Expected Outcomes or Project Impacts:

1a. Adoption of the push pull strategy for the management of pasture flies will result in significant reduction of insecticide use on animals and in the environment. This will reduce the amount of insecticide entering our food chain and greater food safety.

1b. Development of efficient pest monitoring tools for livestock will result in increased precision in evaluation of implemented treatment measures.

1c. Results of these studies will bring new insecticidal products and repellents to the fore front for use in livestock pest management. Insect growth regulators used in the autodissemination studies will provide a novel treatment for the control of insects using hormone mimics. Results should provide information for use of treated fence for protection of animals from biting and other nuisance flies. It is anticipated that the use of this innovative fencing would help reduce the fly dissemination of pathogens associated with livestock. Publications will include descriptions for use and how to evaluate results. Bait testing results will give producers another method for stable fly control, either alone or in conjunction with attractive traps or targets.

1d. Results will represent novel contributions to the knowledge of dairy fly management. In the short term, we expect that dairy farmers will have increased awareness and knowledge of IPM on the dairy. We expect, in the longer term, that there will be increased producer adoption of reduced-risk fly management methods and reduced reliance on pyrethroids and organophosphate insecticides to manage dairy fly pests. A practical method to monitor flies around dairy calves and a broader understanding of the impact flies have on calves. Data from bedding treatment trials will be analyzed and compiled and initially presented as technical reports from which extension and research publications will be developed. This project will provide a thorough comparative evaluation of walk through fly traps. Results will provide producers with data specific to efficacy, bionomics, and economics of using walk through fly traps.

2a. A greater understanding of the mechanism(s) of resistance to imidacloprid will become available. Identification of the mutations responsible for resistance will allow for the development of molecular assays for monitoring field populations. This information would become the basis for developing resistance management strategies for imidacloprid in house flies. We will increase the knowledge base of known insecticide resistance and mechanisms in house fly, stable fly and horn fly populations from at least five cooperating states. With this knowledge, we will increase the awareness of cattle producers to the futility of using insecticides that are no longer effective and direct these producers toward insecticide applications or alternative control strategies that will reduce pestiferous fly populations attacking their livestock. At the end of the five year project, collaborators will have a better understanding of the *kdr-his* allele frequency in house flies and stable flies, as well as the frequency of other mutations in *Vssc* identified as a result of this project, in their respective field populations over time. This temporal data set will contribute to a broader picture of *kdr-his* prevalence in the United States and Canada, providing a baseline to assess allele frequency fluctuations at these sites relative to periods of insecticide usage and over an

extended period of time. Monitoring field populations over time will strengthen the fly community's understanding of the role that *kdr-his* and other *Vssc* mutations play in stable fly permethrin resistance.

2b. Access to house fly and stable fly genomes will ultimately provide the fly community with a resource to improve our understanding of biochemical pathways that are critical to stable fly survival. Identifying these important molecules creates opportunities for collaborative teams to develop approaches that disrupt or modify these vital pathways in an effort to reduce stable fly populations. Access to annotated genomes will allow researchers to exploit novel target sites for control of house and stable flies, will shed light on differences between blood feeding and non-blood feeding flies, will offer insights into the sex determination mechanisms that are poorly understood (and could be manipulated for control strategies), and will facilitate identification of resistance mechanisms to new insecticides. These published genomes will creates opportunities for collaborative teams to develop approaches that disrupt or modify these vital pathways in an effort to reduce stable fly populations.

3a. Knowledge gained will lead to our ability to control fly behavior as well as to control biofilm formation for food, medicine, and engineering applications. We expect to identify unique pathogenicity islands or gene clusters that evolve through association with the fly gut or crop. The data we obtain will be used to generate federal funding through USDA and NIH to study impact of flies on human/animal health.

3b. Results from this study will provide insight into stable fly genes that may be critical for its survival in a microbe-rich environment, thereby providing viable targets for development of control alternatives. For managing *C. sonorensis,* a better understanding of midge-bacterial interactions will result in the establishment of a new platform for the development of alternative strategies for BTV and EHDV.

3c. Producer understanding of the role of house flies as carriers of pathogens will improve. Knowledge of salivary gland hypertrophy virus distribution and prevalence will assist with future funding requests to develop strategies to utilize this virus for control of flies. We expect that producer attitudes toward fly management products using essential oils will be altered in favor of using these products over chemicals that may be more persistent or harmful to the environment.

4a. Because stable flies are strong fliers, data on dispersal distances and factors affecting dispersal will be utilized to develop an area wide management strategy. An understanding of population structure, dispersal, and local adaptation is essential for the development of models for population dynamics, insecticide resistance, and integrated management. Data derived from these studies will be fundamental for the understanding of stable fly population dynamics.

4b. Development of integrated control strategies is dependent upon an understanding of pest population dynamics relative to environmental and seasonal variables. Models developed under this objective will be incorporated into decision making tools for evaluating control

options. Integrated pest management programs are dependent upon the ability to accurately sample pest populations. These studies will provide the foundation for developing sampling plans for stable flies which account for spatial variability. In addition, studies frequently require the use of spatially isolated treatment and control sites. An understanding of the intrinsic variation between such sites is necessary for the development of experimental designs.

4c. This work will fill part of the large gap that exists in our understanding of fly larval developmental sites. Data from these studies will be useful for developing strategies to modify substrates to reduce their suitability for fly development and improve our ability to identify larval developmental sites for treatment.

5a. Industry stakeholders **(**livestock and poultry producers, and others involved in animal agriculture) and university/government researchers will have a source from which they can obtain up-to-date information on products available for suppression of relevant pests. We expect that stakeholders using this database will have increased awareness and knowledge of pesticide products available for their use, which should result in improved and more cost-efficient pest management practices on their operations.

5b. For extension personnel and university and government researchers, nationwide collaboration on development of extension information will reduce duplication of effort and free up time for pursuing other objectives. For the production end-users, we expect that our reach will be greatly expanded, resulting in increased awareness and knowledge of best management practices for their livestock and poultry operations.

5c. For the production end-users, we expect that our reach will be greatly expanded on a national level, resulting in increased awareness and knowledge of best management practices for their livestock and poultry operations. For funding decision-makers, we expect that they will have increased awareness and knowledge of the current state of livestock entomology science, which should impact the development of future granting programs.

5d. New information concerning how to reduce fly borne pathogens of human food will be passed onto extension individuals, who will reach the public food handlers and others involved in producing a human food safe of human pathogens.