire area of the chassis except where space is utilized by axle or axles, utilities, access step storage, or other required and specified accessory items. The compartment will be continuous, but will not interfere with easy access to accessory items. It will be designed to support at least 100 lbs. per square foot and will be sized to allow ground clearance as per Federal DOT Regulations. The compartment exterior will be 0.050 in. aluminum sheeting and the interior shall be 1/4 in. exterior grade sealed and primed plywood. Doors will be placed on both street and curb sides of the compartment and will be hinged at the top. Doors will be no longer than 4 ft. and will be gasketed and have handles with locks, all keyed alike. Provision will be made for positive drainage of the compartment.

(21) Painting and marking.

(a) The following nomenclature shall be painted on each side of the trailer exterior in a maroon color (No. 20061, Fed. Std. 595).

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MOBILE LABORATORY

(b) The first two lines will be in letter 5 1/2 in. high and the last line will be in letter 4 1/2 in. high. Painting and marking will be done according to MIL STD 1223.

c. Interior

(1) Walls shall be lined with 1/4 in. marine grade plywood and covered with either a yellow steel porcelanized surface, 0.024 gauge, mounted on laminated hard board and backed with 0.001 in. aluminum foil, or an equivalent chemically resistant, washable finish.

(2) Ceiling. The ceiling height shall be at least 90 in. from the floor. The ceiling surface shall be flush with or below electrical circuits, lighting fixtures, and air ducts, which will be continuous for the length of the trailer. Ceiling surface may be acoustical panels, light diffusing panels, or other materials as per contractor's standard practice. Ceiling shall be installed so as to provide easy access to ceiling-mounted utilities; however, any panels or tiles used in the ceiling will be sufficently secured in position to prevent dislodging during transit.

(3) Floor. The subfloor shall be 3/4 in. marine plywood or equivalent. Floor surface shall be poured or sprayed seamless epoxy, minimum 3/16 in. thick, with a skid-resistant surface.

(4) Insulation

(a) A minimum of three inches of compressed fiberglass insulation having a density of two lbs/sq. ft. (or equivalent) with vapor barrier, shall be installed on all surfaces, including floor, sides, and roof, between the exterior shell and the plywood lining.

(b) All insulation, to the maximum practicable extent, shall be installed prior to the closing of spaces in body sides, front and rear panels, ends, doors, upright body members, roof, roof bows, and other parts.

3. Trailer performance

a. Speed. The semi-trailer shall evidence no damage when towed at speeds as great as 65 mph over dry, smooth, level, improved (concrete, macadam, or brick paved) highways and when towed at speeds as great as 15 mph over dry, relatively smooth, level, unimproved (compacted gravel, crushed stone, or hard dirt) roads and across dry, reasonably firm uneven terrain.

b. Tracking ability. The semi-trailer shall comply with the tracking requirement of Federal DOT Safety Regulations, Part 393.70(e).

c. Braking ability. The vehicle combination (semi-trailer and towing vehicle) shall conform to the braking performance requirements of Federal DOT Safety Regulations, Part 393.52.

d. Turning ability. The semi-trailer shall assume a 90 degree angle, left and right, to the coupled towing vehicle without cramping or side slipping, and without interference between or damage to either the semi-trailer or the towing vehicle.

4. Appurtenances

a. Furniture

(1) Overall arrangement of the furniture and other equipment is shown in Figure 1. Location of items may be changed with consent of owner in order to facilitate installation or operation. All shelving, panels and equipment items are to be removable from the trailer, with the exception of wall cabinets, work bench and sink floor units. This will allow the trailer interior to be modified for general laboratory work as required.

(2) All laboratory furniture shall be metal "ready built" of a color to be approved by the owner prior to installation. Items listed in this specification are number-keyed to items shown on Figure 1. Dimensions shown are approximate and variations from these dimensions are permissible to utilize standard items, provided functional requirements and overall size constraints of the trailer are met. Description of certain items refers to equipment in Fisher Scientific Catalog, 70m ed. This is done for the sole purpose of assisting in size and style selection. Laboratory furniture manufactured by any of the companies in this field shall be acceptable provided it meets requirements of the Military Specification for casework, MIL-C20709a, 30 Sep 64, and amendments. All laboratory furniture tops shall be continuous and shall be constructed of stainless steel conforming to Fed. Spec. QQ-S-775, Class 316, Condition A, with four inch curbing (splash backing) of same material. All drawers and doors shall be equipped with suitable latches to insure that they remain closed during transit. If locks are used as latching devices, all locks will be keyed alike and six keys will be provided. Recessed toe-space will be provided on all base and sink units.

(3) The following items will be purchased by the contractor and installed in the trailer before delivery:

Ref. No. (See Figure 1)	Item
1	Sink unit, 30 in. high, 22 in. deep, 24 in. wide, with storage cabinet and hinged door below. Sink is to be stainless steel with single valve and gooseneck spigot for cold water service. Sink is to be approximately 18 in. wide and 15 in. front to rear. Ref. Fisher 97-290 - except 30 in. high.
2	Bioassay work unit, 30 in. high, 20 in. deep, 18 in. wide; all drawers, as shown in Figure 1. Ref. Fisher 90-150 (2 adjacent units.)
3	Bioassay work table, 30 in. high, 22 in. deep, 36 in. wide, one drawer, with open space beneath. Ref. Fisher 97-630 with 90-600 legs.
4	Work bench unit 36 in. high, 22 in. deep, 48 in. wide. Ref. Fisher 97-430.
5	Sink unit, 36 in. high, 22 in. deep, of sufficient width to accomodate water heater underneath. Sink is to be stainless steel, approximately 18 in. x 15 in., with double valve and single spigot for hot and cold water service. Base unit will contain single or double side-hinged doors. Ref. Fisher 97-290 or 97-390.
6	Work bench unit 36 in. high, 22 in. deep, 48 in. wide. Ref. Fisher 97-470.
7	Work bench top to fit above oven. 24 in. wide x 22 in. deep. To be level and continuous with adjacent work surfaces. Note: This item must be no closer than 10 ft. to rear of trailer to provide room for refrigerator/freezer and owner-supplied equipment in treatability area.

(4) Shelving

(a) Where indicated on Figure 2, the interior walls of the trailer shall be equipped with wall-mounted standards for removable adjustable height shelves. Standards shall be installed so as to be fixed to vertical wall supports and shall not be fastened merely to the interior wall material. These standards shall be mounted at uniform spacing so that shelves will be completely interchangeable and continuous.

(b) Shelves along sides of trailer will be 12 in. deep and come in equal length sections approximately 3 ft. long and will be capable of supporting 40 lbs. per lineal foot. Ninety lineal feet of anodized aluminum shelving of this type will be provided.

(c) Shelves along front of trailer will hold water tanks for bioassay studies. Three shelves positioned across the front end of the trailer will be provided. They will be designed and supported to hold 150 lbs. per lineal foot (about 1000 lbs. per shelf). The shelves will be approximately 3 ft. deep, and fabricated of anodized aluminum or other structurally adequate material. The bottom shelf will be mounted on rollers or other mechanisms which will allow it to be moved away from the front wall of the trailer, and thus allow access to the lower tanks. The top two shelves will be removable and adjustable in height.

(d) Provision will be made to allow positioning of shelves adjacent to work surfaces in a continuous fashion at same height as permanently installed work surfaces to provide additional analytical bench space. Shelving should be height-adjustable in regular intervals from the floor to within 12 inches of the ceiling.

(5) Panel Supports

(a) Supports will be provided for test panels which will be constructed by the owner. The panels will be of plywood construction, 6 ft. high and 3 ft. wide. Panels should be sufficiently supported to prevent movement while equipment on panels is being attached or operated.

(b) Four owner-made panels will be used in bioassay tests. These will be mounted on and parallel to the side walls as shown in Figure 1. The estimated weight of each panel and its accessories is 75 lbs.

(6) Wall cabinets are to be installed and positioned as shown in Figure 2. Approximately 24 linear feet of cabinet space will be provided. The cabinets will be 18 in. high, 18 in. deep, and will be installed so that the bottom of the cabinets is at least 2.5 ft. above the work surface. Cabinets will have one interior adjustable shelf. Doors shall be opaque sliding panels with latching mechanisms. Cabinets shall be installed so as to be fixed to vertical wall supports and shall not be fastened merely to the interior wall material.

b. Contractor-installed equipment

(1) Contractor-installed items shall be wall, floor, or bench mounted according to illustration in Figure 1. All supports for wall mounting of equipment shall be an integral part of the trailer's structural framing. The type of floor and bench mountings selected shall be designed to permit easy removal of the attached items from the trailer. Reference equipment models are cited for assistance in equipment selection. The contractor shall provide the referenced models or equipment which is equivalent in size, performance, and quality.

(2) Incubators. Two incubators shall be designed in accordance with the method adopted by the American Public Health Association for determination of BOD in water and capable of holding up to 220 standard BOD sample bottles. They shall be capable of maintaining any preset temperature between 5°C and 50°C within ± 1.0°C. In addition, they shall be provided with indicating thermometers calibrated in 0.5° increments from 0°C to 50°C, mounted so as to be visible from the front exterior with the door closed. The incubators operate on 110 VAC, 60 cycle. Incubators shall be floor mounted side-by-side, with both incubator doors hinged as shown on Figure 1. A single unit of similar design and capacity is acceptable. Ref. Fisher No. 11-679-30.

(3) Muffle furnace. This equipment shall be operable to 1900°F maximum. It will be non-spalling and have multilayer insulation to reduce heat loss. Door shall be self-latching. Minimum chamber size shall be 12 1/2 in. wide x 10 in. deep x 6 1/2 in. high. Overall exterior dimensions shall not exceed 21 1/2 in. wide x 20 in. deep x 19 in. high. Furnace will be mounted on the work surface as shown in Figure 1. It shall come equipped with an electronic solid-state temperature controller. It shall be automatic feed-back potentiometer type with an operating scale range of 100° to 2200°F and a setting accuracy of 1% of scale range. Controller should compensate for differences in line voltage. Controller equipment shall include connecting kit of flexible cable, thermocouple leads, power wire, all hardware, and marked terminals. Maximum dimensions

shall be 7 1/2 in. wide x 11 1/2 in. high x 6 1/2 in. deep. Controller shall be wired for operation on 220 VAC, 60 Hz current. It will be mounted on the side of the furnace. Ref. Fisher Catalog, p. 561; Thermolyne type 6000 Furnace, Fisher 10-558; and Thermolyne Dubuque III, Type 8700 Controller, Fisher 10-558-20.

(4) Oven. The oven shall be of the forced-draft design for rapid drying and shall have at least three removable and one fixed interior shelves providing a minimum of 6 1/2 square feet of shelf space. Interior dimensions shall equal or exceed 16 1/2 in. x 14 3/4 in. x 16 in. The temperature range shall be controllable between 40° and 200°C, and shall have a minimum constancy of ± 1.5°C at 100°C and ± 0.9°C at 200°C. The unit shall operate on 110 VAC, 60 cycle and be floor-mounted beneath counter surface, as in Figure 1. Reference Fisher 13-244-4 except controls should be at top of oven so as to be operated from standing position.

(5) Distilling apparatus with integral distilled water storage tank. This unit shall be designed for operation on hard water with total solids in excess of 50 ppm and capable of producting 2 gallons of distilled water per hour with an electrical resistance of not less than 800,000 ohms complete with floatless low water cut-off which will automatically shut off the electricity if the water level in the evaporator drops below a safe operating level. The unit shall be capable of operation on 60 cycle, 220 VAC. The storage tank shall be connected to the distillation apparatus and have a minimum storage of 10 gallons, complete with exterior level indicating sight glass. Overall unit dimensions shall not exceed 27 in. wide, 41 in. high, and 15 in. deep. All metal parts of tank coming in contact with water shall be tin lined, and the faucet shall be constructed of brass and shall have fiber washers. The faucet shall be located so that it drains to the nearest sink. Ref. Fisher Catalog No. 9-017-60, Barnstead Model Two-Ten.

(6) Cartridge-type deionizer, of capacity compatible with that of the distillation apparatus, shall be provided in conjunction with the distilled water system. Ref. Barnstead Type HN, Mixed Bed. (Fisher Catalog No. 9-035-25).

(7) Refrigerator/freezer - approximately 10 cubic feet. Refrigerator compartment with door storage, 2.5 cubic feet freezer compartment. Thermostat-controlled temperature range of +2° to +10°C in refrigerator

chamber and -18 to -7°C in freezer. Compressor rated at approximately 1/6 Hp. Maximum width of unit shall be 33 in. Unit is to operate at 110 VAC, 60 Hz. Ref. Lab Line "Frigid-Cab" Model 13.

(8) Freezer, chest type, top-loading, approximately 25 cubic feet capacity. Normal operating temperature of 0°F and minimum temperature of -10°F or lower. Unit is to operate on 110 VAC, 60 Hz current. Overall dimensions shall not exceed 36 in. high (lid closed), 61 in. high (lid open), 70 in. wide, and 28 in. deep. Compressor shall be rated at approximately 1/3 Hp. Top shall be covered with durable, chemical resistant material to allow use of the freezer top as a work area. Ref. Frigidaire Model CF-253T.

(9) Storage and distribution facilities for water will be provided by the contractor. Delivery of water to the van will be arranged by the owner. The following contractor-supplied items will then be required:

(a) Storage tank - approximate dimensions: 78 in. long x 33 in. wide x 20 in. high (approximately 200 gal. capacity). Tank is to be fabricated of fiberglass or other suitably strong, light-weight material. It shall be shelf-mounted, and located as shown on the top shelf at the front of the trailer.

(b) Fish colonization tanks, 4 each, fiberglass, will be provided. Each tank will have 50 gallon capacity and will be sized so as to allow associated equipment such as lights and pumps to be placed above and adjacent to the tanks on shelves described in paragraph 4a(4)(c). Front wall of each tank will be a clear pane of borosilicate glass at least 1/4 in. thick.

(c) Dechlorinator, activated carbon cartridge type, will be installed in inlet line to the storage tank. Cartridges shall be replacable and have capacity for 5 gpm flow rate. Valves shall be placed on inlet and outlet of dechlorinator. This equipment shall be positioned so as to facilitate servicing and cartridge replacement. Immediately preceeding the dechlorinator in the piping system will be a connection with appropriate valves to allow flow through the dechlorinator of either stream water or water from the trailer supply system without the possibility of a cross connection. A dechlorinator by-pass will also be provided in the stream water line, as shown in Figure 5. Ref. Culligan "Flavr-gard" Compact Water Purifier.

(d) Piping and connections for the stream water line will conform to paragraph 5c(1) with the exception that piping will be minimum 3/4 in. I.D. An inlet connection (W_3, Figure 4) shall be conveniently located on the underside of the trailer adjacent to the storage tank. This connection shall be standard threaded 3/4 in. male equipped with a removable cap fastened to the vehicle with a suitable chain. The connection shall be replacable in event of thread damage. Note that this connection is not part of the water supply system described in paragraph 5c. Piping from this inlet will run to the dechlorinator cartridge and then to the tank at a convenient location. Gravity-feed lines to fish tanks will be arranged by the owner.

(10) Humidifier/dehumidifier with humidistat for humidity level selection will be provided. Capacity shall be approximately 14 gallons/day dehumidification. The unit shall have variable speed humidification and constant level dehumidification. Automatic shut-off and indicator capability will be provided for full and empty tank conditions. Provision will be made for drain hose connection. The unit will be shelf-mounted in a convenient location and run on 110 VAC, 60 Hz current. Ref. Sears Catalog No. 47-H-3952N (Fall-Winter 1972).

c. The following accessory items will be provided by the contractor:

(1) Tie-downs. Recessed tie-down rings shall be provided, screwed or bolted to the floor, 2 in. inward from laboratory furniture and equipment on both sides of the laboratory compartment center aisle at 3 ft. intervals. In addition, similar tie-down rings shall be installed on the exposed portions of the side walls in 3 ft. intervals horizontally, and 15 in intervals vertically, beginning just above the splash backs on the counters. All wall-mounted tie-downs will be fixed to vertical wall supports and not merely fastened to the interior wall material.

(2) Water connection for future use shall be provided in the street side rear of the van (W_2 as shown in Figure 4). Connection shall extend from underside of trailer to interior side wall and shall be standard threaded 3/4 in., male at both ends with removable caps. Interior end of connection will be about 1 ft. from floor and will extend not more than 2 in. from wall. Outside cap will be fastened to the vehicle with a suitable chain. Connections will be replacable in the event of thread damage. Note that this connection is not part of the fresh water supply system described in paragraph 5c.

(3) Telephone. A telephone connection shall be built into the street side wall as indicated in Figure 1. The connection will be approximately 4 ft. from the floor. Appropriate wiring conduit from this connection shall terminate at an electrical box mounted under the trailer.

(4) An electric clock, 110 VAC, 60 Hz, with second hand, shall be mounted on street side wall as shown in Figure 1.

(5) A paper towel dispenser for individual towels shall be installed on the laboratory wall near the standing level sink.

(6) Draining rack for glassware, to be installed on laboratory wall directly behind standing level sink.

(7) Fire extinguisher, 2 each, 5 pound dry chemical with heavy duty truck mounting brackets. Extinguishers shall meet National Board of Fire Underwriters Class A, B, and C standards, and will be installed in convenient locations in the laboratory compartment. Provision shall be made for visual determination of whether the extinguisher is adequately charged.

(8) Fire blanket, National Board of Fire Underwriters approved, to be installed immediately adjacent to side door of trailer.

(9) Locks and keys. All locks on exterior of the trailer shall be of the same key code and all locks on interior of the trailer shall be of the same key code. Six keys of each key code type will be provided.

(10) A spare tire and wheel shall be provided and mounted under the rear of the trailer.

(11) Mud flaps will be provided and installed.

(12) Wood or metal wheel chucks with chain attached to chassis will be provided for both front and rear of wheels, right and left side of trailer. They will be stored and transported under the trailer when not in use.

(13) Hydraulic leveling jacks, 4 each, will be provided at corners of trailer to stabilize the unit on location. The jacks will be manually operated with a 24 in. minimum operating range. They will be heavy duty type, each capable of lifting a minimum of 10,000 lbs. They will be

vertically supported with sandshoes (minimum size 12 in. by 12 in.) and completely retractable for transit. The jacks will be of sufficient strength to withstand a horizontal wind loading of 75 mph perpendicular to the long axis of the trailer when the jacks are in the fully extended position.

(14) Two ventilation fans shall be provided, one in the front (located between the water tanks and the bioassay panels) and one in the rear of the van. They will be mounted on the side walls of the trailer, at least 6 ft. above the floor. Fans will be approximately 12 in. in diameter, variable speed, and reversible, with a capacity of at least 300 cfm each. Controls will be conveniently placed on or near each fan. Motors will be 110 VAC, 60 Hz, rated for continuous duty, and designed and mounted for minimum noise and vibration. Outside openings will be protected by adjustable louvers or by an equivalent device which may be completely closed. Inside opening will be screened.

(15) Marking

(a) All outside connection points for utilities shall be identified with name plates, i.e. freshwater; drain line; 220 VAC, 60 Hz; etc.

(b) All electrical switches, 220 VAC outlets, and circuit breakers shall be identified with name plates.

(c) All valves controlling the flow of air, water, or vacuum shall be identified with name plates.

(d) Letters on name plates mentioned on (a), (b), and (c) above shall be a minimum of 1/4 in. high.

5. Utilities

a. Electrical system and connections

(1) Input receptacle and wiring shall be suitable for 200 amp, 110/220 VAC service. Power for the trailer shall be obtained directly from 220 V pole-mounted wiring. Provision shall be made to connect the power supply to a suitable main switch (described in paragraph 5a(3)) and circuit breaker box of sufficient size to provide protection for the entire 110/220 VAC system. Connections shall be made via a distribution box

carried with the trailer, a telescopic mast mounted on the trailer, or other effective, safe arrangement recommended by the contractor. All external connections and receptacles shall have weather-proof covers.

(2) Supply cable. The contractor will supply a 3 wire 100 foot electrical cable, divided in two equal lengths with appropriate water proof connections.

(3) Main electrical switch

(a) The main switch shall be of the center-off type with a choice of two service entrances. One service entrance will be fused for 200 amp, 220 VAC, and connected to the electrical source receptacle described in paragraph 5a(1). The other service entrance will be fused for 30 amp, 220 VAC. This second entrance will be inactive but provision will be made for emergency connection to a generator.

(b) The switch box will be provided with a latching, but not locking, door.

(c) The load side of the main switch shall deliver power through circuit breakers as noted in the following paragraph. The circuit breaker housing will be provided with a latching, but not locking door.

(4) Circuits shall be so arranged that a maximum of two 220 VAC outlets will be served by one gauged pair of 20 ampere circuit breakers and a maximum of six 110 VAC outlets shall be served by one 30 ampere circuit breaker. In the treatability area 3 of the 110 VAC outlets will each be on a separate 30 amp circuit to accommodate fermenting equipment to be installed by the owner. The other outlets shall be included in a six outlet circuit. Separate circuits equipped with suitable circuit breakers shall be provided for each of the following:

(a) Refrigerator-freezer combination and freezer

(b) Incubators 1 and 2

(c) Distilling apparatus

(d) Muffle furnace

(e) Drying oven

(f) Water heater

(g) Overhead and wall-mounted lighting

(h) Vacuum pump and compressor

(i) Humidifier/dehumidifier

(j) Heating/cooling

(5) Outlets will be double electrical receptacles of the 3 prong, grounded type. Outlets will be provided for all items in paragraph 5a(4) above and also as follows:

(a) Six 110 VAC outlets in forward water tank area - placed according to shelf configuration.

(b) Six 110 VAC outlets placed at treatability area

(c) Other internal 110 and 220 VAC outlets placed as shown on Figure 3.

(d) One 110 VAC outlet provided on the street side exterior of the trailer. It will be located on the underside of the trailer within 1 ft. of the side, as shown in Figure 4. It shall be waterproof and protected by a hinged cover which is secured in a closed position by spring action or by a latching device.

(6) Ground circuit. The common electrical ground circuit will be taken to a convenient ground lug on the exterior of the trailer. A portable ground rod at least 8 ft. long with 40 ft. of suitable cable will be provided.

(7) General

(a) All electrical work shall conform to the National Electrical Code and shall meet the approval of the Board of Fire Underwriters.

(b) A complete wiring diagram showing all circuits shall be provided and fastened to the inside of the circuit breaker panel door.

b. Lighting - Interior

(1) Dome lights. Three overhead dome lights will be spaced above the center aisle of the trailer so as to evenly distribute the available light. They will be controlled by a switch located inside the side door and will be powered by the same 12-volt system as the outside lights over access steps.

(2) Fluorescent lights

(a) The entire interior length of the trailer shall be provided with three continuous rows of fluorescent light fixtures located on the ceiling on 20 in. centers. Fixtures are to be two lamp, 40-watt, 48 in. slimline type with shield, complete with lamps. The lights will be controlled by switches conveniently located inside the side access door. The outside rows of lights will be controlled by one switch and the center row will be controlled by another switch.

(b) In addition, an adjustable 18 in., two-tube fluorescent desk lamp, wall mounted, will be provided at the bioassay bench. The lamp will be removable from its wall supports and will receive power from 110 VAC wall outlets.

(c) Water supply and drainage systems

(1) All water piping shall be minimum 1/2 in. inside diameter seamless type K annealed copper tubing complying with Federal Specification WW-T-799A. Fittings shall be copper or brass with soldered joints. All fixtures will be provided with separate valves enabling maintenance without disrupting use of other fixtures.

(2) The entire water system and all units attached thereto must be equipped so that complete drainage can be effected to prevent freezing.

(3) A water supply inlet (W1 in Figure 4) shall be conveniently located under the street side rear exterior of the vehicle. The inlet shall be standard threaded 3/4 in. male equipped with a removable cap fastened to the vehicle with a suitable chain. This inlet shall be replacable in the event of thread damage.

(4) A pressure regulator and gauge shall be installed on the water supply line between the inlet and any interior connections, and a cut-off valve shall be installed between the inlet and this pressure regulator. The pressure regulator shall limit the dynamic water pressure within the piping system to a maximum of 60 psi.

(5) Waste lines will be located as follows:

(a) From each sink there will be a two inch diam. acid resistant pipe.

(b) Two inch diam. pipes will serve floor drains located at the extreme front end of the van, near the bioassay panels, and near the treatability panels. The location of these drains is shown in Figures 3 & 4. Floor drains will have a removable 4 in. to 6 in. diameter grating which fits flush with floor surface.

(c) The distilling apparatus will have a 1 1/2 in. drain line connected to the main drain.

(d) All drains shall connect to a 3 in. acid resistant main drain which will conveniently terminate under the street side rear of the trailer, and be fitted with a standard male pipe thread with a screw-on cap, secured to the trailer with a chain. This thread outlet shall be replacable in the event of thread damage. Main drain line shall slope toward this outlet.

(e) Drain lines shall contain no sediment traps.

(6) Hoses will be provided for the water supply and drainage systems as follows:

(a) Water hose. Two 50 linear feet sections of 3/4 in. high pressure rubber hose, approximately one inch outside diameter. Hose will be fitted with 3/4 in. standard male threaded connection on one end and female connection on other end.

(b) Drain hose. Two 50 linear feet sections of 3 in. drain hose, approximately 3 1/2 in. O.D. The hose will be fitted with 3 in. standard male threaded connection on one end and female connection on other end.

(c) Hoses will be stored in the utility compartment under the trailer.

(7) A water heater with a 15 to 20 gallon capacity shall be provided and shall be located under the analytical sink unit as shown in Figure 1. The heater will be electrically operated on 110 VAC, 60 Hz current and equipped with an automatic low-water shut-off device. Hot water lines will be connected only to the sink above the heater. (Ref. Sears Catalog No. 42-H-32121N).

(8) Connections from the water supply system will be provided to the following locations in the manner specified:

(a) Distilling appartus: a 1/2 in. O.D. cold water service line connected to the distillation apparatus provided with a shut-off valve conveniently located.

(b) Sink on bioassay bench: cold water service is to be provided, along with an aspirator with shut-off valve and a water stopcock complete with tapered connection for 1/4 in. I.D. flexible tubing.

(c) Sink on standing level work bench: both hot and cold water service is to be provided through a gooseneck, single-spigot fixture extending approximately 6 in. over the sink beyond the rear sink wall.

(d) Treatability area: four water faucets with tapered serrated connections for 1/4 in. I.D. flexible tubing will be provided. These will be wall-mounted as shown in Figure 3. Each faucet will have its own on-off valve. Fixtures will be installed 4 ft. above the floor.

(e) Bioassay area: one 3/4 in. standard male threaded connection will be provided at the top front shelf area to supply water to the large storage tank. Piping shall channel water through the dechlorinator as described in paragraph 4b(9)(c).

d. Vacuum system

(1) Source will be an electrically operated vacuum pump (approximately 1/2 Hp, rated for continuous duty and providing a continuous vacuum of at least 25 in. Hg. The pump will be equipped with intake oiler/filter, exhaust filter, gauges and regulators. Motor shall be heavy duty, ball bearing type with internal thermal protection for 110 VAC, 60 Hz operation.

(2) The vacuum pump will be installed in a compartment beneath the van as shown in Figure 4. The compartment door will be secured with a padlock.

(3) The vacuum pump will be controlled by a conveniently mounted wall switch in the trailer.

(4) Vacuum lines with on-off connections will be provided at the following locations:

(a) Double ground key aircock at standing level bench adjacent to sink. Cocks shall have tapered connections to accommodate 1/4 in. I.D. flexible tubing.

(b) A similar connection at the bioassay work bench.

(c) Two separately controlled vacuum outlets will be located in treatability area (See Figure 3). These outlets shall be stopcock type with tapered connections to accommodate 1/4 in. I.D. flexible tubing. Fixtures will be installed 4 ft. above floor.

(5) Vacuum lines shall be 3/8 in. I.D. diameter copper tubing installed as indicated.

e. Compressed air system

(1) Compressed air source will be an electrically operated air compressor (110 VAC, 60 Hz, approximately 1/2Hp), rated for continuous duty and providing a continuous pressure of at least 25 psig. An appropriate pressure gauge will be mounted on the compressor. The compressor will be mounted on an ASME-approved, 10 gallon storage tank with condensation drainage provision and automatic safety pressure relief features. The compressor will also be provided with a filter or other device to insure delivery of oil-free air.

(2) The air compressor will be installed under the trailer in a manner similar to the vacuum pump (paragraph 5d(2)). It may be installed in the same or an adjacent compartment. It will be controlled by a conveniently mounted wall switch in the trailer.

(3) Compressed air line and connections will be of the same design and will be installed in the same locations as the vacuum lines and connections.

f. Heating, cooling and ventilation

(1) A heating/cooling system shall be provided for the entire trailer. The equipment will be mounted on the front of the trailer and will extend a minimum distance out from the trailer to avoid contact with the cab during turns. The system shall be designed to maintain 72 ± 5°F temperatures within the trailer in ambient conditions varying from 0°F to 110°F and with an internal electrical load as described in this specification. The unit will be designed for continuous operation,

powered by 220 VAC current, and will be thermostatically controlled. The thermostat will contain an integral indicating thermometer covering the range 10° to 90°F and will be manually controlled to establish the desired ambient temperature in the range of 60°F - 80°F. The thermostat will be conveniently located near the front of the trailer and away from any direct air currents. The cooling equipment will be provided with automatic defrost and with copper collection lines to channel condensation below the trailer chassis. The equipment will be designed and mounted so as to minimize noise and vibration transferred to the trailer body interior.

(2) Exterior air intakes shall be provided with removable devices designed to protect the unit from dust and dirt during transit. Air filters used on the system shall be provided and shall be readily accessible for cleaning and/or replacement.

(3) Discharge and return air ducts will be installed in the ceiling. Vents and grills will be ceiling mounted and will be distributed evenly throughout the trailer. Baffles will be installed in discharge vents to regulate the flow of air evenly, without drafts, to all parts of the trailer. Air return vents shall have on-off and directional controls at each opening.

(4) Squirrel cage blowers will be provided instead of bladed fans, in order to reduce noise.

(5) Compressor will be constant-run type with hot gas bypass valve.

(6) Copper collection lines shall be provided to channel cooling unit condensation to drain below the trailer chassis. Provision for positive drainage shall be made to avoid freezing.

6. Inspection and delivery

a. Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

b. Government verification. Quality assurance operation performed by the contractor will be subject to Government verification at unscheduled intervals. Verification will consist of observation of the operations so as to determine that practices, methods, and procedures of the contractor's inspection are being properly applied. Failure of the contractor to promptly correct product deficiencies discovered shall be cause for suspension of acceptance until correction has been made or until conformance of product to specification criteria has been demonstrated.

c. The following tests shall be performed:

(1) Road testing. Upon completion of construction and notification by the contractor that each unit is complete and ready for delivery to Aberdeen Proving Ground (Edgewood Arsenal), the contract shall, prior to delivery, at his expense, subject the completed units to a 50-mile road test over paved and unpaved roads selected by the contractor and approved by an authorized government representative who shall witness the test. During the road test the trailer will contain the full complement of accessories and equipment as described in this specification. At the completion of the road test the authorized Government representative shall inspect each unit and determine what damage, if any, exists. All damage shall be corrected by the contractor; and, at the option of the authorized Government representative, additional road tests shall be performed at contractor expense following the rework by the contractor. Delivery to Edgewood Arsenal for a 30-day final inspection period will not take place until all damage has been corrected by the contractor. During this 30-day period, the trailer and its accessories will be subject to inspection activities only and not to actual operational use.

(2) Water system testing. At the completion of the road test, a hydrostatic test shall be applied to the in-place water system less water heater and distillation apparatus. This hydrostatic test will be deemed successful if a pressure of 100 psi can be maintained on the system for 15 minutes with no evidence of leakage and no addition of air or water to maintain the pressure. Upon completion of test, lines shall be drained and heater and distillation apparatus reinstalled and connected to the piping.

(3) Drainage system testing. The installed system shall be tested after completion of the road test by fixing the cap on the main drain, filling the portion of the drain system below the floor with water and inspecting the system for leaks. The absence of visible leakage after 30 minutes shall satisfy the test requirements.

(4) Heating and cooling system testing. The trailer shall be tested in a temperature-controlled environment at the extremes specified in paragraph 5f(1). If the temperature inside the trailer remains within the range specified in paragraph 5f(1) after first being stabilized at 72°F, the requirements of the test shall be satisfied. At least 2/3 of the trailer's electrical load shall be activated during the cooling system testing. Compliance shall be determined by readings on 8 thermometers over a 12-hour period. The thermometers shall be placed in the trailer 4 ft. above the floor, with one thermometer at the front of the trailer, one in the rear, and 3 on each side.

(5) Compressed air system testing. The complete system shall be tested after the completion of the road test by pumping the system to a pressure of 40 psi. If this pressure is held for 15 minutes with no further pumping, the requirement of this test shall be satisfied.

(6) Vacuum system testing. The complete system shall be pressure tested after the completion of the road test by pumping the system to an air pressure of 40 psi. If this pressure is held for 15 minutes with no further pumping, the requirement of this test shall be satisfied.

(7) Waterproofness testing. Tests shall be performed according to MIL Standard 810-B. The trailer shall withstand 2 hours of concentrated water spray on doors, windows and panel joints without visible evidence of leaks.

d. Servicing and adjustment. Prior to acceptance of the vehicles by the Government inspector, contractor shall service and adjust each vehicle for operational use including at least the following: proper adjustment of the brake system, inflation of all tires; and complete lubrication of chassis and running gear with grades of lubricants recommended for the ambient air temperature at the delivery point.

e. Workmanship. Defective components or parts and assemblies which have been repaired or modified to overcome deficiencies shall not be furnished. The welded, bolted, and riveted construction utilized shall be in accordance with the highest standards of the industry.

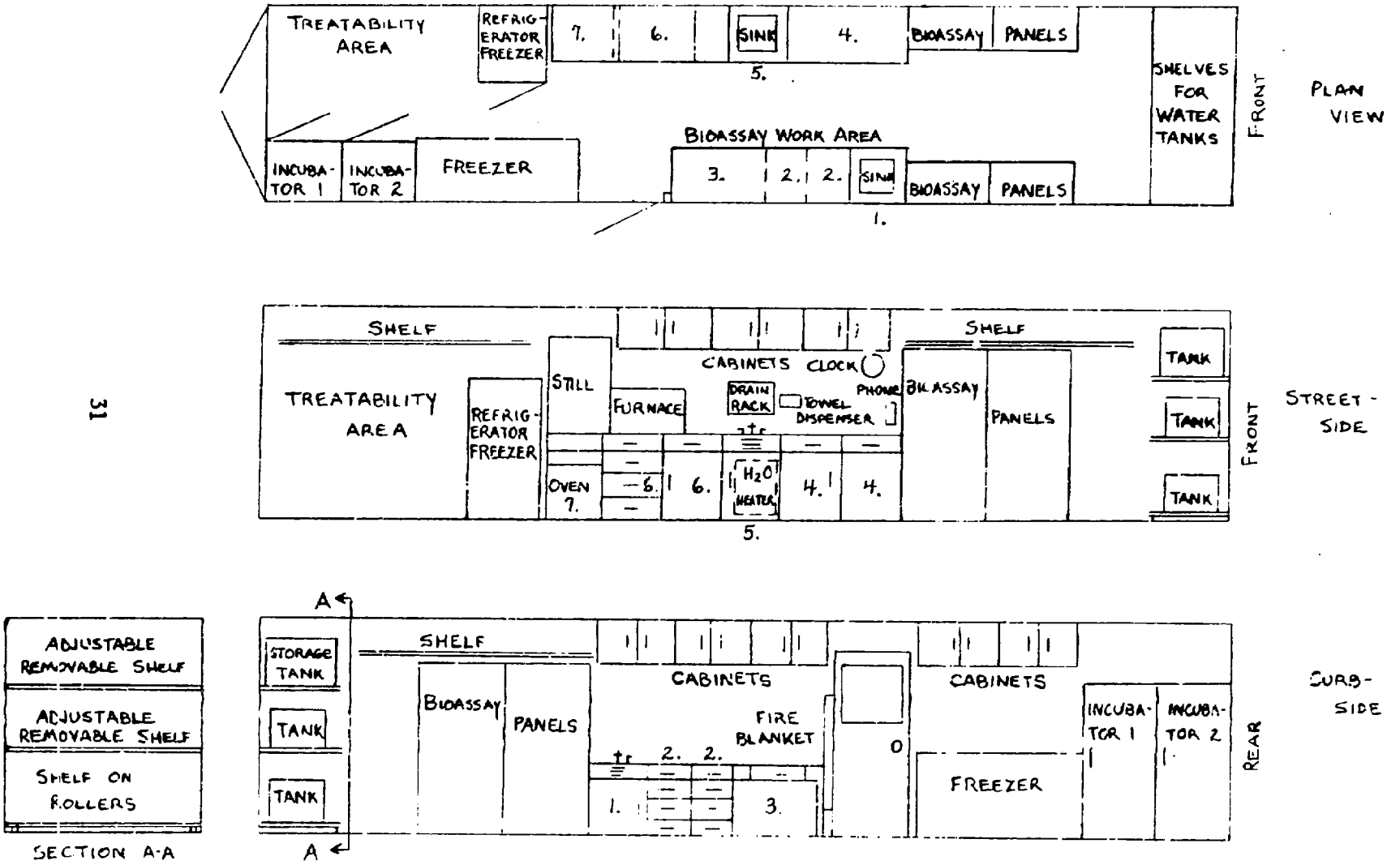


FIGURE 1. Interior Arrangement of Mobile Laboratory Scale: 1" = 5'

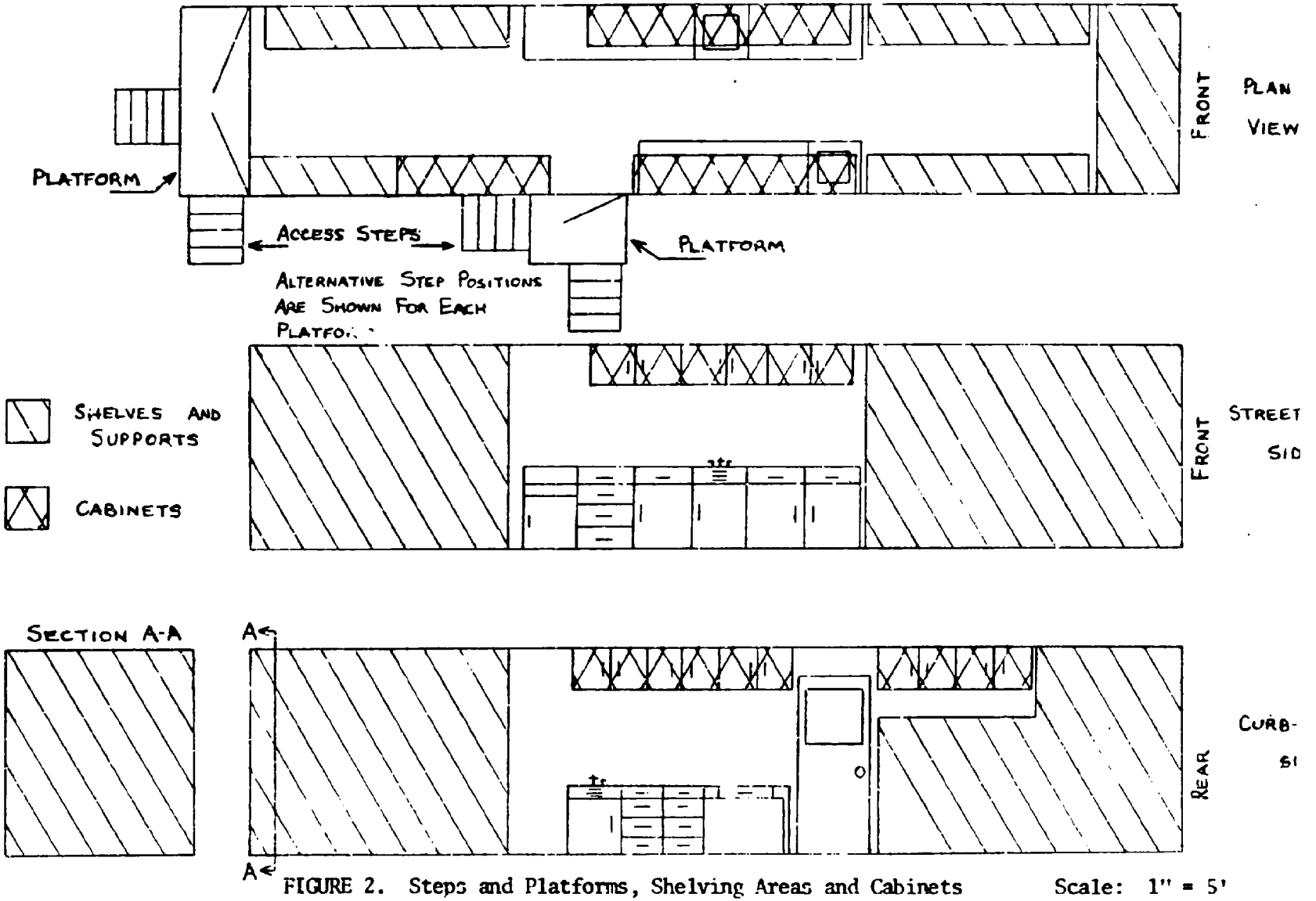


FIGURE 2. Steps and Platforms, Shelving Areas and Cabinets Scale: 1" = 5'

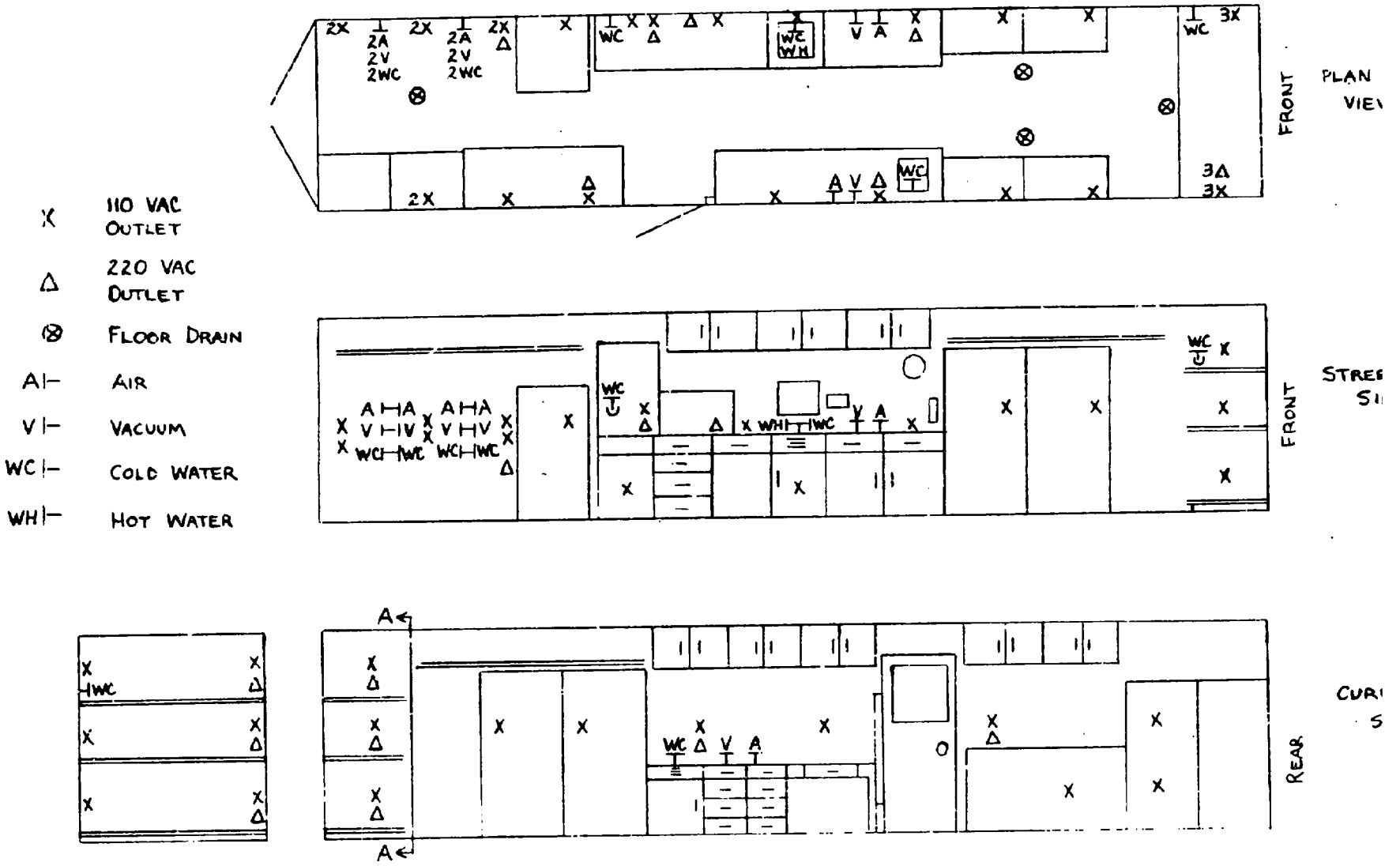
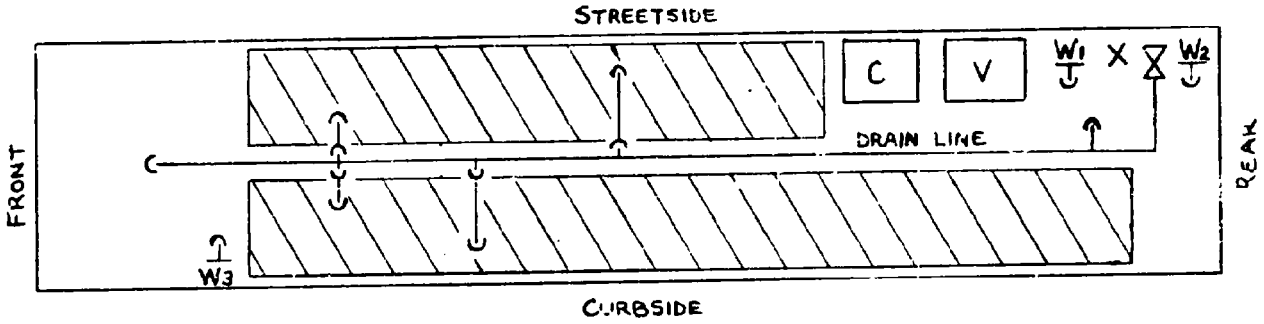


FIGURE 3. Interior Utilities of Mobile Laboratory

Scale: 1" = 5'



W_1	WATER SUPPLY CONNECTION
W_2	WATER CONNECTION FOR FUTURE USE
W_3	CONNECTION FOR BIOASSAY WATER
C	COMPRESSOR
V	VACUUM PUMP
⋈	DRAIN CONNECTION
X	110 VAC OUTLET
▨	STORAGE COMPARTMENTS (AS SPACE PERMITS)

NOTE: 110/220 VAC INPUT RECEPTACLE SHALL BE POSITIONED AS PER CONTRACTOR'S RECOMMENDATION

FIGURE 4. Connections and Accessories on Underside Exterior of Trailer

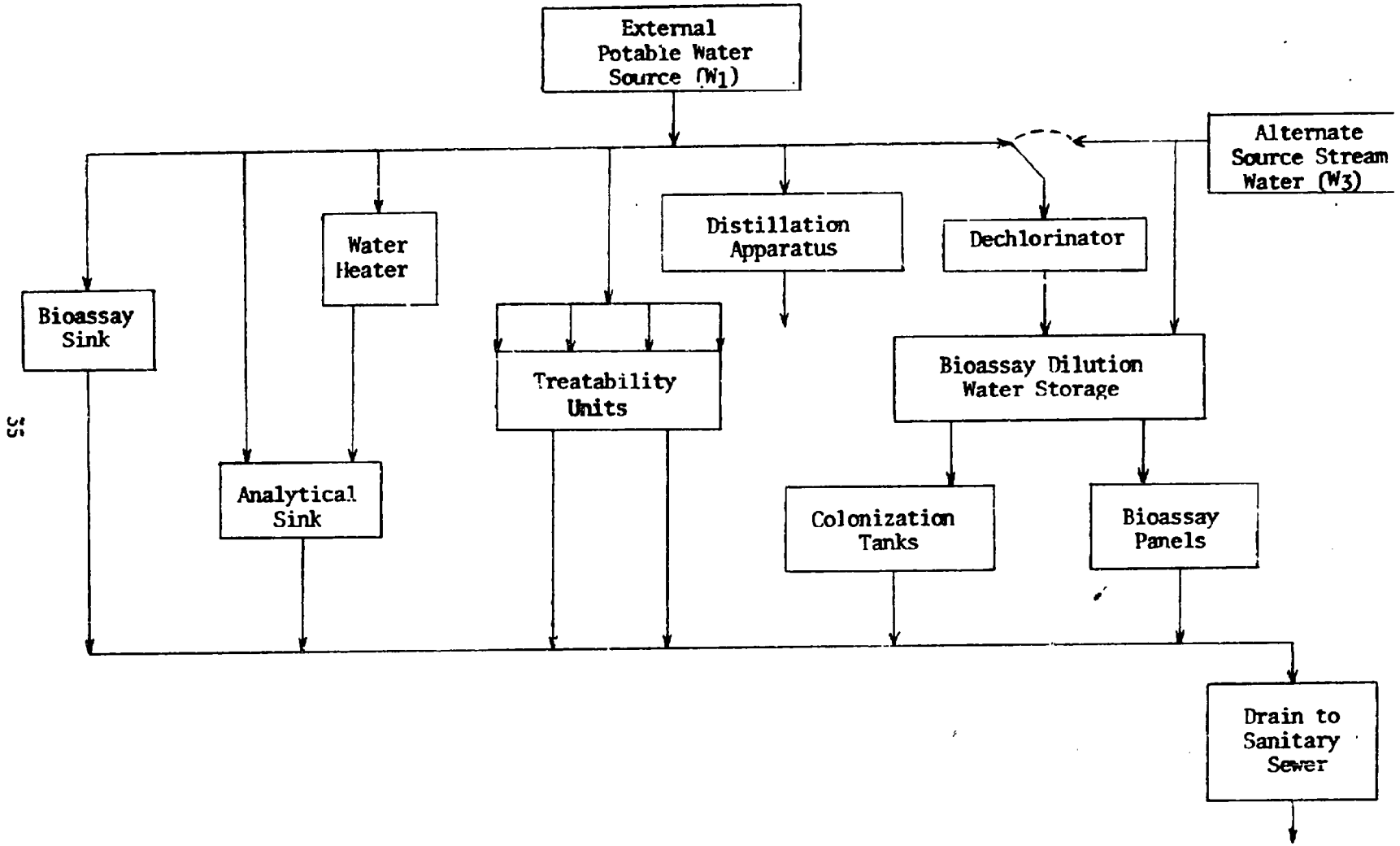


FIGURE 5. Water Flow Plan - Mobile Laboratory