ASAE EP267.7 NOV1996 (R2017)
Prevention of Mosquito Problems Associated with Irrigation and Drainage Systems

STANDARD

American Society of Agricultural and Biological Engineers

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

NOTE: ASABE Standards, Engineering Practices, and Data are informational and advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. The ASABE assumes no responsibility for results attributable to the application of ASABE Standards, Engineering Practices, and Data. Conformity does not ensure compliance with applicable ordinances, laws and regulations. Prospective users are responsible for protecting themselves against liability for infringement of patents.

ASABE Standards, Engineering Practices, and Data initially approved prior to the society name change in July of 2005 are designated as "ASAE", regardless of the revision approval date. Newly developed Standards, Engineering Practices and Data approved after July of 2005 are designated as "ASABE".

Standards designated as "ANSI" are American National Standards as are all ISO adoptions published by ASABE. Adoption as an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by ASABE.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

CAUTION NOTICE: ASABE and ANSI standards may be revised or withdrawn at any time. Additionally, procedures of ASABE require that action be taken periodically to reaffirm, revise, or withdraw each standard.

ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA, phone 269-429-0300, fax 269-429-3852, hq@asabe.org

ASAE EP267.7 NOV1996 (R2017)

Prevention of Mosquito Problems Associated with Irrigation and Drainage Systems

EP267 was initially prepared by the ASAE Soil and Water Division Committee on Irrigation System Design for Mosquito Control; finalized by the ASAE Committee on Surface Irrigation of the Irrigation Group; approved by the Soil and Water Division Steering Committee; adopted by ASAE as a Recommendation January 1958; revised December 1963, December 1968, March 1974, December 1974; reconfirmed and reclassified as an Engineering Practice December 1978; revised December 1979; reconfirmed December 1984; revised March 1985; reaffirmed December 1989, December 1990, December 1991, December 1992, December 1993, December 1994, December 1995; revised November 1996; reaffirmed December 2001, February 2003, February 2008, December 2012; October 2017.

Keywords: Drainage, Irrigation, Mosquito

1 Purpose and Scope

1.1 The following principles and practices are recommended for prevention of mosquito production sources (i.e., breeding habitat) associated with irrigation and drainage systems in humid, semiarid, and arid areas. Although these practices apply to all mosquito species, the primary targets are those that transmit diseases to humans and animals. Information herein is directed towards engineering practices. Chemical and biological control measures are also part of a complete control program, and more complete, detailed information on their use should be obtained from appropriate sources. Complete mosquito control programs result from deliberate combinations of structural, management, and chemical/biological practices. Mosquito control programs may include possible conflicts with other irrigation and drainage project objectives such as creation of wildlife habitat, canal safety, and aesthetics that must be resolved.

1.2 The document does not address control measures for non–mosquito borne diseases associated with irrigation such as schistosomiasis, a serious disease vectored by snails that is a major problem in irrigated areas in the tropics. However, many of the same considerations for mosquito control will also apply to these other problems.

2 Normative References

2.1 The following engineering practice contains provisions which, through reference in this text, constitute provisions of this Engineering Practice. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this Engineering Practice are encouraged to investigate the possibility of applying the most recent edition of the document indicated below. Standards organizations maintain registers of currently valid standards.

ASAE EP408 Surface Irrigation Runoff Reuse Systems

3 Extent of Problem

3.1 Mosquito borne diseases are global problems that are often exacerbated by irrigation activities. Poor surface drainage, improper handling of waste water, and poor emergent/aquatic vegetation control in irrigation storage, delivery, application, and drainage systems contribute to mosquito habitat and infestations.

3.2 Examples of significant human and animal pathogens transmitted by mosquitoes that are associated with irrigation include: Malaria parasites, transmitted by genus *Anopheles*; Filaria (a nematode), carried by *Anopheles, Mansonia*, and *Aedes* species, and *Culex quinquefasciatus*; the Japanese B encephalitis virus, transmitted primarily by *Culex tritaeniorhynchus* — a major problem throughout the rice-growing areas of Asia from Japan to India; and Murray Valley encephalitis virus in Australia, transmitted by *Cx. annulirosttis*. Rift Valley (primarily transmitted by *Aedes macintoshi*) and Chikungunya fever, transmitted by *Anopheles gambiae* and *Anopheles funestus*, are serious diseases associated with irrigation in east Africa and Southeast Asia. Major mosquito borne diseases in the United States are viral (encephalitis) and include Western Equine (strongly associated with irrigated agriculture), Eastern Equine (associated with wetlands on the East Coast and citrus irrigation in Florida by *Culiseta melemura*), St. Louis, and various California encephalitis (by Aedes species) viruses. All can be transmitted by species that are produced in irrigation waste water.

3.3 With increasing mosquito insecticide resistance, greater regulation of insecticide use, and reductions in labeled insecticides available for mosquito control, non-chemical control measures such as habitat management and the use of biological predators should be encouraged. However, chemical/larvicidal control programs (e.g., B.t.i. [*Bacillus thuringiensis israelensis* (H-14)], larval developmental inhibitors, insecticides) may sometimes be required to supplement other methods, especially after initial inundation of an area.

3.3.1 It should be noted that mosquitoes do not cause infection unless the pathogen is maintained by vertical transmission (e.g., mosquitoes get pathogen from hosts and then transmit it to their progeny). In the United States, passeriform birds are the principal sources of the mosquito borne encephalitis viruses. Thus, control efforts should also be directed towards reducing the potential for infection of vertebrate sources as well as by interfering with and/or minimizing suitable habitat for mosquito production.

3.4 Mosquito breeding habitats resulting from irrigation and drainage projects can be minimized by proper construction, management, and regular maintenance of all irrigation storage, delivery, application, and drainage facilities. Mosquito control should be coordinated with other objectives such as agricultural production, soil and water conservation, flood control, hydroelectric power, wildlife management, and recreation.

4 Project Planning Considerations

4.1 Irrigation developments that create and/or enlarge surface water bodies often expand existing or create new mosquito habitat unless preventive measures are provided.

4.1.1 Mosquito prevention and control measures should be incorporated during planning, construction, operation, and maintenance of irrigation developments to prevent or reduce mosquito propagation and reduce or eliminate the need for chemical control.

4.1.2 In the absence of mosquito control districts, the need for continuing funds to provide ongoing surveillance and implementation of prevention and control measures should be considered in pre-project planning.

4.1.3 Mosquito control programs shall conform to environmental protection and all other legislation and regulations pertaining to the project development.

4.2 Project design and management should facilitate biological control measures including establishing and sustaining viable populations of specific species of lavivorous (mosquito larvae-eating) fish (e.g., *Gambusia affinis* and guppies [*Poecilia reticulata*]), invertebrate predators (e.g., water beetles — *Hydrophilidae*, Family Dytiscidae), vertebrate animals (e.g., frogs and ducks) and maintaining high numbers of predators and competitors with mosquito larvae. These measures should be used in conjunction with structural and management alternatives where areas cannot be drained, surface water disposal is difficult, or the cropping patterns (e.g., rice culture) may not facilitate control.

4.3 Mosquito populations can be reduced through crop selections to provide less habitat and/or disrupt the life cycle.