

<sup>2</sup>Stanislaus County Ordinance, Title 9, Chapter 9.88

**TITLE 9  
HEALTH AND SAFETY**

**CHAPTER 9.88  
FOOD PROCESSING BY-PRODUCTS**

**SECTIONS:**

- 9.88.010**     **Definitions**
- 9.88.020**     **General Prohibition, Permit Required**
- 9.88.030**     **Term of Permits and Renewals**
- 9.88.040**     **Application, Renewal and Revocation Procedures**
- 9.88.050**     **Fees, Financial Guarantee, Insurance**
- 9.88.060**     **Plan of Operation Information**
- 9.88.070**     **General Permit Terms and Conditions**
- 9.88.080**     **Administrative Appeal**
- 9.88.090**     **Appeal to Board of Supervisors**
- 9.88.100**     **Suspension and Revocation**
- 9.88.110**     **Transfer of the Permit**
- 9.86.120**     **Establishment of Regulations**
- 9.88.130**     **Misdemeanor Violation**
- 9.88.140**     **Civil Injunction**
- 9.88.150**     **Severability**
- 9.88.160**     **Judicial Review**

## **Section 9.88.010 Definitions**

The following words and phrases shall have the following meanings when used in this Chapter for the Stanislaus County Food Processing By-Product Program:

A. "Composting" means the process of the controlled biological decomposition of organic material into a humus-rich soil amendment. US Composting Council defines "Compost is the product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and processed to further reduce pathogens (PFRP), as defined by the U.S. EPA (Code of Federal Regulations Title 40, Part 503, Appendix B, Section B), and stabilized to the point that it is beneficial to plant growth. Compost bears little physical resemblance to the raw material from which it originated. Compost is an organic matter source that has the unique ability to improve the chemical, physical, and biological characteristics of soils or growing media. It contains plant nutrients but is typically not characterized as a fertilizer."

B. "Department" means the Stanislaus County Department of Environmental Resources.

C. "Direct Feed" means receiving, processing and feeding food processing by-products to livestock.

D. "Dehydration" means receiving food processing by-products and drying the material so that it may be further processed into any beneficially used material.

E. "Food Processing By-Product" means the by-products of food processing that are solid or semisolid substances derived from agricultural plant material delivered to a food processor for processing that are not utilized in the final product. Food processing by-products includes culls, peelings, seeds, under or over ripe food, skins, cores, pomace, puree, hulls, shells, pits, stems, leaves and any substance including soil washed from plant produce.

F. "Food processor" means a processor of fruit, nut or vegetable raw products which may include but are not limited to tomato, peaches, almonds, walnuts, pears, grapes, grain products or other raw plant material, and that includes, i.e., canneries, nut processors, vegetable processors, frozen food processing, etc.

G. "Land Application" means the spreading, discing, and incorporating of food processing by-products onto agricultural fields for any beneficial use.

H. "Permit" means a permit for use of food processing by-products issued by the County to a person under this Chapter.

I. "Permit holder" means a person or legally recognized entity that holds an effective and current permit under this Chapter.

J. "Person" means any human being or an incorporated or unincorporated business entity or association established under the laws of the State.

### **Section 9.88.020 General Prohibition; Permit Required**

A. It shall be unlawful for any person to conduct, engage in or allow to be conducted or engaged in the land application, direct feed, composting and/or dehydration of food processing by-products in the unincorporated area of Stanislaus County except if authorized by permit issued pursuant to this Chapter, and conducted in accordance with specific permit terms and conditions, the provisions of this Chapter, and all applicable federal, State and local laws, regulations and ordinances.

B. The owner, managing partner, officer of a corporation or such other person who shall be primarily responsible for activities involving use of food processing by-products shall apply to the Department of Environmental Resources for a permit under this Chapter and, if granted, shall maintain operations authorized by the permit in conformity with the terms of this Chapter and of the permit.

C. The fact that an applicant for permit possesses other types of federal, State or county permits or licenses shall not exempt the applicant from obtaining a permit under this Chapter, nor shall the terms and conditions of any other such permit or license modify the requirements of a permit granted under this Chapter.

D. This program prohibits the land application of food processing rinse water, saline waste streams such as boiler blow-down, and ion exchange reject.

### **Section 9.88.030 Term of Permits and Renewals**

A. Each permit shall expire one year after the date of its issuance. Any permit may be renewed by the Department for successive one-year periods upon the submission of an application by the permit holder. At the time of consideration of a renewal application, the Department shall consider the applicant's compliance with permit conditions during the prior term.

B. Notwithstanding subsection A of this Section, all permits issued pursuant to this Chapter shall expire upon the effective date of an ordinance to repeal the provisions of this Chapter.

C. Any application for renewal shall be filed at least fifteen (15) calendar days before expiration of the permit.



D. Any application for renewal may be rejected if:

1. The application is filed less than fifteen (15) calendar days before its expiration.

2. The permit is suspended or revoked at the time of the application; provided, however, that an application for renewal may be filed within ten days after the granting of a permit holders appeal of the suspension or revocation of a permit.

E. Wherever this Chapter requires the County to give notice to an applicant, appellant or permit holder, such notice shall be given by the Department, in writing, and shall be delivered either by personal delivery or by certified U.S. mail, postage prepaid, return receipt requested.

#### **Section 9.88.040 Application for Permit**

A. The Department may grant a permit for food processing by-products use, upon application therefore whenever in the opinion of the Department the granting of such permit is in the public interest and welfare and complies with all applicable federal, State and local laws, regulations and ordinances, including the California Environmental Quality Act or other environmental reviews required by law. The Department will inspect the site(s) prior to issuing a permit to assure that permit requirements can be met. During the period when by-products are received and for 60 days following the end of a season or termination of the program the Department may inspect the site(s) to assure that the permit holder is adhering to conditions of the permit and Plan of Operation. Inspections will occur weekly or at other frequencies as determined by the Department.

B. Each application shall be submitted on a standard form adopted by the Department, which sets forth or incorporates by reference the information as set forth in the Regulations for the Use of Food Processing By-Products in Stanislaus County by Permitted Use Sites.

C. The filing of an application shall be deemed complete upon the submission of an application and Plan of Operation in conformance with this Chapter and payment of any application fees required by this Chapter.

D. The Department shall provide written notice of the application for permit to operate a Food Processing By-Product Use Site to members of the Food Processing By-Product Committee, Central Valley Regional Water Quality Control Board, the California Department of Food and Agriculture and property owners, as shown on the latest Assessor's Roll, located within one-quarter mile (1320 feet) and/or two parcels in each direction of the subject site.

E. An application may be reviewed and copied by any member of the public in accordance with the California Public Records Act; provided, however, the Department shall keep confidential, to the extent reasonable and authorized by law, any information revealed during the application process that is protected under privacy laws of the State, or when requested by the applicant, any proprietary project and program information.

### **Section 9.88.050 Fees, Financial Guarantee, Insurance**

A. Permit Administration. The permit holder shall reimburse the Department for all costs incurred by it in administering the permit, including, but not limited to, processing the permit application, enforcing the permit terms, and monitoring permitted activity at the permit location. All costs will be based on the current weighted labor rates of the appropriate Department staff member. The Department shall issue an invoice itemizing all costs incurred by the Department and the permit holder shall remit payment as shown in the invoice within 30-days of the invoice date. Fees under this paragraph are due and payable on or before the thirtieth day after the date an invoice is issued and, thereafter, are deemed to be delinquent until paid.

B. Research Project Surcharge. Each permit holder shall also pay a surcharge fee equal to \$0.10 per ton of by-products received at each of the permitted reuse sites to be used for research required by the Regional Water Quality Control Board, and assessed for the period or periods when such research is required to maintain State approval of the Food Processing By-Product Program. Each permit holder shall report to the Department within 10-days after the end of each month the amount of by-products received by the permit holder during the reporting period. The Department shall issue an invoice based upon the reported amount of by-products received, and the permit holder shall remit payment as shown in invoice within 30-days of the invoice date. The surcharge fee shall be delinquent if unpaid within thirty days after the due date.

C. Fee Delinquency. All fees referred to in this ordinance shall be promptly paid in lawful money of the United States on or before the date such fees are due and payable. A late payment charge equal to 1.5 percent of the unpaid invoice amount shall accrue and shall be added to the total amount each month that an invoice is past due. In addition to late payment charges, persons that have not promptly paid fees when due and payable shall be subject to any or all of the following actions as imposed at the discretion of the Department: (1) the temporary suspension or permanent revocation of a permit to receive and use food by-products, or (2) the posting of security in an amount determined by the Department to be necessary and reasonable to offset additional delinquencies plus estimated collection costs, including reasonable attorney fees.

D. Performance Bond. Before or at the time a permit is issued under this Chapter, the permit holder shall submit a cash bond, certificate of deposit, irrevocable



letter of credit, or a faithful performance bond in favor of the County of Stanislaus, in an amount reasonably determined by the Department to be sufficient for clean-up and remediation at the permit location.

E. Insurance. No permit shall be issued under the provisions of this chapter, nor shall any such permit be valid after issuance, unless there is at all times in force and effect a policy or policies of insurance for comprehensive general liability and automobile liability with limits in an amount approved by the Department, and issued by a company approved by the Department. Insurance policies shall waive any exclusion for pollution coverage, and shall provide a specific endorsement, except Worker's Compensation insurance, if any, naming the County and its officers, officials and employees as additional named insureds. The Department may require additional types or increased amounts of insurance coverage and may adopt such other requirements as may be necessary to protect the County. Satisfactory evidence in the form of a certificate of liability insurance as required by this section shall be furnished to the Department by each permit holder.

#### **Section 9.88.060 Plan of Operation**

An application will not be accepted or approved unless the applicant submits a Plan of Operation that provides the information set forth in the Regulations for the Use of Food Processing By-Products in Stanislaus County by Permitted Use Sites, and additional information deemed necessary by the Department to determine the potential effect of the proposed operations on the health, safety and welfare of the public.

#### **Section 9.88.070 General Permit Terms and Conditions**

Throughout the term of the permit, each holder of a permit issued under this Chapter shall not violate any provision of this Chapter and shall comply with the standard terms and conditions set forth in the Regulations for the Use of Food Processing By-Products in Stanislaus County by Permitted Use Sites. Permit holders shall also comply with the following additional terms and conditions:

A. The permit holder grants to the Department the right of access, during normal business hours, to the permit location for all reasons and purposes reasonably related to the administration of this permit by the Department, including, but not limited to the right to enter upon the permit location to remediate any problem related to the permitted activity.

B. The permit application and Plan of Operation and supplements or amendments thereto submitted by the permit holder to obtain a permit are incorporated herein by reference. The permitted activity shall be operated in conformance with the above documents, these permit conditions and all applicable state and local laws, ordinances, regulations and codes. In the event of any conflict between the permit

application or the Plan of Operation and the permit conditions, the permit conditions shall take precedence. All supplements, amendments or changes to the Plan of Operation must be submitted in writing to the Department for review and approval prior to initiating said changes in the permitted activity. The issuance of this permit does not release the permit holder from responsibility to comply with any other requirements regulating activities on the site.

C. The Department will modify the conditions of a permit for cause, after prior notification to the permit holder, to eliminate, reduce or ameliorate any condition or nuisance that adversely affects the public health, safety or welfare, or does not fully protect surface and groundwater quality. The Department will notify the Central Valley Regional Water Quality Control Board of changes in permit conditions.

D. The provisions of a permit are intended to be severable, and if any individual condition or provision hereof is held to be invalid by the order of the Board of Supervisors, by order of any court of competent jurisdiction or for any other reason, the remaining terms of this permit shall not be affected thereby; provided, however, the Department, in its sole discretion, may terminate this permit if it determines that the permit, as modified by the severance, no longer achieves the objectives of the Department or adequately protects the public health, safety and welfare.

E. A permit may be suspended or revoked by the Department for cause. Permitted operations shall comply with all applicable federal, State and local laws, ordinances and regulations, including without limitation, County building, zoning and health codes, and shall allow inspections to ensure conformance with such regulations.

F. The permit holder shall not be delinquent in the payment of fees required by this Chapter.

G. The Department may, in its discretion, add, delete, or modify general permit conditions as necessary to protect the health, safety and welfare of the public.

H. Where applicable, the site operator shall demonstrate compliance with the Central Valley Regional Water Quality Control Board's Irrigated Lands Regulatory Program (Resolution No. R5-2003-0105).

### **Section 9.88.080 Administrative Appeal**

A. Any applicant, permit holder, or other interested person or entity that is dissatisfied with a decision resulting from the application, interpretation or enforcement of the provisions of this Chapter by the Department may appeal any administrative determination related to any of the following actions:

1. Finding that an application is complete or incomplete.



2. Determination that an application is not in the interest of the public health and welfare.

3. Establishment or modification of operating conditions.

4. Grant or denial of permit.

5. Suspension or revocation of a permit.

B. Administrative appeals under this Section must be made in writing, must clearly set forth the reasons why the appeal ought to be granted, and must be received by the Director of the Department within fifteen (15) days of the postmark date on the envelope that transmits the administrative determination. When the last day of the appeal period would fall upon a non-workday or a holiday, the appeal period shall be extended to include the next subsequent regular working day.

C. Within thirty (30) days after the filing of an appeal of an administrative determination, the Department shall set the matter for hearing before a hearing officer or panel, at which time the appeal shall be heard in public session. The Department shall provide written notice of the appeal hearing to the appellant and all interested parties as provided in Section 9.88.040 D. The appellant and any interested parties will be allowed to address the panel regarding the appeal.

D. Within thirty (30) days after conclusion of the administrative hearing on the appeal, the hearing officer or panel shall issue a decision on the appeal, and the Department shall mail a copy of the decision on appeal to all interested parties that participated in the hearing. The decision on appeal shall be final and binding upon all parties to the appeal unless that decision is appealed to the Board of Supervisors as provided in Section 9.88.090.

### **Section 9.88.090 Appeal to Board of Supervisors**

A. Any applicant, permit holder, or other interested person or entity that is dissatisfied with a decision after administrative appeal may appeal to the Board of Supervisors. The appeal must be made in writing and must be received by the Clerk of the Board of Supervisors within fifteen (15) days of the postmark date on the envelope within which the notice of the decision of appeal was sent. When the last day of the appeal period would fall upon a non-workday or a holiday, the appeal period shall be extended to include the next subsequent regular working day. Appeals filed shall be accompanied with a fee in an amount set by resolution of the Board.

B. Decisions appealed to the Board of Supervisors shall be set for specific time and place of public hearing at the next regular meeting and considered not later than forty-five days from the date on which the appeal is filed. The hearing date may be extended beyond forty-five days upon request or consent of the appellant.

C. Written notice of the appeal hearing shall be mailed to the appellant and all interested parties as provided in Section 9.88.040 D., and shall set forth the grounds for the appeal, the method of submitting comments to the County regarding the appeal, and the date and location of the hearing of the appeal.

D. Any appeal that is not timely filed, or that is not accompanied by the required fee, will be deemed ineffective and the administrative determination that is being appealed will become final.

E. The Board of Supervisors may take any appropriate action upon the original administrative action that was appealed pursuant to Section 9.88.080, including granting or denying the appeal or imposing, deleting or modifying operating conditions of the permit. The decision of the Board of Supervisors shall be final.

### **Section 9.88.100 Suspension and Revocation**

A. The Department may initiate the revocation or suspension of a permit when it shall appear that the permit holder violates the terms and conditions of the permit or the requirements of federal, State or local laws, ordinances or regulations.

B. No permit shall be revoked or suspended by virtue of this Section until a hearing has been held in the same manner as described in Sections 9.88.080 and 9.88.090. Notice of the hearing shall contain a brief statement of the grounds for revoking or suspending the permit and the time and date for the hearing.

C. The decision of the administrative panel may include suspension, revocation or the modification of the permit by adding conditions that are designed to reduce or remove the problems that caused the proposed revocation or suspension of the permit.

D. Within ten days after conclusion of the hearing of the appeal by the administrative panel, the Department shall give notice of the decision of the panel.

E. Any interested party may appeal the determination of the administrative panel to the Board of Supervisors within ten days after the date of the notice of the decision of the administrative panel. The Board of Supervisors shall act upon the appeal in accordance with Section 9.88.090.

F. Notwithstanding any other provision of this Chapter, the Department may suspend, or temporarily amend a permit without notice or a hearing whenever an emergency exists that threatens the public health, safety or welfare. In such cases, the Department shall notify the permit holder prior to the action. The Board of Supervisors shall review the emergency action at its next regularly scheduled meeting and at every regularly scheduled meeting thereafter until the emergency condition or situation



ceases to exist, or shall set the matter for hearing to revoke the permit in accordance with the provisions of this Chapter.

#### **Section 9.88.110 Transfer of the Permit**

A. A permit issued under this Chapter does not grant any interest in real property or create any interest of value. A permit is not transferable, and automatically terminates upon transfer of ownership of the property.

B. A transferee of an existing permit may apply for a new permit by submitting an application, Plan of Operation and fees that comply with this Chapter. The Department shall verify information in the application and Plan of Operation and shall approve the new permit unless it fails to comply with the standards set forth in this Chapter. The new permit holder must qualify and agree to comply with and be bound by the terms and conditions of the authorization, and the new authorization shall contain any new conditions or stipulations, which circumstances may warrant. A new permit issued pursuant to this Chapter shall be effective on either the date of transfer of ownership of the property or facilities subject to the permit, or the date of approval and issuance of a permit by the Department, whichever occurs last.

#### **Section 9.88.120 Establishment of Regulations**

The Board of Supervisors may establish, by resolution, regulations for the administration and implementation of this Chapter. Such regulations, when adopted, shall become and thereafter be a part of Chapter 9.88. A copy of the regulations established by resolution of the Board shall be filed with the Clerk of the Board and with the Department.

#### **Section 9.88.130 Misdemeanor Violation**

Any person violating any of the provisions or failing to comply with this Chapter shall be guilty of a misdemeanor, and, upon conviction thereof, shall be punished as set forth in Section 1.36.010. Each person shall be guilty of a separate offense for each and every day during any portion of which any violation of any provision of this Chapter or the permit is committed, continued or allowed in conjunction with the operations and shall be punishable accordingly.

### **Section 9.88.140 Civil Injunction**

In addition to the penalties provided in this Chapter, any condition caused or allowed to exist in violation of any of the provisions of this Chapter shall be deemed a public nuisance and shall, at the discretion of County, create a cause of action for injunctive relief, and which may be enforced pursuant to Chapter 2.92.

### **Section 9.88.150 Severability**

The provisions of this Chapter are hereby declared to be severable. If any provision, clause, word, sentence or paragraph of this Chapter or the application thereof to any person, establishment or circumstances shall be held invalid, such invalidity shall not affect the other provisions or application of this Chapter.

### **Section 6.88.160 Judicial Review**

Judicial review of a final decision made under this Chapter may be had by filing a petition for a writ of mandate with the Superior Court in accordance with the provisions of Section 1094.5 of the California Code of Civil Procedure. Any such petition or any other action seeking judicial review shall be filed within ninety (90) days after the day the decision becomes final.



**Regulations for the Use of Food Processing By-Products  
in Stanislaus County by Permitted Use Sites**

**SECTIONS:**

- 1            General Definitions**
- 2            Definitions**
- 3            Application for Permit - Contents**
- 4            Plan of Operation - Contents**
- 5            General Permit Terms and Conditions**
- 6            Land Application - Additional Conditions**
- 7            Direct Feed Operations - Additional Conditions**
- 8            Dehydration Operations - Additional Conditions**
- 9            Composting Operations - Additional Conditions**
- 10          Reporting Forms**

## **Section 1            General**

Pursuant to Stanislaus County Code Section 9.04.180, and in accordance with the provisions of the Stanislaus County Code for the beneficial use of food processing by-products in the unincorporated area of the County of Stanislaus, the following regulations shall govern the permit holder's operations and shall be included in the terms of the permit to operate.

Any person proposing the use of food processing by-products must comply with all provisions of Stanislaus County Refuse Ordinance Title 9 including the application for a permit prior to feeding, land applying, dehydrating, composting or any other beneficial use of food processing by-products. Proposed activities must also conform to the June 2007 Manual of Best Practices for Application of Food Processing By-Products on Farmlands as prepared for the Stanislaus County Food Processing By-Products Use Program.

## **Section 2            Definitions**

All of the definitions set forth in Stanislaus County Code 9.88.010 are hereby incorporated by reference in these Regulations. In addition the following words and phrases shall have the following meanings when used in these Regulations:

1. "Agronomic Rate" means the application rate, which will provide the amount of nitrogen, or other critical nutrients required for optimum crop growth and development, and that, will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.

2. "Best Management Practice" means the use of by-products on farmland under regular monitoring and testing to protect soil and groundwater quality.

3. "Cation Exchange Capacity or CEC" refers to the buffering capacity of soils to retain or resist soil pH change when by-products are applied. As defined by Singer, CEC is "The total amount of positive ions (cations) that a soil can adsorb exchangeable." Buffering action is effective in controlling soluble concentrations of aluminum, calcium, hydrogen, magnesium, potassium, and sodium ions. In addition, Calcium carbonate content not associated with CEC is an important part of soil buffering capacity. Soils having high buffering capacity are those containing high humus and/or montmorillonite or vermiculite clays. Calcareous soils also have high buffering capacities, as soil pH will remain at about 8.4 until calcium carbonate is exhausted. Leaching of ions from soils containing CEC > 10 cmolc/kg is small. In summary, CEC values at pH 7 range in the order of clay loams > silt loams > sandy loams > loamy sands.

4. "Crop Nutrient Requirements" means the amount of plant nutrients or essential elements necessary for promoting crop growth and development. This includes macronutrients, micronutrients, and trace elements.
5. "Department" means the Stanislaus County Department of Environmental Resources.
6. "Exchangeable Sodium Percentage or ESP" is a method of estimating the sodium hazard. Soils with ESP values higher than 15 within the first 24" of the soil profile indicate excess sodium and tend to be hard and cloddy when dry, to crust badly, and to drain poorly.
7. "Fallow-Dry Soil" is a condition of soil after tilling without sowing for a season.
8. "Food Processing By-Product" means the by-products of food processing that are solid or semisolid substances derived from agricultural plant material delivered to a food processor for processing that are not utilized in the final product. Food processing by-products includes culls, peelings, seeds, under or over ripe food, skins, cores, pomace, puree, hulls, shells, pits, stems, leaves and any substance including soil washed from plant produce.
9. "Food processor" means a processor of fruit, nut or vegetable raw products which may include but are not limited to tomato, peaches, almonds, walnuts, pears, grapes, raw olives, grain products or other raw plant material, and that includes, i.e., canneries, nut processors, vegetable processors, frozen food processing, etc.
10. "Geostatistical-based Standards of Practice" are statistical methods, which can adequately represent spatial distributions.
11. "Liquid" is a substance that exhibits textures and properties very much like water, such as wastewater.
12. "Liquid Waste" is process wash or rinse water that provides none of the benefits of food processing by-products.
13. "Natural Background Concentration" means the concentration of chemical, physical, or biological substances normally present in the environment and not influenced by regional or localized human activities.
14. "Permit" means a permit for use of food processing by-products issued by the County to a person under this Chapter.
15. "Permit holder" means a person or legally recognized entity that holds an effective and current permit under this Chapter.
16. "Person" means any human being or an incorporated or unincorporated business entity or association established under the laws of the State.



17. "Salinity Loading Rate" means the by-product application rate that will provide the amount of overall salt-based elements (calcium, magnesium, potassium, and sodium and their associated anions) for normal crop growth and development, and that will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.

18. "Semi-Solid" means a substance that has intermediate properties, such as rigidity, between solid and liquid.

19. "Slurry" as it applies to the Stanislaus County Food Processing By-Product Program, means a by-product mixture that contain between 75 and 97 percent moisture or 3 to 25 percent solids with a smooth, homogeneous texture.

20. "Sodium Adsorption Ratio or SAR" refers to the portion of sodium ions compared to the concentration of calcium plus magnesium. A SAR value higher than 15 indicates excess sodium in the soil and causes soil to be hard and cloddy when dry, to crust badly, and to drain poorly.

21. "Soil Amendment" means land-applied by-products that are intended to improve the physical, chemical, or biological characteristics of soil for optimum crop growth and development, and that will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.

22. "Solid" is a substance that is stackable, of definite shape and volume, can hold a definite angle of repose, and is not liquid or gaseous.

### **Section 3                      Application for Permit - Contents**

Each application shall set forth or incorporate by reference the following information in a standard form adopted by the Department:

1.     Address or location of the proposed site, the name and address of the permit holder and, if different, the name and address of the owner or owners of the land on which permit operations will be conducted.

2.     If the applicant is an individual, the full name, present mailing address and telephone number of the applicant. If the applicant is not an individual, the name and address of the applicant's agent who is authorized to receive notice of actions pertaining to the proposal, and an applicant in one of the following categories must furnish the information specified for that category:

A.     If the applicant is a State or local government agency, a copy of the authorization under which the proposal is made.

B.     If the applicant is a public corporation, the statute or other authority under which it was organized.



C. If the applicant is a Federal Government agency, the title of the agency official delegated the authority to file the proposal.

D. If the applicant is a private corporation, evidence of incorporation and its current good standing.

3. An initial Plan of Operation in compliance with Section 4 of these Regulations.

4. A description of the methods by which the applicant will mitigate any potentially adverse impacts, of excessive objectionable food processing by-product odors, and excessive insect, rodent or other nuisances or public health hazards.

5. Written certification that the applicant has reviewed and understands and accepts the standard conditions that are set forth in this Chapter. If the applicant does not own the premises where the permit operations will occur, the applicant must provide a notarized letter from the owner that states that applicant has the owner's consent to conduct the proposed project on that parcel, that the owner has approved the proposed Plan of Operation, and that the landowner acknowledges that the landowner could be held responsible for clean-up and abatement of any condition resulting from the permitted operations.

6. Certification, under penalty of perjury, that all the information contained in the application is true and correct.

7. A statement by the applicant that it has the ability to comply with all laws regulating businesses in the State of California and that it shall maintain compliance during the term of the permit.

8. Additional information as needed to conduct an environmental assessment of the proposed permit as may be required to comply with the California Environmental Quality Act.

#### **Section 4 Plan of Operation - Contents**

An application will not be accepted or approved unless the applicant submits a Plan of Operation that provides the information set forth in this section, and additional information deemed necessary by the Department to determine the potential effect of the proposed operations on the health safety and welfare of the public.

1. List the owner of the site. If different from the permit applicant, list the property owner's name, mailing address and phone number.

2. List the address and the assessor's parcel number(s) of the site.

3. List the general plan and zoning designation of the site.

4. List the current use of the site.
5. List the soil types of the project site. List their approximate absorption/water holding capacities.
6. List the approximate depth to groundwater at the site. State how the depth was determined, and the month and year the depth was determined.
7. Provide a vicinity map showing the location of the site and all proposed delivery routes.
8. Provide a plot plan drawn to a legible scale, which clearly shows the intended project. The map must contain the following information:
  - A. Sufficient description to define the location, date, north arrow, scale and boundaries; (full width of all public and private road ways bordering the property must be shown).
  - B. Name and address of recorded owner(s).
  - C. Name and address of person(s) preparing the map.
  - D. Acreage to the nearest acre.
  - E. Location and size of all waterways, drainage courses, pipelines, existing irrigation and drainage facilities, irrigation and drainage patterns, existing or proposed water wells, septic tanks and drainage (leach) fields, sewage lines and structures used in connecting therewith, slope of the land.
  - F. Outline of existing buildings and other structures to remain in place within the project area, showing the distance to existing or proposed public and private roadways.
9. Provide an 8 ½ inches by 11 inches reproducible, to scale, legible area map showing specific land uses (crops, houses, buildings, parcel lines and parcel sizes, etc.) for the adjacent two parcels in each direction from the subject property.
10. Name the site manager, provide a mailing address and list a 24-hour contact phone number.
11. List the types of by-product you plan to accept at the site, and describe how by-product will be ultimately utilized.
12. List the names, addresses, phone numbers and contact persons for the food processing plant(s) that will provide the by-product.
13. List the names, addresses, phone numbers and contact persons of the hauler(s) who will haul the by-product(s) to your site.



14. State how many tons per day of by-product will be delivered to your site. List the total tons for the season.

15. If more than one type of by-product will be delivered, estimate the tons per day of each type of by-product that will be delivered to the site.

16. State how many truckloads per day will be delivered to your site.

17. Give the date that by-product deliveries will start and the date they will stop each season or indicate if you will accept the by-product year-round. Estimate how many days per year the site will accept by-product.

18. List the days of the week, and the approximate times that by-product will be delivered to your site.

19. Explain in a detailed, step-by-step manner, how you will use or process the by-products. Applicants for direct feed operations shall also contain the following information:

A. Indicate what type of livestock or poultry will be fed.

B. List the percentage (by dry weight) of the feed ration at which this by-product will be used.

C. List the number of lactating and non-lactating animals.

D. List the number of livestock or poultry that will consume the by-product, or a list of purchasers and their intended use.

20. Explain in detail, the methodology to be used for tracking, receiving, storing, and depositing by-products. This tracking procedure must include records of when by-product is received, where it is received, and the location of the by-product when it is used at the site.

21. List the types of the equipment you will use to manage the by-products. Indicate if that equipment is under your ownership. List stand-by equipment available in case of equipment breakdown.

22. Explain in detail how you will prevent the following conditions from occurring, and provide contingency plans in the event these conditions occur:

A. Excessive liquid accumulation and excess moisture.

B. Excessive dust.

C. Excessive noise.

D. Excessive objectionable odors.

- E. Excessive fly, mosquito and/or vector nuisance.
- F. Inclement weather.

23. Describe how the by-products will be contained on the site and not allowed to flow or otherwise be deposited on other surrounding properties or waterways.

24. Applicant shall provide Department staff with written verification from the food processing by-product processor, that all by-products deposited on permitted sites in Stanislaus County will not pose a risk to land, air, water, to human and animal health or the environment and that utilization of the by-product as direct feed or as a soil amendment is an acceptable use of said by-product.

## **Section 5                    General Permit Terms and Conditions**

Throughout the term of the permit, each holder of a permit issued under these Regulations shall not violate any provision of Stanislaus County Code Chapter 9.88 and shall comply with the standard terms and conditions set forth in this section.

1. Only the types and amounts of food processing by-product listed in the permit application and Plan of Operation may be received and used at the permit location.

2. The permit holder is prohibited from receiving milk, whey, cheese by-products, meat and processed animal by-products, including dead animals, as well as fruit and vegetable by products that, because of processing, contain high concentrations of salts or constituents that are agriculturally or environmentally deleterious.

3. The total amount of by-product delivered to the permit location shall not exceed the amounts stated in the approved Plan of Operation.

4. The permit holder shall maintain a daily log approved by the Department, which shall contain the following information:

- A. Date and time of each delivery of material,
- B. Name of the hauler of the material,
- C. Amount (by weight) delivered,
- D. Source of material, and
- E. Type of material.

All daily logs shall be submitted annually to the Department and shall be made available to the Department for review and inspection upon reasonable request of the Department.



5. Written procedures acceptable to the Department shall be developed whereby food processing by-product trucks are directed to the correct discharge lanes/areas during all delivery times. These procedures shall be implemented whenever the site receives food processing by-products.

6. The site shall be operated and managed at all times so that no excessive objectionable food processing by-product odors are produced, and no excessive insect, rodent or other nuisances or public health hazards are created.

7. Approved spray equipment, insecticides and pesticides shall be readily available for use at all times to control flies, mosquitoes, gnats and other pests. All insecticides and pesticides used shall be stored and used according to the label directions and in compliance with applicable local, state and federal rules, regulations and laws.

8. Mechanical equipment shall be readily available and be adequate to perform the necessary by-product operations. Standby equipment must be readily available, in the event of mechanical failure. If no equipment is available or if equipment becomes inoperable, no by-product materials shall be accepted at the site until operable processing equipment is available and existing stockpile is processed.

9. To prevent surface water quality degradation, ensure that all site personnel are familiar with the proper use and function of any on-site water control structures, which allow discharge. Maintain all valves that allow runoff and repair immediately as needed.

10. Within sixty (60) days of the cessation of deliveries of food processing by-product to the site or at the end of the site season, the operator shall report to the Department the amount of by-product delivered daily (tons); the total amount of by-product delivered to the site (tons).

11. An annual inspection of vehicles collecting and/or transporting food processing by-products shall be made, and an identification sticker will be issued and shall be displayed on each vehicle. The following are checked during the inspection: leak proof beds/bodies, load covering, current vehicle registration, broom and shovel, fire extinguisher, operable brake lights and turn signals. Applicant must provide proof of certification/documentation to the Department that the hauler complies with the California Department of Business, Transportation and Housing B.I.T. Program at the time of permit renewal.

## **Section 6            Land Application - Additional Conditions**

In addition to the general permit terms and conditions set forth in Stanislaus County Code Section 9.88.070 and Section 5 of these Regulations, permits issued for land application operations shall also comply with the terms and conditions set forth in this section.

1. Nutrient and Irrigation Management is key to the effective use of by-products. Field operators shall seek consultation from California State University specialists, UC Cooperative Extension specialists, certified crop advisors, agronomists, or soil scientists to properly manage by-product inputs as part of a fertilizer program to maintain farm economic viability and to minimize potential impacts on soil and water quality.

2. Prior to accepting food processing by-products at the site, the soil shall be prepared to receive by-products. Clods of soil shall be broken by a Schmeizer or equivalent. The soil surface shall be leveled to reduce pocket holes and furrows. Soil shall be sufficiently dry to retain moisture applied with food processing by-product in the surface 12 inches.

3. Food processing by-product shall be discharged from the trucks as thinly and evenly as practical. Overlapping onto previously spread food processing by-product shall be minimal. Check runs shall be no longer and slopes shall be no greater than that which permits uniform infiltration, evaporation and maximum practical irrigation efficiency. The quantity of by-products applied to any given area within the permit location shall not exceed the agronomic rate, but may be done in two or three lifts to allow for even drying.

4. Within twenty-four hours of deposition at the site, the food processing by-product shall be spread and crushed with a tandem drag or equivalent. The by-product shall dry for a minimum of 48 hours after which it shall be disced or harrowed. The soil should be worked to an appropriate depth with alternate discing or harrowing and drying until final drying and incorporation into the soil are complete. In the event of inclement weather, the site operator may invoke the contingency plan outlined in the Plan of Operation upon approval by the Department.

5. The applicant shall maintain the following minimum setbacks for all by-product areas:

Setback Definition:	Setback (feet):
Edge of by-product area to public property (e.g., street)	300'
Edge of by-product area to other non-owned agricultural property	100'
Edge of by-product area to occupied residences (on-site)	150'
Edge of by-product area to occupied residences (off-site)	300'

6. All cans, metal, wood, plastic, paper, cardboard, and other refuse in the food processing by-product at the site shall be removed and placed in approved containers and disposed of at an approved refuse disposal site. This refuse shall be removed and properly disposed of as needed.

7. Crops shall be grown on the land application areas. Crops shall be selected based on nutrient uptake capacity, tolerance of anticipated soil moisture and salinity conditions, water needs and evapotranspiration rates. All crops shall be grazed or they shall be harvested and removed from the by-product areas at least once per year.



8. By-product shall be tested and the following parameters and constituents: moisture, total nitrogen, organic carbon, sodium, chloride, potassium, calcium, magnesium, phosphorus, pH and total solids versus volatile solids. Results of the analysis must be submitted to the Department within 30 days of receipt of results. The Department shall determine the number and frequency of sampling the food by-products after a review of the current Plan of Operation.

9. Application rates shall be based on agronomic rates.

10. Soil samples from fields to which by-products are applied shall be analyzed for cation exchange capacity, plant nutrients, total organic carbon, and ESP. Plant nutrients must include total nitrogen, nitrate and ammonium nitrogen, available phosphorous (Olsen), potassium, magnesium, calcium, sodium, and chloride. Saturation paste extracts shall be analyzed for soluble salts (electrical conductivity), and pH. Results of the analysis must be submitted to the Department within 30 days of receipt of results.

Samples shall be drawn from 1-foot intervals to the rooting depth. Alternative sampling intervals may be employed with technical justification. Each field scheduled to receive by-products in any given year should be sampled in late spring or early summer prior to the by-products application. Obtaining representative samples is critical to getting valid and interpretable analytical results. One method to ensure representative samples are collected is to conduct the soil sampling as follows. Collect soil samples from the depth intervals of 0-12 inches, 12-24 inches, and 24-36 inches at 10 to 20 sites per field based on geostatistical-based standards of practice. Mix samples taken from the same depth intervals to form a single composite sample for that depth interval. This composite sample should have a minimum weight of one pound. Submit each composite sample to a certified laboratory for analysis, for a total of three composite samples per field representing the three depths. Results of the analysis must be submitted to the Department within 30 days of receipt of results.

11. Land application of by-product to any sub-area or irrigation check not having a fully functional tail water/runoff control system is prohibited.

12. Applicant shall avoid excessive use of food processing by-product or practices that may create saturated soil conditions or other conditions that are harmful to crops and potentially degrading of underlying groundwater by overloading the shallow soil profile and causing by-product constituents (organic carbon, nitrate, other salts and metals) to percolate below the evaporative root zone.

13. Within sixty (60) days of the cessation of deliveries of food processing by-product to the site or at the end of the site season, the operator shall report to the Department a record of fields where by-products are applied, rate of application and total application/year/field.

## **Section 7                    Direct Feed Operations - Additional Conditions**

In addition to the general permit terms and conditions set forth in Stanislaus County Code Section 9.88.070 and Section 5 of these Regulations, permits issued for direct feed operations shall also comply with the terms and conditions set forth in this section.

1.        The by-product receiving pad shall be constructed of concrete or asphalt and maintained in good repair, free of cracks and openings that would allow food by-products and liquid to drain or leach into the soil. The pad shall be kept clean of accumulated by-product and maintained to prevent fly and mosquito production and objectionable odors.

2.        By-product shall be fed on concrete, asphalt or other approved manger and not applied to open ground.

3.        Food processing by-product must be processed or fed within twenty-four (24) hours of delivery to the site. If the by-product is not processed or consumed within twenty-four (24) hours after delivery, no additional by-product shall be delivered to the site until such time as all by-products at the site has been consumed or properly processed per the procedures in the current site Plan of Operation.

4.        No liquid or runoff from food processing by-product use areas shall be discharged from or allowed to drain off-site or onto adjacent property. The site shall comply with appropriate Regional Water Quality Control Board requirements, which may include individual or general Waste Discharge Requirements.

5.        Food processing by-product used, as an animal feed shall conform to the applicable sections of the Commercial Feed Law and Regulations, as issued by the California Department of Food and Agriculture. The permit holder shall provide confirmation satisfactory to the Department that the feed meets the applicable requirements of the California Food & Agriculture Code, including but not limited to compliance with labeling, testing, and receiving sections of the Code.

6.        By-product shall be tested for the following attributes: moisture, total nitrogen, organic carbon, sodium, chloride, potassium, calcium, magnesium, phosphorus, and pH. Results of the analysis must be submitted to the Department within 30 days of receipt of results. The Department shall determine the number and frequency of sampling the food by-products after a review of the current Plan of Operation.

## **Section 8                    Dehydration Operations - Additional Conditions**

In addition to the general permit terms and conditions set forth in Stanislaus County Code Section 9.88.070 and Section 5 of these Regulations, permits issued for



dehydration operations shall also comply with the terms and conditions set forth in this section.

1. The by-product receiving pad shall be constructed of concrete or asphalt and maintained in good repair, free of cracks and openings that would allow food by-products and liquid to drain or leach into the soil. The pad shall be kept clean of accumulated by-product and maintained to prevent fly and mosquito production and objectionable odors.

2. By-product shall remain on the receiving pad no longer than 24 hours before processing commences.

3. By-product shall be tested for the following attributes: moisture, total nitrogen, organic carbon, sodium, chloride, potassium, calcium, magnesium, phosphorus, pH and total solids versus volatile solids. Results of the analysis must be submitted to the Department within 30 days of receipt of results. The Department shall determine the number and frequency of sampling the food by-products after a review of the current Plan of Operation.

4. Site shall comply with appropriate Regional Water Quality Control Board requirements, which may include individual or general Waste Discharge Requirements.

## **Section 9 Composting Operations - Additional Conditions**

In addition to the general permit terms and conditions set forth in Stanislaus County Refuse Code Section 9.88.070 and Section 5 of these Regulations, permits issued for composting operations shall also comply with the terms and conditions set forth in this section.

1. The by-product receiving pad shall be constructed of concrete or asphalt and maintained in good repair, free of cracks and openings that would allow food by-products and liquid to drain or leach into the soil. The pad shall be kept clean of accumulated by-product and maintained to prevent fly and mosquito production and objectionable odors.

2. By-product shall remain on the receiving pad no longer than 24 hours before processing commences.

3. By-product shall be tested for the following attributes: moisture, total nitrogen, organic carbon, sodium, chloride, potassium, calcium, magnesium, phosphorus, pH and total solids versus volatile solids. Where composting is over packed soil, samples shall be taken from the surface three feet in one-foot increments. Analytes shall include at a minimum pH, nitrate nitrogen, Olsen phosphorus, ammonium acetate extractable potassium, electrical conductivity of the saturation extract and sodium absorption ratio. The top foot of access holes shall be backfilled with bentonite clay to minimize leaching and to prevent re-sampling back fill material. Results of the analysis must be submitted to the Department within 30 days of receipt of results. The

Department shall determine the number and frequency of sampling the food by-products after a review of the current Plan of Operation.

4. Site shall comply with appropriate Regional Water Quality Control Board requirements, which may include individual or general WDRs.

## **SECTION 10.00                      Reporting Forms**

Permit holders must report data using a form approved by the Department. Permit holder may request use of alternate formats that are reviewed and approved by the Department before data is submitted.





**FOOD PROCESSING RESIDUE USE SURVEY**  
**YEAR \_\_\_\_\_**

**Business Name :** \_\_\_\_\_  
**Business Address :** \_\_\_\_\_  
**City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_**  
**Mailing Address :** \_\_\_\_\_  
**City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_**  
**Person Completing Form :** \_\_\_\_\_  
**Phone No. :** \_\_\_\_\_

TYPE OF RESIDUE <sup>1</sup>	HAULER(S)	USE SITE & LOCATION	WEIGHT OF RESIDUE <sup>2</sup> (in tons)

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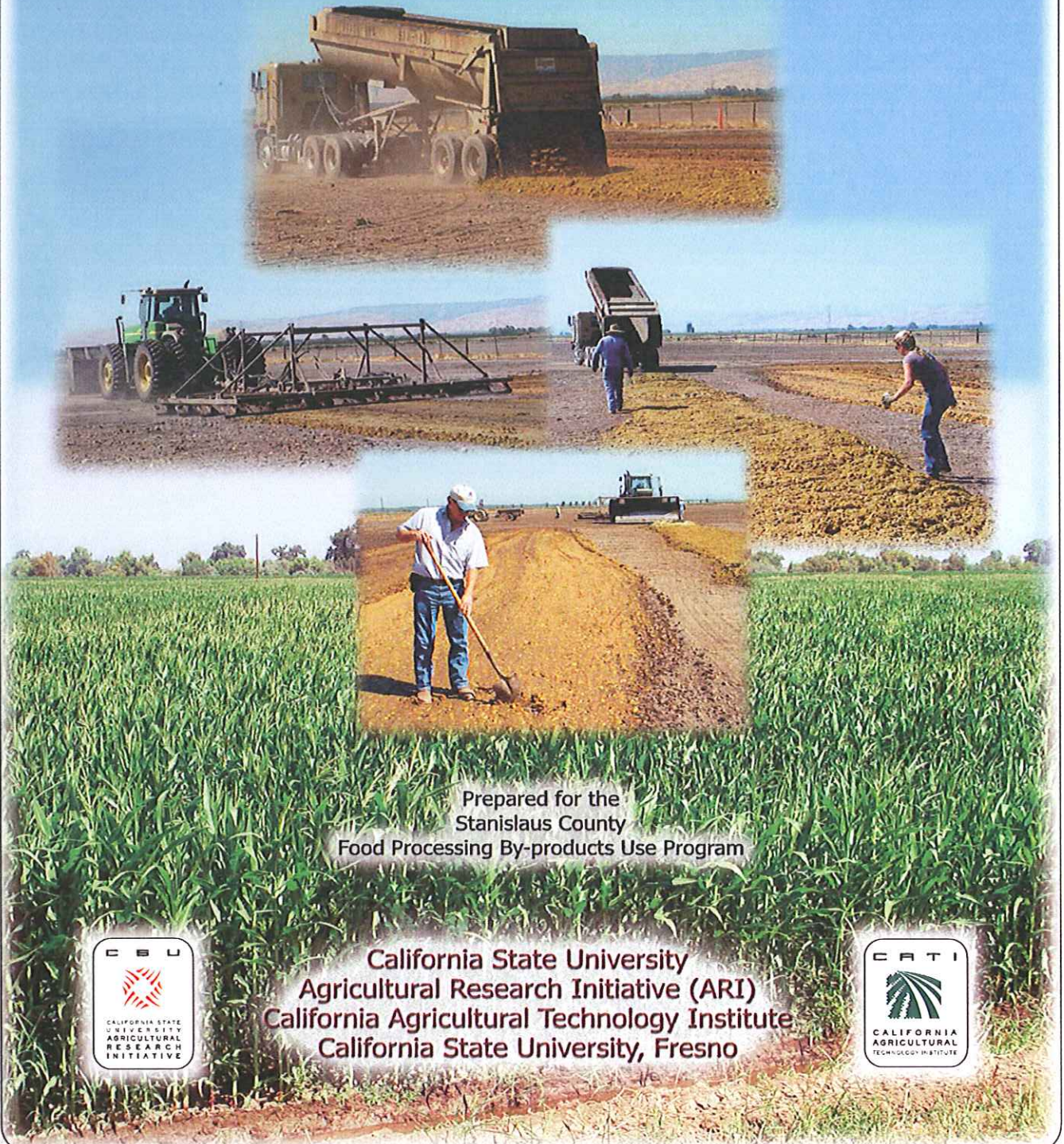
<sup>1</sup>PLEASE itemize each type of residue.

<sup>2</sup>PLEASE express the weight of the residue in tons.

Return the completed survey form to:  
**DEPARTMENT OF ENVIRONMENTAL RESOURCES**  
**3800 Cornucopia Way, Suite C**  
**Modesto, California 95358-9494**



# Manual of Best Practices for Application of Food Processing By-products on Farmlands



Prepared for the  
Stanislaus County  
Food Processing By-products Use Program



California State University  
Agricultural Research Initiative (ARI)  
California Agricultural Technology Institute  
California State University, Fresno





# **M**anual of Best Practices for Application of Food Processing By-products on Farmlands

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June 29, 2007

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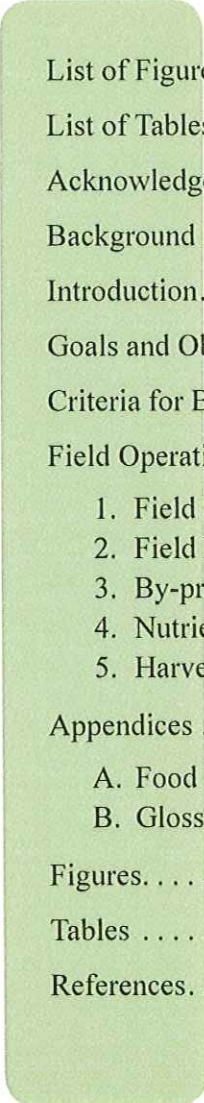
**CALIFORNIA STATE UNIVERSITY  
AGRICULTURAL RESEARCH INITIATIVE (ARI)  
CALIFORNIA AGRICULTURAL TECHNOLOGY INSTITUTE (CATI)  
CALIFORNIA STATE UNIVERSITY, FRESNO**

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# Table of Contents



- List of Figures ..... *iii*
- List of Tables..... *iii*
- Acknowledgements..... *iv*
- Background Information.....1
- Introduction.....2
- Goals and Objectives .....3
- Criteria for By-products Land Application.....5
- Field Operations Manual.....6
  - 1. Field Selection .....7
  - 2. Field Preparation .....9
  - 3. By-products .....9
  - 4. Nutrient and Irrigation Management .....11
  - 5. Harvesting Crops .....13
- Appendices .....15
  - A. Food Processing By-products Reference Sheet.....17
  - B. Glossary of Terms .....27
- Figures.....29
- Tables .....33
- References.....36



## List of Figures

<i>Figure 1.</i> Soil texture triangle. ....	29
<i>Figure 2.</i> Determining soil texture by the feel method. ....	30
<i>Figure 3.</i> Relationships of soil texture classes and soil water by volume ....	31
<i>Figure 4.</i> The trend of availability of various plant nutrients under different soil pH. ....	32

## List of Tables

<i>Table 1.</i> Various chemical properties of food processing by-products collected in Stanislaus County in 2006. ....	33
<i>Table 2.</i> Estimated trace-element balances of agricultural soils in California. ....	34
<i>Table 3.</i> Background concentrations of selected trace elements in California soils. ....	35

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## Background Information

### Early Local Oversight

For nearly 30 years, Stanislaus County has been active in researching, implementing and developing solutions for the beneficial re-use of food processing by-products in the agricultural community. In 1978, Stanislaus County recognized the potential challenges of handling, transporting and using food processing by-products, and in concert with interested parties developed a program to address concerns and solve challenges related to the handling and re-use of food processing by-products. This collaboration resulted in a unique self-supporting program for the operation and oversight of food processing by-product use sites in Stanislaus County.

### Beneficial Re-use to Achieve Multiple State Policy Objectives

The Stanislaus County Food Processing By-product Use Program (the Program) has a long history of providing beneficial uses for by-products, materials once regarded as problematic. Since 1978, more than six million tons of by-products have been land-applied as a soil amendment to farmlands, fed to cattle, or dried and processed for other beneficial applications. Additionally, the California Integrated Waste Management Board (CIWMB), which oversees the mandate for all California jurisdictions to reduce the amount of solid waste disposal in landfills, is of the opinion that had this material been landfilled, rather than diverted to beneficial uses, Stanislaus County may not be in compliance with the mandated landfill diversion requirements of AB 939.

### Review by Water Board Staff

In 2005, staff of the Central Valley Regional Water Quality Control Board (RWQCB) expressed concerns about the land-application program. The Stanislaus County Department of Environmental Resources (DER) and RWQCB staff had discussions over many months about the land-application program, in the hope that the department would be able to continue to operate the program given its agronomic and public policy benefits.

### Board Resolution

In 2006, the RWQCB issued Resolution No. R5-2006-0052 regarding the reuse of food processing by-products within Stanislaus County ([http://www.waterboards.ca.gov/centralvalley/adopted\\_](http://www.waterboards.ca.gov/centralvalley/adopted_)



orders/Resolutions/). The Work Plan required of the county under Resolution No. R5-2006-0052 was submitted on August 1, 2006, and was approved by RWQCB staff on November 2, 2006 (<http://www.co.stanislaus.ca.us/er/>). The Research Team was established with collaborative efforts from staff of DER; RWQCB; the California Agricultural Technology Institute (CATI) of California State University, Fresno; California State University, Stanislaus; CDFA; CIWMB, a non-profit organization; Dellavalle Laboratory Inc.; consultants; food processors; and by-products site operators.

## Introduction

California's food industry leads the nation in the processing of fruits and vegetables such as tomatoes, olives, peaches, and grapes (Reed, 2006). These operations, especially the ones that use raw fruit, nut, and vegetable based materials, generate various types of food processing by-products (by-products) which are non-hazardous wastes. By-product constituents are

dependent on the source of raw material utilized and the substances associated with processing. The application of by-products to agricultural farmlands, while certainly not new, has become increasingly widespread. Well-regulated practices are important not only for properly recycling nutrients back into the soil, but also for managing elements of concern (e.g., sodium, chloride, and trace elements) that would otherwise be concentrated elsewhere.

Expansion of land-applied non-hazardous wastes is projected to rise because of environmental impacts and economic restraints of landfill

disposal and incineration, and because of presumed inherent agricultural benefits (O'Connor et al., 2005). In addition, there are other potential management options for these by-products, depending on their physical and chemical characteristics, available local infrastructure, market demand, and other economic considerations. Some of these potential options (<http://www.ciwmb.ca.gov/Organics/>) are outside the scope of this BMP Manual, including source reduction, animal feed, fertilizer manufacture, energy generating technologies, composting, rendering of meat by-products, and in some cases, landfill disposal.



*Truck delivers by-products to a prepared site.*

This Manual of Best Practices for applications of food processing by-products on farmlands was established as part of the Approved Work Plan addressing Resolution No. R5-2006-0052. Our objective is to provide a detailed description of the land application program and program requirements that will allow Stanislaus County and other jurisdictions to implement a food processing by-products land application program. The results of the Literature Review and Technical Review were used to develop Best Management Practices (BMP's) for land application of food processing by-products on farmlands under the Stanislaus County Food Processing By-products Program. The major goal of the BMP Manual is to effectively utilize by-products as a soil amendment, with the least detrimental potential impacts on soil and groundwater quality.

## Goals and Objectives

This program is limited to the reuse of solid, semi-solid and slurry by-product forms. The major goal of this BMP Manual is to adopt a program that will minimize potential soil and water quality impacts through practical and available management practices or technologies. To address RWQCB's resolution requirements, the following items are essential components to be considered in the BMP's:

1. Implementation of an environmental and by-product monitoring program with consideration for site and by-product characteristics and conditions.
2. Evaluate and determine the actual or potential water quality impacts that the high strength and low pH food processing by-products may have in land application practices.
3. Develop proper controls, management measures, conditions and prohibitions (given site and by-product characteristics) to address these types of food processing by-product application to farmlands.
4. Determine the percentage of TDS in food processing by-products that is present as VDS, and how much of this VDS will degrade in the soil profile.
5. Evaluate the actual or potential impacts to groundwater of food processing by-product with a high moisture content that is applied to land prior to planting crops.
6. Evaluate the actual or potential impacts to groundwater caused by on-site storage of food processing by-products during rain events.
7. Develop proper controls, management measures, and prohibitions given site and waste characteristics to ensure



storage of food processing by-products is done in a manner that is protective of groundwater quality.

8. Identify site and by-product characteristics and conditions that would prohibit the application of food processing by-products to land.
9. Establish requirements that prohibit the discharge of liquid wastes to land under the county's Program.
10. Recommend methods to minimize food processing by-products and associated problematic characteristics, as well as decision making guidelines for selecting the best alternative management options available for managing food processing by-products.

Good management practices must be followed to ensure that a nuisance is not created and that there are adequate protections of both surface and groundwater as well as soil quality. The other purpose is to provide field operators of land application a "how-to" or "step-by-step" manual for land application of food processing by-products.

The major components of this BMP Manual include a field manual for operators describing decision making guidelines for management options and the "how-to" of properly land applying food processing by-products. The "how-to" manual for field operation includes but is not limited to the following:

1. Background information on the food processing by-products program
2. Benefits of the re-use of food processing by-products
3. Methods to minimize challenges associated with food processing by-products
4. Potential alternative management options for food processing by-products
5. Permitting processes
6. Selecting land application sites
7. Site preparation and pre-application soil sampling
8. Site characteristics of land application site (such as soil profile, depth to groundwater and condition of soil)
9. Sampling and analyzing food processing by-products
10. Maximum concentrations and loading rates
11. Transportation of by-products
12. Methods of application of food processing by-products
13. Application rates
14. Crop selection
15. Field rotation
16. Site monitoring and inspection
17. Record keeping
18. Odor control
19. Storage considerations
20. Program performance review



## Criteria for By-products Land Application



*By-products are unloaded on fallow dry soil.*

Interested parties should consult the *Stanislaus County Food Processing By-products Use Program, May 2006* (<http://www.co.stanislaus.ca.us/er/>) to learn about permit processes, fees, performance bonds and insurances, plans of operation, terms and conditions, sampling and testing, site inspections, and vehicle inspections and hauler requirements for land application operations. Some technical information or discussion can be found within this BMP Manual.

This BMP Manual refers to the reuse of food processing by-products only in solid, semi-solid and slurry forms. The following definitions of solid, semi-solid, slurry and liquid materials are used:

- A **solid** is a substance that is stackable, of definite shape and volume, not liquid or gaseous.
- A **semi-solid** is a substance that has intermediate properties, such as rigidity, between solid and liquid.
- A **slurry** is a mixture of finely divided solid and liquid substances such as tomato paste, and exhibits properties much like liquid and more than solid.
- A **liquid** is a substance that exhibits textures and properties very much like water, such as wastewater.

Additional questions about the by-products reuse program within Stanislaus County should be referred to the county's Department of Environmental Resources at 209-525-6700.

- "*By-products*" as used in this manual refers to **solid, semi-solid, or slurry** residues of food processing, including but not limited to culls, peelings, seeds, under or over-ripe fruits, skins, cores, pomace, puree, hulls, shells, pits, stems, leaves, and any substance including soil washed from plant produce.

- The by-product site operations always refer to a pre-plant application, or application of by-products as a *soil amendment on fallow-dry soil* prior to planting.
- The food processing by-products with **pH lower than 3.5 or higher than 12.0 should be pH-neutralized** before land application. Materials with high salt content (e.g., certain processed vegetables), or high sugar content (e.g., certain processed fruits) require adjustment in the application rate to minimize potential negative effects on crop growth and development, as well as to protect environmental quality.
- The use of ‘liquid wastewater’ or ‘rinse water’ collected from food processing facilities is prohibited under the Stanislaus County Program, and therefore outside the scope of this BMP Manual. Operations related to the use of wastewater may refer to *Manual of Good Practice for Land Application of Food Processing/Rinse Water* by California League of Food Processors (CLFP, 2007), or may contact the Regional Board staff for guidance.

## Field Operations Manual

This section of the BMP Manual for food processing by-products reuse is a field guide for site operators, describing decision-making guidelines for management of by-products, and the “how-to” of land-application. Good management practices must be followed to ensure that a nuisance is not created and that there are adequate protections of surface and ground-water, and to protect soil quality.

*By-products are spread over dry soil surface.*



*Nutrient and Irrigation Management* is a major key for an operation to maintain good farming practices, as well as to protect environmental quality. To optimize use of by-products as a soil amendment, site operators must manage the use of by-products as a part of their soil fertility program. Performing periodically a *Crop Nutrient Assessment* is recommended on sites receiving by-products, to ensure that quantities of selected elements of concern are below or equal to amounts removed by crops at harvest.



Site operators shall consult with county agricultural extension specialists or certified crop/soil consultants or universities to ensure the effective use of by-products in their fertilizer and irrigation practices. The following guidelines are intended to give site operators options for good management practices to achieve specific goals when using land-applied by-products.

## 1. Field Selection

Site operators shall select areas receiving by-products that meet all requirements under the Program's permit terms and conditions, and they shall preferably select sites that contain minimal risk to soil, surface water, and groundwater quality. While from an economical standpoint, sites near food processing facilities are ideal to receive by-products, *soil properties* play an important role in biological decomposition processes that control constituents of the soil and by-product mixture. The guidance below provides important technical information that may help in selecting an appropriate area to apply by-products.

### 1.1 Soil texture

- The physical properties of soil are represented by three groups of soil particle sizes: sand (largest size), silt (medium size), and clay (smallest size). Their relative percentage proportions represent *soil texture*, which is an important soil characteristic that primarily governs *infiltration rate*, or the rate of water movement through the soil profile. Sizes of soil particles and names of various soil texture classes, as established by the USDA with the use of *textural triangle*, are shown on **Figure 1** (page 29).
- Characterization of the land application site as **alkaline loamy soil** makes it best suited for land application operations. Application on fields that contain **sandy soils (deep or loamy sand)** or more than 70 percent sand particles is discouraged.
- To determine soil texture, soil samples shall be submitted to a certified analytical laboratory to quantify sand, silt, and clay particle content. Site operators are encouraged to use a 'quick test method' or 'feel method' to preliminary determine soil texture class (**Figure 2**, page 30).

### 1.2 Soil chemical properties

- To determine baseline or natural background concentration of potential sites prior to by-product application, soil samples should be submitted to a certified analytical laboratory. This information is essential as a housekeeping record to determine impacts of by-product applications on soil and on crop nutrient balance.



- At **minimum**, testing for plant nutrients must include nitrate and total nitrogen, available phosphorous (Olsen), potassium, magnesium, calcium and sodium. Saturation paste samples shall be analyzed for soluble salts (electrical conductivity), pH, and buffer pH (lime requirement), cation exchange capacity (CEC), sodium adsorption ratio (SAR), and exchange sodium percentage (ESP). See **Appendix A** for reference and discussion of each parameter.
- Alkaline or basic soils may gain benefit from acidic by-products, and vice versa, because most crops grow well within a pH range of from 5.5 to 8.5. Acidic by-products would lower pH of alkaline soils to a desirable range.
- Site operators shall limit by-product applications to surface soils (0-12" depth) containing CEC lower than 10. Leaching of ions from soils containing CEC > 10 cmolc/kg is slight. The CEC values at pH 7 range are in the order of **clay loams > silt loams > sandy loams > loamy sands**, respectively. This represents an order of preference to the soil types that shall receive by-products.
- Repeat application of by-products over the same piece of land for a second consecutive year shall be limited to the values of CEC, SAR, and ESP of the site and within the proper range of crop nutrient requirement.

### 1.3 Locations of surface water and groundwater

- The goal is to apply by-products on sites in a manner that poses minimal risk to surface and groundwater, and to protect soil quality.
- Minimizing potential risk to surface runoff and/or erosion with increasing slope area. Slope at greater than 12 percent can cause severe effects to cultivated crop lands.
- By-products land application shall be limited to pre-plant application on *fallow-dry soil* with the water table a minimum of five feet deep.
- Site operators shall make field observations of areas with the potential for a high water table. Areas with surge of water table at less than five feet in depth shall be monitored frequently to ensure protection of groundwater quality. In some cases, subsurface drainage systems may be required.

## 2. Field Preparation

- Site operators shall coordinate with food processing facilities, truck driver, tractor driver, and other parties prior to by-product delivery.
- Sites receiving by-products shall be maintained for minimum setbacks at least 300 feet away from public properties (street, residence area, and river), and at least 100 feet away from other non-owned agricultural property.



A strip of by-products for each truck-load.

- Site operators should refrain from applying by-products to relatively wet soil (e.g., shortly after irrigation or significant rainfall). For one, the infiltration rate into wet soils is lower than in dry soils. For another, moisture would accelerate the biological decomposition rate of the soil-byproduct mix.
- Areas receiving by-products shall be *fallow-dry soil* and tilled to reduce large soil clods in order to increase evenness after the application. Keeping tractor traffic to a minimum helps to reduce soil compaction.

- Transferring by-products from the truck to the field shall be done in a proper manner. By-products shall be spread shortly after application to minimize accumulation of by-products in a manner that may cause nuisance conditions or leaching.
- Uniform application of by-products on soil surface will increase air circulation to maintain aerobic conditions during drying and decomposition processes.

## 3. By-products

- Site operators shall keep a five-year record of analytical tests performed on by-product chemical characteristics.
- Maintaining historical records of by-product constituents is very important to determine potential plant nutrient contributions from by-products, which shall be accounted for as part of the total fertilizer application program during the growing season for crops.





By-products are sampled for chemical analysis.

- Stanislaus County requires analytical tests for by-product constituents. Site operators shall follow standard protocols from the Program. Samples of by-products shall cover each type/source of by-products land-applied. At **minimum**, by-products shall be tested for moisture content, EC, pH, total N, P, K, Mg, Ca, Na and Cl.

- Composite samples of by-products shall be collected prior to land application. Container labeling for each plastic bottle shall include load number, field/site number, type of by-product, and date. Samples shall be kept in a cool ice chest at all times before

transporting them to the analytical laboratory. This helps to minimize decomposition of the samples.

- Applications of semi-liquid or slurry by-products shall be limited to the rate that can cause saturated soil conditions. This helps to minimize anaerobic decomposition processes causing nuisance as well as leaching.
- Currently, no maximum loading rate has been established. By-product application shall therefore be limited by salt loading rates, agronomic loading rates, or a rate that prevents soil saturation from occurring.
- Site operators shall consult with county agricultural extension specialists or certified crop/soil consultants or universities to determine how much *fertilizer replacement value* came from the by-products. This can help the grower to avoid over-fertilizing their crops, thereby maintaining optimum crop production.
- Calculations of applied by-product per acre dry weight, and calculations of nutrient contribution from by-products, are shown below.

#### A. Calculation of Applied By-product per Acre

Formula (1) can be used to calculate dry weight of by-product applied per acre. Formula (2) is the same as (1) but with values



from the 2006 report submitted to Stanislaus County. These by-products contained 91.69 percent moisture content.

$$(1) \text{ dry lbs/acre} = \text{wet tons} \cdot 2,000 \text{ lbs/ton} \cdot (100 - \text{moisture}) \\ \text{lbs/100 lbs} \div \text{acres}$$

$$(2) 49,335 \text{ wet tons} \cdot 2,000 \text{ lbs/ton} \cdot (100 - 91.69) \text{ lbs/100 lbs} \\ \text{water} \div 420 \text{ acres} = \underline{19,500 \text{ lbs/acre}}$$

*B. Calculation of Element/ Nutrient Contribution from By-product per Acre*

Any other by-product constituent applied per acre can be calculated using formula (3). The ratio mg/kg can be expressed as lbs/106 lbs. The zinc concentration in these by-products was 42.06 ppm.

$$(3) \text{ lbs Zn/acre} = \text{lbs dry by-product/acre} \cdot \text{lbs Zn/106 lbs dry by-product}$$

$$(4) 19,500 \text{ lbs dry by-product/acre} \cdot 42.06 \text{ lbs Zn/106 lbs dry by-product} = \underline{0.83 \text{ lbs Zn/acre}}$$

A typical agronomic application rate for zinc fertilizer is 10 pounds of zinc fertilizer per acre. For this case, if zinc fertilizer is needed, only nine pounds of zinc application per acre is necessary.

#### 4. Nutrient and Irrigation Management

Site operators shall consult with county agricultural extension specialists or certified crop/soil consultants or universities prior



*Texture of fruit and vegetable by-products.*



to establishing their farm's fertilizer and irrigation scheduling program. Other important information in regards to farming practices toward sustainable agriculture can be found under University of California, Sustainable Agriculture

Research and Education Program (<http://www.sarep.ucdavis.edu/>). See **Appendix A** for additional references and discussion on this topic.

- It may be necessary to apply similar types of by-products on adjacent areas with similar soil properties to minimize variability of by-product constituents on soil properties. This will ensure that further fertilizer needs in these areas can be effectively met.
- To determine *soil nutrient availability* prior to by-product and/or fertilizer application, *pre-planting soil* tests are recommended.
- To determine the nutrient contribution from *irrigation water*; testing irrigation water at various times of the year is recommended.
- To determine *plant nutritional status* and maintain productive crops that will reach optimum yield, mid-season plant tissue sampling for any element of concern is recommended. It is essential to perform periodic site monitoring for plant symptoms that may suggest the need for testing for any specific elemental-deficiency or toxicity (metal or salinity).



A few days after land-applied by-products.

- There are lists of protocols (timing, crop physiology, plant organ) in regard to tests for crop nutritional status. See *Western Fertilizer Handbook* (California Plant Health Association, 2002) for detailed information.
- *Irrigation Management* is critical to properly maintain an amount of water and nutrients within the plant root zone, to meet crop needs during the growing season. *Over-watering* not only can cause leaching and runoff, but also results in unnecessary costs from fertilizer loss and electricity needed to pump water.
- Effective irrigation management is crucial for sodic or saline-sodic soils ( $SAR > 13$  and  $ESP > 15$ ) because maintaining low salt levels within the plant root zone is essential for crop health.
- Knowing the *soil water holding capacity* is essential to determine how much water is held by soil. Relationships of soil texture and percent water to levels of *available water* and *unavailable water* at *field capacity* or *permanent wilting point* are shown on **Figure 3** (page 31). Detailed information



on soil water holding capacity and irrigation management is posted on <http://www.cmg.colostate.edu/gardennotes/261.pdf>.

- Prolonged saturated soil conditions can diminish plant health, create anaerobic conditions that prohibit the decomposition process, and induce losses of nitrogen through leaching and denitrification.

## 5. Harvesting Crops

- Crop nutrient assessment on crop nutrient removal rates shall be established as a part of the crop nutrient management plan on sites receiving by-products.



Corn field with previously received by-products.

- To determine an *annual nutrient budget*, it is essential to obtain the plant tissue samples from all cuttings or harvests that occur during a 12-month period. Several sources of nutrient inputs are from fertilizer, irrigation, soil amendment, and cover crop. Outputs of nutrients that can be easily accounted for are biomass from all harvested crops/materials. However, nutrient losses from other pathways include leaching, runoff, volatilization, and denitrification.
- Collect whole plant tissue samples (similar to the cutting/clipping for commercial harvest) at 10 to 20 sites per field based on geostatistical-based standards of practice. Mix samples taken from the same site to form a single composite sample. Alternatively, tissue samples may be collected from hay bales using hay sampler in the same manner as representative samples. This composite sample should have a minimum weight of 1 lb. Submit each composite sample for a total of three composite samples per field to a certified laboratory for analysis.
- At **minimum**, plant tissue samples shall be tested for total N, P, K, Mg, Ca, Na and Cl. Further tests for B, Cu, and Zn concentrations in plant tissue will be needed when plant toxicity symptoms are observed on the site.

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## **Appendices**

**Appendix A.** Food Processing By-product Reference Sheet

**Appendix B.** Glossary of Terms



## Appendix A: Food Processing By-products Reference Sheet

### 1. By-products Properties

The *Agricultural Waste Management Field Handbook, Part 651* of the NRCS National Engineering Handbook Series categorized wastes based on their moisture content as follows (Barth et al., 1999):

- **Solid waste** contains less than 75 percent moisture content or exhibits textures of solid that can be stacked and hold a definite angle of repose.
- **Semi-liquid or Slurry waste** contains between 75 and 95 percent moisture content or 5 to 25 percent solids.
- **Liquid waste** contains more than 95 percent moisture content or exhibits textures very much like water.

Although some fruits and vegetables contain significantly high moisture content and/or high soluble solids, their appearances are solid-like textures and they are stackable. For instance, romaine lettuce collected from Santa Cruz, California in 2004 contained an average 94.9 percent water content ( $\pm 0.82$  percent,  $n=48$ ) (Pasakdee, unpublished data), and processing tomatoes collected from San Joaquin and Contra Costa counties in 2002 contained as high as 95 percent moisture content and 5 percent soluble solids (Mullen et al., 2002). These results pose a critical question as to whether by-products generated from these types of raw materials are liquid waste.

### 2. By-products Characteristics

The composition of by-products is often highly variable even when composed of similar raw materials. A number of factors, such as the differences in crop variety, farming location (soil type and/or land history), and fertility practice (soil management) can each significantly influence concentrations of various elemental components in fresh fruits and vegetables. For instance, peach juices obtained from three cultivars showed nutrient compositions distinctive from one another (Versari et al., 2002). Particularly, various chemicals used during canning processes such as peeling and disinfection can ultimately be collected in the waste stream, mixed with discarded raw materials, and become by-product constituents.

The elemental composition of by-products consists of macro- and micronutrients and trace elements similar to agricultural residues collected from various farmlands. However, enrichment of some elements can occur during processing, and they can accumulate in by-products. Organic acid content of fruit induces lower pH in by-products, while salt can accumulate from concentrated fruit and some chemicals utilized during the peeling or washing processes. These chemicals include salts from sodium- and/or potassium-based materials.

The majority of by-product applications under the Program are from residual vegetables and fruits, especially from those crops locally grown in the Central Valley of California (apricots, peaches, pears, tomatoes or olives). By-products collected in 2006 under the Program were tested for various chemical properties. The summary of their constituents is shown on **Table 1** (page 33).

### 3. Selected Important Topics

*Beneficial Use:* Land application of by-products utilizes soil to recycle various elements back to the earth. Some of these elements are essential plant nutrients that growers can use as a soil amendment, supplement or substitution in their fertilizer programs. The majority of by-product constituents are organic forms of various elements. This may help to maintain levels of organic matter in soils receiving by-products as part of the fertility program.

*Nutrient and Irrigation Management* is key to the effective use of by-products. Field operators may seek consultation from California State University specialists, UC Cooperative Extension specialists, certified crop advisors, agronomists, or soil scientists to properly manage by-product inputs as part of a fertilizer program to maintain farm economic feasibility and to minimize potential impacts on soil and water quality.

From a *Plant Nutrition* standpoint, by-products may contain a number of macro- and micronutrients and other trace elements. Macronutrient [nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S)] refers to elements which plants require in large concentrations, while micronutrients or trace nutrients [iron (Fe), copper (Cu), manganese (Mn), zinc (Zn), boron (B), molybdenum (Mo), and chlorine (Cl)] are those elements that plants need in relatively small concentration to complete their life cycles and maintain proper growth and development. Additional



mineral nutrient elements, also called trace elements, are assimilated by plants but are not necessarily essential plant nutrients. Some are essential for animal nutrition. These include sodium (Na), cobalt (Co), vanadium (Va), nickel (Ni), selenium (Se), aluminum (Al), and silicon (Si). Trace nutrient concentration margins between beneficial and toxic can occur in a very narrow concentration range. On the whole, all of these elements are constituents of parent materials of the Earth's crust which has weathered over time to form the soils.

*Soil Organic Matter (SOM)* is a vital soil component and a key indicator of soil health. Maintaining soil organic matter is considered to be a major factor in sustaining long-term soil fertility (Craswell and Lefroy, 2001). Adding an organic form of nitrogen was reported to maintain soil organic matter level better than adding only synthetic nitrogen fertilizer (Wander et al., 1994). Concentrations of total soil C and soil N significantly increased up to three and four times, respectively, compared to control soil (no biosolids added) after biosolids were continuously applied to an apricot orchard as a substitution to commercial fertilizer for six years (Banuelos et al., in press). Continuous application of by-products on farmlands can benefit soil by sustaining levels of SOM. This is crucial especially in arid or semi-arid areas where soils often contain low levels of SOM. The followings describe how SOM benefits the soil (Chaney et al., 1992):

- Increases biological activity, i.e., supplying nutrients, energy, and habitat for beneficial soil organisms
- Acts as a nutrient reservoir because decomposition of SOM releases nutrients for plant uptake
- Provides for retention of nutrients in available form because humus molecules have many negative charges; therefore, they can interact with positively charged ions such as  $K^+$ ,  $Ca^{2+}$ ,  $Mg^{2+}$ , and  $H^+$ , and hold them temporarily in a form that is readily available to plants
- SOM increases aggregate formation by several mechanisms resulting in a desirable, crumb-like structure
- SOM increases soil porosity, which improves physical structure and can alter water retention properties and water infiltration rates

*Soil pH* is an essential soil chemical property that controls the availability of all elements present in soils. Most crop plants grow

well between pH 5.5 and 8.5 (Gardiner and Miller, 2004); however, crops often grow better at their preferred soil pH because availability of some elements promotes their physiological development. Soil pH typically ranges from pH ~4 (extremely acidic) to about pH 10 (very strong alkaline/basic). It is important to note that the pH is a logarithmic scale, so soil at pH 5 has 100 times more hydrogen ions ( $H^+$ ) in solution than soil at pH 7. Strongly acidic soils (pH <5.5) are undesirable because Al and Mn can reach toxic levels and suppress microbial activity. Soil pH >8.5 or strongly alkaline soils contain lower micronutrient availability (except B, Cl, and Mo), and Fe, Zn, Mn, and P may become deficient. Adding some types of soil amendments or fertilizers can temporarily alter soil pH so desirable plant nutrients will become available and benefit crop growth and development. The trend of availability of various plant nutrients under different soil pH is shown on **Figure 4** (page 32). Farmers adjust their soil pH to a desirable range by 'liming' to increase pH of acidic soils, or they may lower pH of alkaline soils by adding sulfur, iron sulfate, aluminum sulfate, urea, urea phosphate, ammonium nitrate, ammonium phosphate, ammonium sulfate, or monopotassium phosphate (Gardiner and Miller, 2004). Addition of acidic by-products would have the same desirable effects.

The capacity of soil to retain soil pH or resist soil pH change when large amount of materials such as by-products are applied is called *buffering capacity*. Buffering capacity increases as the cation exchange capacity (CEC) increases (Gardiner and Miller, 2004). To exhibit buffering, the soil must remove  $H^+$  of added acidic materials or neutralize the hydroxyl ions ( $OH^-$ ) of added basic materials. This occurs by cation exchange and neutralization. Buffering action is effective in controlling soluble concentrations of  $H^+$ ,  $Al^{3+}$ ,  $Ca^{2+}$ ,  $Mg^{2+}$ ,  $K^+$  and  $Na^+$ . Soils having high buffering capacity are those containing high humus and/or montmorillonite or vermiculite clays. Clay soils have higher CEC values than sandy soils. Calcareous soils also have high buffering capacities, as soil pH will remain at about 8.4 until calcium carbonate is exhausted.

By-products containing low pH, medium to high total dissolved solids (TDS), and salinity (electrical conductivity or EC) may impair soil and water quality after application, especially when the by-products are not properly disposed of and/or managed based on critical limits of elements of concern (e.g., salinity or hydraulic loading factors) under current farming conditions. However, a well-managed land-applied by-product operation can provide a variety of essential plant nutrients as a substitute for commercial fertilizer, as



well as an organic source of soil amendment. Farmers can benefit from utilizing by-products on farmlands when they can reduce their need to buy fertilizer because by-product fertilizer-replacement value is feasible. Agricultural use of by-products can be the most economical way to manage an increasing amount of by-product generated by a growing food processing industry. Local reuse of by-products is recommended because the costs of transportation tend to be high, with fuel prices continuously rising.

Special attention should be given to the levels of *soil salinity or Electrical Conductivity (EC)*, *Cation Exchange Capacity (CEC)*, *Sodium Adsorption Ratio (SAR)*, and *Exchange Sodium Percentage (ESP)*. Management of salt-affected soils is crucial for a productive farming system because levels of soil salinity influence plant growth and development (<http://anrcatalog.ucdavis.edu/pdf/8066.pdf>). Plants show relative tolerance to salty soils at various levels ranging from sensitive to moderately sensitive, moderately tolerant, and tolerant. Overall, crop yield reduction is somewhat anticipated for farming under salted-affected soils.

“*Cation Exchange Capacity, or CEC*” refers to the buffering capacity of soils to retain or resist soil pH change when by-products are applied. Buffering action is effective in controlling soluble concentrations of aluminum, calcium, hydrogen, magnesium, potassium, and sodium ions. Soils having high buffering capacity are those containing high humus and/or montmorillonite or vermiculite clays. Calcareous soils also have high buffering capacities, as soil pH will remain at about 8.4 until calcium carbonate is exhausted. Leaching of ions from soils containing  $CEC > 10$  cmolc/kg is small. In summary, CEC values at pH 7 range in the order of clay loams > silt loams > sandy loams > loamy sands (Brady and Weil, 1999).

“*Sodium Adsorption Ratio or SAR*” refers to the proportion of sodium ions compared to the concentration of calcium plus magnesium. Soils containing SAR value higher than 15 indicate excessive sodium in the soil, causing the soil to be hard and cloddy when dry, to crust badly, and to drain poorly.

“*Exchangeable sodium percentage or ESP*” is the method of estimating the sodium hazard. Soils with ESP value higher than 15 (sodic soil) indicate excessive sodium in the soil, which causes the soil to be hard and cloddy when dry, to crust badly, and to drain poorly.

#### 4. Irrigation Management

Effective irrigation management becomes a key factor in successful farming in arid or semi-arid areas. Improper irrigation management not only wastes available water resources, but also causes plant nutrient losses by leaching, runoff, or denitrification of nitrogen and poses detrimental impacts to soil and groundwater quality. Management of salt-affected soils requires maintenance of appropriate levels of soluble salts within the plant root zone for proper crop growth and development. This requires knowledge of soil-water-plant relations.

**The California Irrigation Management Information System (CIMIS)**, a program of the Office of Water Use Efficiency (OWUE), California Department of Water Resources (DWR), provides information to the public regarding irrigation and water sciences. Site operators shall consult the CIMIS website (<http://wwwcimis.water.ca.gov/cimis/info.jsp>) for further information to improve their crop water use efficiency. Lists below are samples of useful information from CIMIS website:

- *Irrigation overview*  
(<http://wwwcimis.water.ca.gov/cimis/infoIrrOverview.jsp>)
- *Water budget*  
(<http://wwwcimis.water.ca.gov/cimis/infoIrrBudget.jsp>)
- *Irrigation scheduling*  
(<http://wwwcimis.water.ca.gov/cimis/infoIrrSchedule.jsp>)
- *Mobile lab*  
(<http://wwwcimis.water.ca.gov/cimis/infoIrrMobileLab.jsp>)

Proper soil salinity management in areas containing salt-affected soils is critical to optimize crop productivity. Follow this link ([ftp://ftp.fao.org/agl/agll/docs/salinity\\_brochure\\_eng.pdf](ftp://ftp.fao.org/agl/agll/docs/salinity_brochure_eng.pdf)) for an overview of information about '*Management of Irrigation-Induced Salt-Affected Soils*' published by the Food and Agriculture Organization (FAO) of the United Nations.

Movement of water downward through the soil surface is called *infiltration*. The process of *percolation* occurs soon after water flows downward into saturated or nearly saturated soil. In general, the rate of water movement or *soil permeability* is greater for coarse-textured soils than fine-textured soils, or in an order of *sandy soils* > *loamy soils* > *fine-textured soils*.



**Figure 3** (Page 31) shows the relationships of soil texture and soil water (by volume). Soil texture significantly influences the quantity of 'Available water' for plant uptake and influences overall crop production.

## 5. Sampling and Testing Soil Protocol

It is crucial to establish natural background concentrations of soil constituents from sites before initiating by-product application. This will assist site operators in record keeping to assess long-term effects of by-product applications on the farm.

Samples shall be drawn from one-foot intervals to the rooting depth. Alternative sampling intervals may be employed with technical justification. Each field scheduled to receive by-products in any given year should be sampled in late spring or early summer prior to by-products application. Obtaining representative samples is critical to getting valid and interpretable analytical results. One method to ensure that representative samples are collected is to conduct the soil sampling as follows: Collect soil samples from depth intervals of 0-12", 12-24", and 24-36" at 10 to 20 sites per field based on geostatistical-based standards of practice. Mix samples taken from the same depth intervals to form a single composite sample for that depth interval. This composite sample should have a minimum weight of one pound. Submit each composite sample to a certified laboratory for analysis, for a total of three composite samples per field representing the three depths.

Soil samples from fields to which by-products are applied shall be analyzed for cation exchange capacity, plant nutrients, salinity, and sodicity. *At minimum, testing for plant nutrients must include total nitrogen, available phosphorous (Olsen), potassium, magnesium, calcium and sodium. Saturation paste samples shall be analyzed for soluble salts (electrical conductivity), pH, and buffer pH (lime requirement), cation exchange capacity (CEC), sodium adsorption ratio (SAR), and exchange sodium percentage (ESP).*

## 6. Sampling and Testing By-products Protocol

It is essential to test by-products for major plant nutrients, i.e., N, P, K, Ca, Mg, and S because these concentrations can be used for their fertilizer-replacement value. Farms may require lower fertilization rates when utilizing by-products as a soil amendment. Other elements, especially B, Na, and Cl, may diminish plant vigor if the by-product application rates cause rising levels of these concentrations within the soil's plant root zone.

By-products shall be sampled following land application but in a manner so that no contamination with soil occurs. The total number of tested by-product samples shall be at least 20 samples per growing season to represent general characteristics and to make a good statistical comparison among various parameters. Although some types of by-products (e.g., syrup, mud, olives) may account for a small percentage of the entire amount applied, it is necessary to collect at least three samples per growing season to obtain a good test pool of these by-products.

Repeat application of by-products on the same land for a second consecutive year shall be limited by the values of CEC, SAR, and ESP of the site and shall be otherwise within the proper range of crop nutrient requirements. *At minimum, by-products shall be tested for moisture content, soluble salts (electrical conductivity), pH, total N, P, K, Mg, Ca, Na and Cl.*

## 7. By-products Loading Rate

Site operators shall take an integrated approach when determining a proper by-product application rate. For example, application of by-products at a rate that causes saturated soil conditions shall be prohibited, because anaerobic soil conditions contribute to odors and nuisance, cause incomplete chemical reactions during decomposition of soil by-product mixtures, and increase mobility of some metal compounds (e.g., iron, manganese) that may cause phytotoxicity.

Application rates of by-products should be based on the *agronomic rate* and *salinity loading rate* to meet crop nutrient requirements. Due to the high moisture content of these by-products (often >90 percent) and the current low application rate (no duplicate application under the same piece of land in one year), the current loading rate of all tested parameters based on ~10 tons by-products/acre (dry weight basis) is considerably small. Comparison of the concentrations of As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, and Zn (collected from by-products in Stanislaus County from 2003 to 2006) to the pollutant limits established for biosolids (which are often used as a standard for land application of organic waste) show that the concentrations are below detectable levels (BDL), or well below the maximum or monthly average ceilings given in Title 40 of the Code of Federal Regulations (40 CFR), Part 503 (EPA, 1994). Further studies of maximum loading rate for these types of by-products are recommended.



Special attention shall be made in regards to the use of 'agronomic rate' to determine by-product loading limits, because these types of by-products contain low amounts of nitrogen. In 2006, sites receiving by-products in Stanislaus County estimated ~40 lbs N/acre applied at the current by-product loading rate. To provide a higher rate of nitrogen, site operators may need to raise the rate of by-product application. However, an application rate that may induce saturated soil conditions and/or increase levels of salt and/or trace elements within the plant rootzone that may cause phytotoxicity shall be prohibited.

### 8. Field and Crop Observation

Site operators shall periodically observe the field and crop after receiving by-products. Maintaining good records of site characteristics will assist in determining the sustainable land application of by-products. For example, repeated application of by-products shall be limited in areas of high water table or in areas of sandy soil texture or slope that may contribute to surface runoff.

Field observations of *crop health* and any symptoms related to *phytotoxicity* are necessary. Site operators shall consult with county extension specialists or crop/soil consultants or universities for information regarding symptoms of crop injury from salinity or toxicity of some trace elements or other contaminants.

### 9. Nutrient, Salt, and Trace Element Budget

Crop nutrient removal rates shall be established as part of the crop nutrient management plan on sites receiving by-products. To determine an annual nutrient budget, it is essential to obtain the plant tissue samples from all cuttings or harvests that occur during a 12-month period. Several sources of nutrient inputs are from fertilizer, irrigation, soil amendment, and cover crop. Outputs of nutrients that can be easily accounted for are biomass from all harvested crops/materials. However, nutrient losses from other pathways include leaching, runoff, volatilization, and denitrification

Collect whole plant tissue samples (similar to the first cutting/clipping for commercial harvest) at 10 to 20 sites per field based on geostatistical-based standards of practice. Mix samples taken from the same site to form a single composite sample. Alternatively, tissue samples may be collected from hay bales using a hay sampler in the same manner to receive representative samples. This composite sample should have a minimum weight of 1 lb. Submit each

composite sample for a total of three composite samples per field to a certified laboratory for analysis.

Trace elements are removed or depleted from soils through surface runoff, crop harvest, leaching and volatilization. Quantification of trace element cycling by these means is site-specific, and various factors influence the rate of removal. Such factors include differences in soil texture, parent materials, crop types, precipitation, and agricultural practices affecting the physical, chemical, and biological processes of these element concentrations over time. Estimated levels of inputs and outputs of trace elements for agricultural soils in California and the amount removed by an alfalfa crop based on an annual harvest of dry biomass are listed in **Table 2** (Page 34).

At **minimum**, plant tissue samples shall be tested for total N, P, K, Mg, Ca, Na and Cl. Further tests for B, Cu, and Zn concentrations in plant tissues will be needed when plant toxicity symptoms are observed on the site.



## Appendix B: Glossary of Terms

*“Agronomic rate”* under the Program means the application rate which will provide the amount of nitrogen or other critical nutrients required for optimum crop growth and development, and that will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.

*“By-products”* under the Program means food processing by-products in forms of solid, semi-solid, or slurry materials (residues of fruits and/or vegetables) with pH lower than 3.5 or higher than 12.0 (by-products outside of these ranges should be pH neutralized before land application). For materials with high salt content (e.g., certain processed vegetables) or high sugar content (e.g., certain processed fruits): application rate of these types of by-products must be adjusted to minimize potential negative effects on crop growth and development.

*“Cation Exchange Capacity or CEC”* refers to the buffering capacity of soils to retain or resist soil pH change when by-products are applied. Buffering action is effective in controlling soluble concentrations of aluminum, calcium, hydrogen, magnesium, potassium, and sodium ions. Clay soils have higher CEC values than sandy soils.

*“Crop nutrient requirement”* means the amount of plant nutrients or essential elements necessary for promoting crop growth and development. This includes macronutrients, micronutrients, and trace elements.

*“Exchangeable sodium percentage or ESP”* is the method of estimating the sodium hazard. Soils with ESP value higher than 15 indicate excess sodium and tend to be hard and cloddy when dry, to crust badly, and to drain poorly.

*“Fallow-dry soil”* is a condition of soil after tilling without sowing it for a season.

*“Good management practice”* means the use of by-products on farmlands under regular monitoring and testing to protect soil and groundwater quality.

*“Natural background concentration”* means the concentration of chemical, physical, or biological substances normally present in the environment and not influenced by regional or localized human activities.

Background concentrations of selected trace elements in California soils are presented in **Table 3**, page 35. Metals at concentrations naturally occurring in bedrock, sediments and soils due solely to the geologic processes that formed the materials are natural background. In addition, low concentrations of other persistent substances due solely to the global use or formation of these substances are natural background.

*“Salinity loading rate”* under the Program means the by-product application rate that will provide the amount of overall salt-based elements (calcium, magnesium, potassium, and sodium) for optimum crop growth and development, and that will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.

*“Sodium Adsorption Ratio, or SAR”* refers to the proportion of sodium ions compared to the concentration of calcium plus magnesium. An SAR value higher than 15 indicates excess sodium in the soil and causes soil to be hard and cloddy when dry, to crust badly, and to drain poorly.

*“Soil amendment”* under the Program means land-applied by-products that are intended to improve the physical, chemical, or biological characteristics of soil for optimum crop growth and development, and that will not result in the violation of applicable standards or requirements for the protection of soil and groundwater.



# Figures

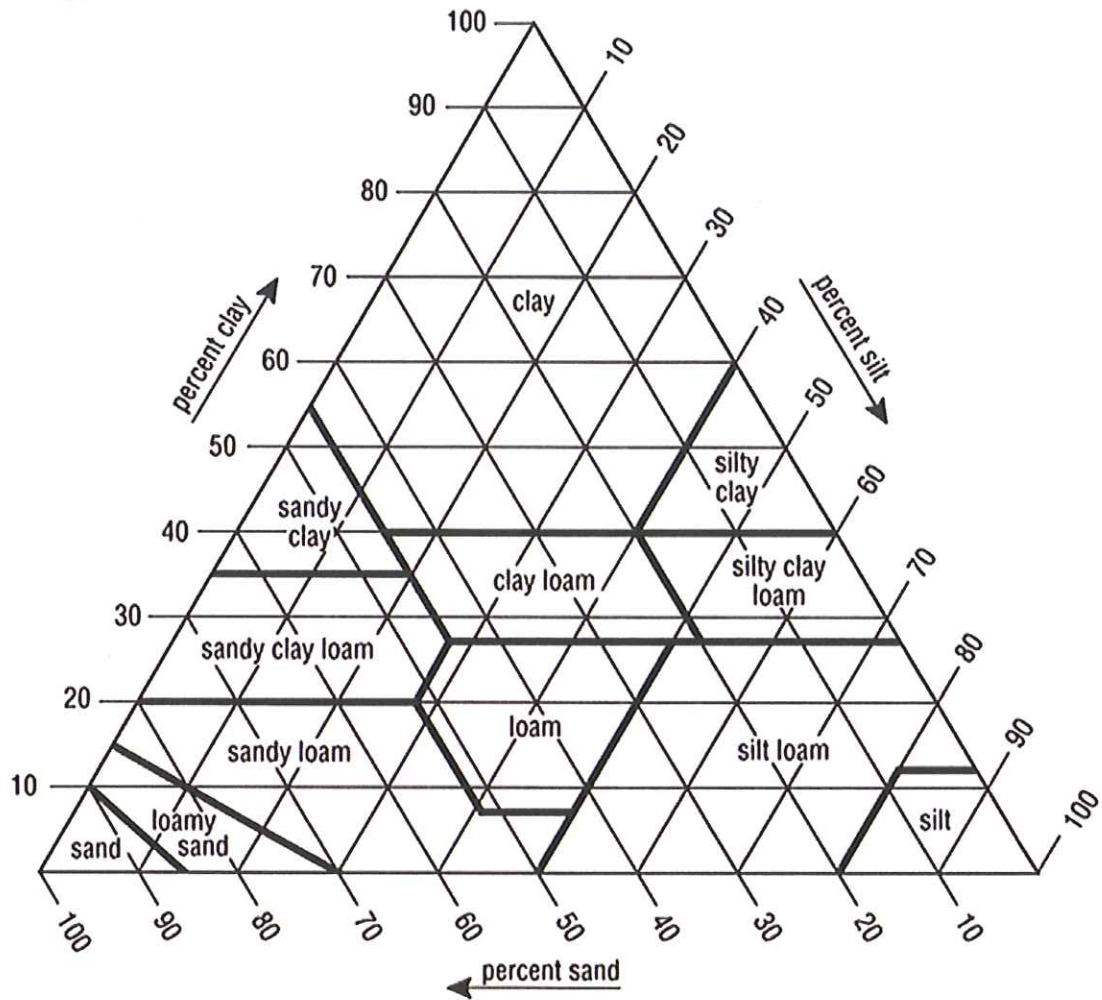


Chart showing the percentages of clay, silt, and sand in the basic textural classes.

**Figure 1.** Soil texture triangle

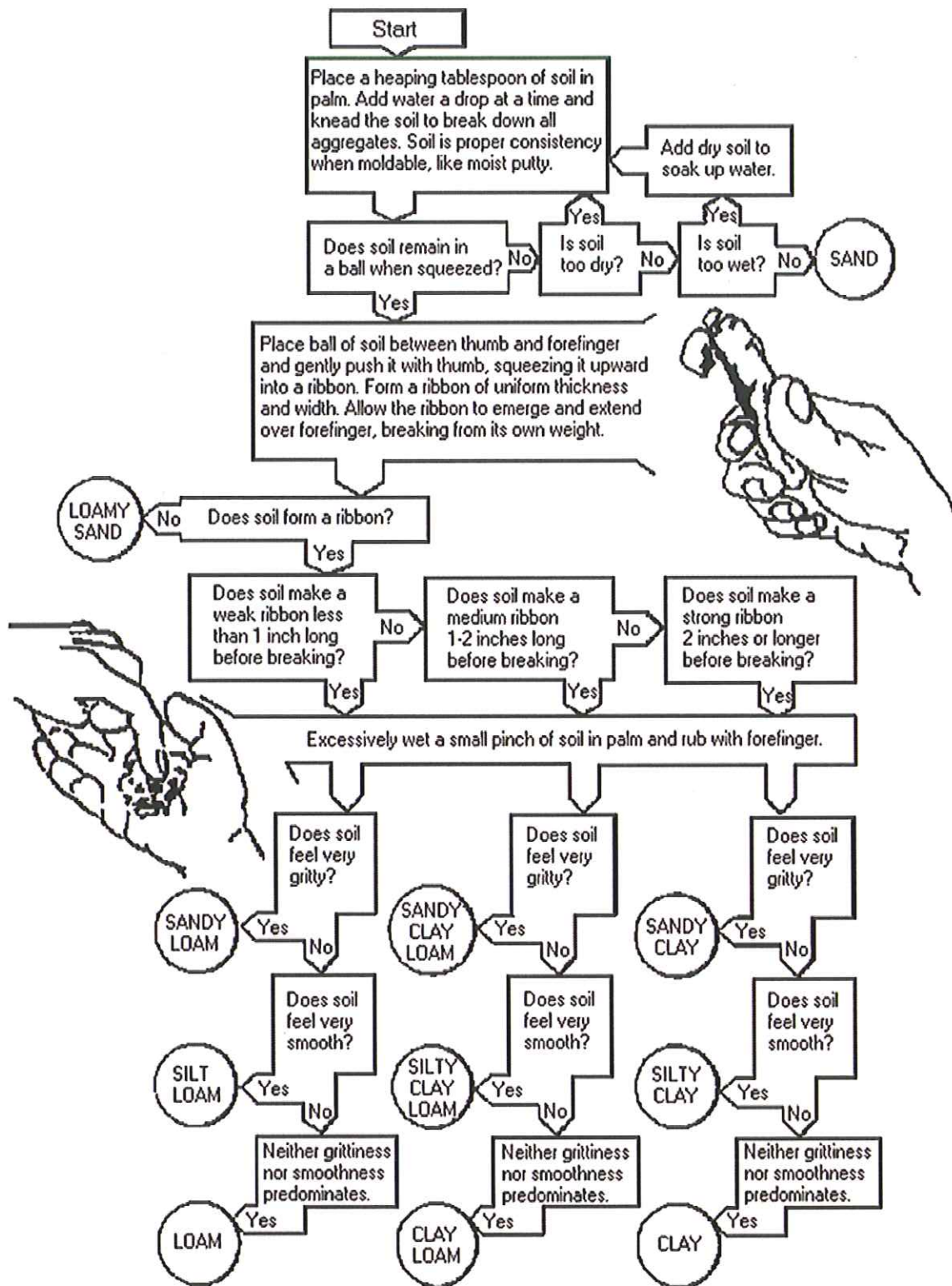
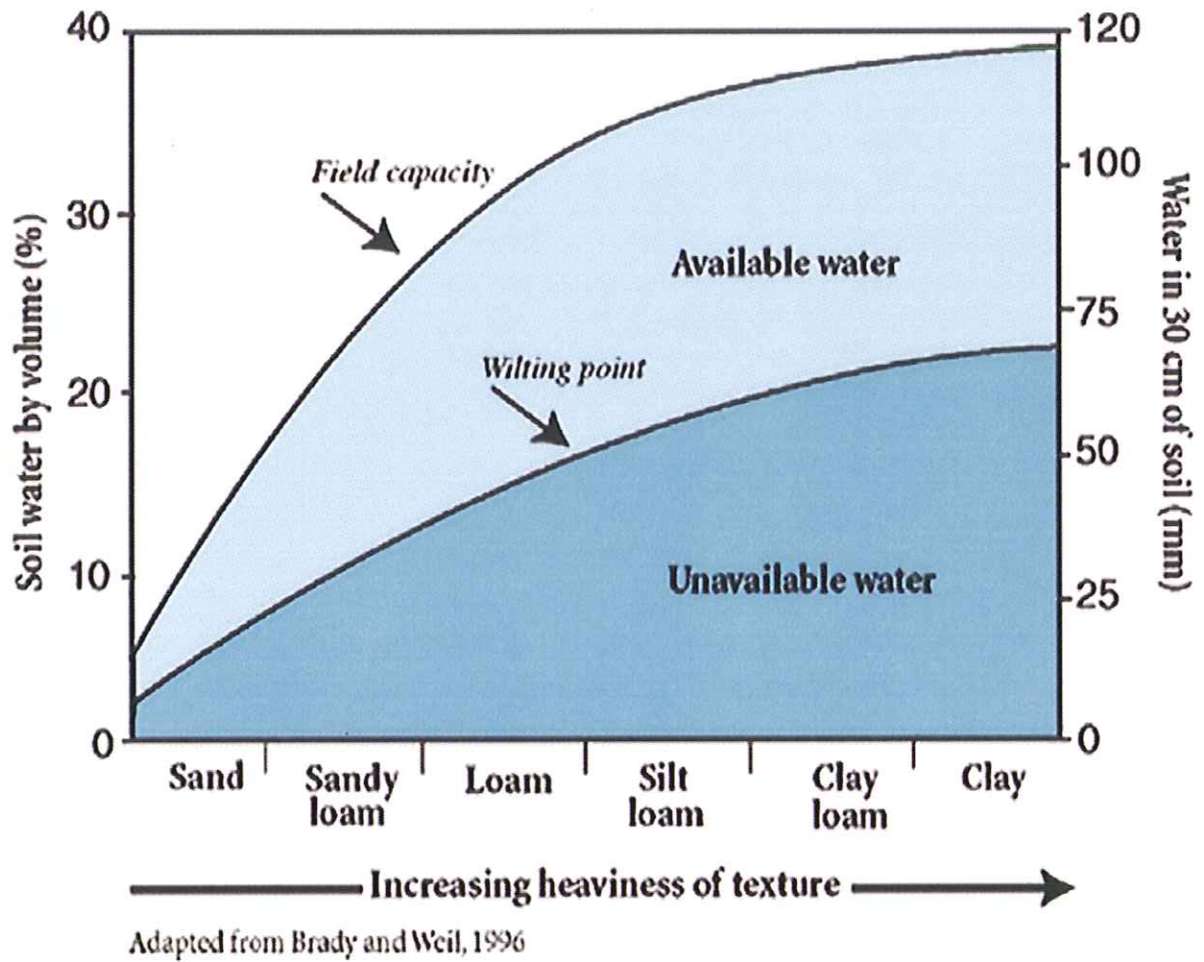
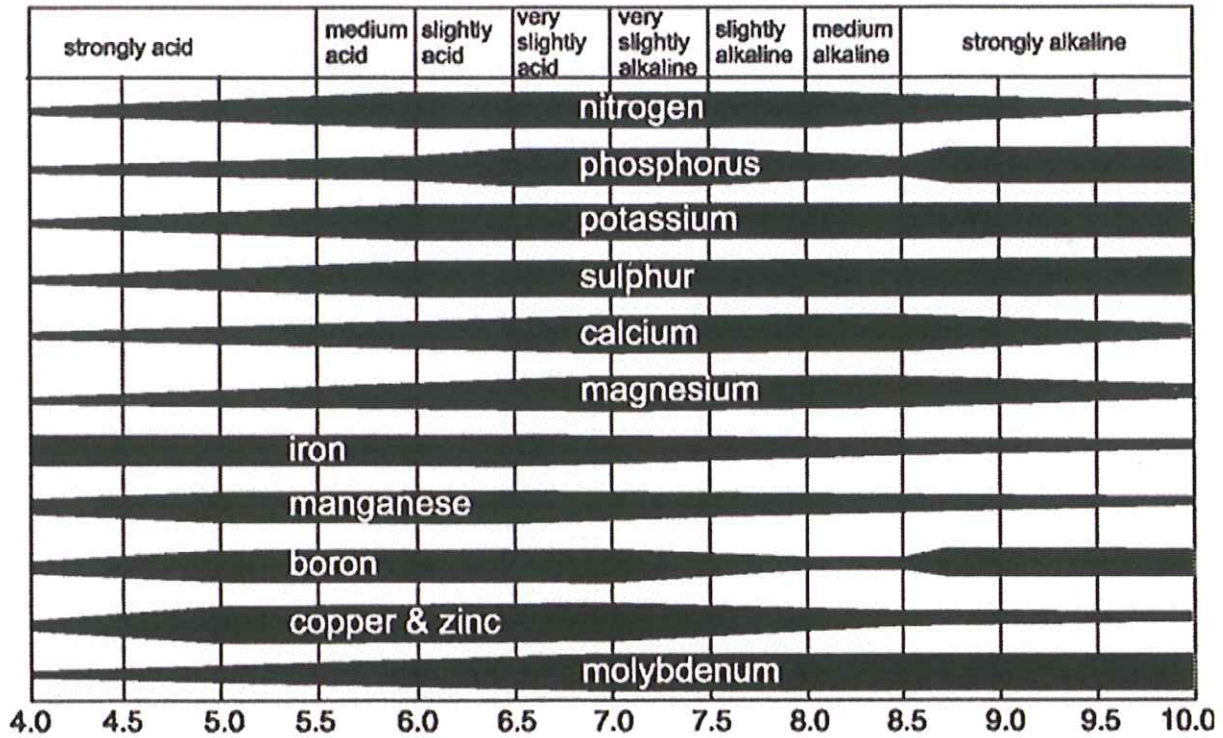


Figure 2. Determining soil texture by the feel method





**Figure 3.** Relationships of soil texture classes and soil water by volume in 30 cm of soil depth



**Figure 4.** Availability of various plant nutrients according to soil pH range from pH 4.0 to 10.0. The width of the dark areas for each element represents comparative amounts available in the soil at various pH levels.



## Tables

**Table 1.** Various chemical properties of food processing by-products collected in Stanislaus County in 2006<sup>a</sup>.

Type	Dry Weight	Organic Carbon	pH	Total N	P	K	S	Mg	Ca	Na	Cl	Cu	Zn	Ni <sup>b</sup>
	-----%			-----%								-----ppm-----		
Apricot	10.3 (3.4) <sup>c</sup>	39.8 (14.8)	4.3 (0.2)	2.1 (1.0)	0.2 (0.1)	1.8 (0.6)	0.3 (0.2)	0.2 (0.1)	0.5 (0.2)	0.2 (0.2)	0.1 (0.0)	3.0 (2.0)	33.0 (15.8)	1.6 (0.8)
Peach	7.5 (2.6)	50.8 (15.1)	4.1 (0.2)	4.3 (2.6)	0.2 (0.1)	1.8 (0.8)	0.2 (0.1)	0.2 (0.1)	0.6 (0.3)	0.1 (0.1)	0.1 (0.1)	7.7 (4.8)	41.2 (3.7)	4.1 (26.4)
Tomato	10.3 (2.2)	46.5 (9.0)	3.7 (0.1)	2.2 (0.7)	0.3 (0.1)	1.2 (0.3)	0.1 (0.1)	0.3 (0.2)	0.6 (0.3)	0.3 (0.2)	0.4 (0.1)	15.1 (3.3)	37.4 (8.7)	3.9 (1.0)
Mixed- fruits	8.0 (2.1)	60.9 (17.8)	4.3 (0.2)	2.4 (0.9)	0.2 (0.1)	1.4 (0.4)	0.2 (0.1)	0.2 (0.1)	0.6 (0.3)	0.2 (0.1)	0.2 (0.1)	15.2 (8.0)	40.8 (17.8)	3.5 (2.8)

<sup>a</sup>Concentrations were reported in dry weight basis.

<sup>b</sup>Other trace elements (As, Cd, Pb, Mo, and Se) were tested. Their concentrations were below detectable limits.

<sup>c</sup>Values in parenthesis represented standard error means (SEM).

**Table 2.** Estimated trace-element balances of agricultural soils in California<sup>a</sup>

Element	Input						Output			
	Irrigation	Wastewater	Biosolids	Fertilizer	Manure	Weathering	Fallout	Drainage	Runoff	Harvest <sup>b</sup>
	g/ha/yr									
Arsenic	25	30	120	4	8	0.4	5	6 <sup>c</sup>	NA	6
Boron	4,200	6,000	500	30	250	20	40	23,660 <sup>c</sup>	NA	30
Cadmium	2	30	64	6	4	0.03	5	3	2	6
Chromium	144	12	1,030	20	150	3	100	15	4	10
Copper	22	240	5,060	4	130	13	50	25	NA	100
Lead	56	60	1,110	125	40	4	100	6	3	1
Mercury	NA	24	21	NA	NA	0.1	2	1	0.1	0.2
Molybdenum	38	60	15	90	300	5	5	338 <sup>c</sup>	NA	12
Nickel	28	120	570	5	200	22	50	12	4	4
Selenium	18	20	57	1	5	1	0.5	507 <sup>c</sup>	NA	2
Zinc	89	480	8,300	40	200	20	200	30	5	100

<sup>a</sup>Source: Chang & Page (2000)

<sup>b</sup>Estimation based on an annual dry-matter yield of 3 tons/acre or 6 Mg/ha.

<sup>c</sup>Estimation based on an annual collection of drainage water at tile drain inlets of alluvial fan at volume of 1.69 m/ha.



**Table 3.** Background concentrations of selected trace elements in California Soils<sup>a</sup>

Element	Minimum	Maximum	Arithmetic Mean	Geometric Mean
	-----mg/kg-----			
Boron	1	74	19	14
Cadmium	0.05	1.7	0.4	0.3
Chromium	23	1,579	122	16
Copper	9.1	96	29	24
Lead	12	97	24	22
Mercury	0.1	0.9	0.3	0.2
Molybdenum	0.1	9.6	1.3	0.9
Nickel	9	509	57	36
Selenium	0.02	0.43	0.06	0.03
Zinc	88	236	149	145

<sup>a</sup>Source: Chang & Page (2000)

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