ERA Economics
Environment • Resources • Agriculture

ERA Economics
1111 Kennedy Place, Suite #4
Davis, CA 95616

Technical Memorandum

Subject: Example Economic Impacts of the Central Coast Water Board Ag Order 4.0

By: ERA Economics LLC

To: Kahn, Soares & Conway LLP

Date: June 19, 2020

Purpose and Background

ERA Economics (ERA) was engaged to review the analysis developed for the Central Coast Draft Agricultural Order 4.0 (Ag Order 4.0, or just "Order") and Draft Environmental Impact Report **(**DEIR). ERA reviewed the analysis completed by the Central Coast Regional Water Quality Control Board (CCWB) and its consultants and summarized its conclusions in a technical memorandum dated 5/11/20 (TM 1). The key finding summarized in TM 1 was that the Order and DEIR did not include an economic analysis. We believe the Order is likely to impose substantial economic costs that would result in land fallowing, crop switching, and socioeconomic impacts in the Central Coast.

This TM describes an example analysis illustrating the likely cost and economic impacts of the Order. The following items are included in this TM:

1. Review nitrogen discharge limits and develop example per acre compliance costs for iceberg lettuce, which are extended to a partial economic impact analysis of total lettuce production in Monterey County
2. Review riparian setback requirements and summarize example economic costs
3. Describe example impacts and how these could be extended to develop a complete economic impact analysis of the Order

The following section summarizes our initial findings and recommendations. This is followed by a summary of the technical approach, quantitative analysis of example economic impacts of nitrogen discharge limits, riparian setback impacts, and summary remarks/recommendations for next steps.

Summary Findings

This TM develops an example impact of the nitrogen discharge limits for lettuce in Monterey County only. Other crops and counties were not considered, nor were other reporting, compliance, and requirements of the Order considered. Therefore, these costs should be interpreted as examples for only one of many crops and one of many regions in the Central Coast. Total costs are likely to be substantially higher. We have not evaluated land fallowing and crop switching. We also note that we

have applied a simplified agronomic relationship between yield and applied nitrogen based on published research that would benefit from future refinements.

Summary conclusions are as follows (again, these impacts apply to lettuce in Monterey County only):

- The loss in gross value of lettuce production in Monterey County due to the nitrogen discharge limits specified in the Order is estimated at $119.4 million per year at the 200 lb/ac limit and $683 million per year at the 50 lb/ac limit.
    - Total annual job losses for these scenarios vary between 1,985 and 11,340. Most of these jobs are filled by residents of economically disadvantaged communities.
    - Labor wages fall by between $54.1 million and $309.4 million per year.
    - Value added, which is a measure of net local economic activity, falls by between $85.6 and $489.6 million per year.
- Losses to consumers due to higher lettuce prices are estimated between $87.4 and $472.6 million per year.
- Farming risk would increase substantially. The probability of covering operating and overhead farming costs for a typical lettuce rotation would fall from 73% currently to 45% under a 50 lb/ac/yr nitrogen discharge limit. That is, in more than half of years a producer would not be able to cover the cost of raising the crop. The probability of generating revenue greater than total costs (i.e., making an economic profit) would fall to 14% under a 50 lb/ac/yr nitrogen discharge limit. This would cause growers to leave the industry, fallow land, and switch crops.
- A multi-crop rotation would likely become economically infeasible under the proposed nitrogen discharge limits. It would not be profitable to produce multiple crops per year and stay under the proposed nitrogen discharge limits. As shown in our analysis, this would likely cause a sharp reduction in land values, lease rates, local businesses, and jobs.
- Many of the farm jobs affected by the Order are in job classifications and areas that would affect economically disadvantaged communities. Therefore, these losses are likely to result in additional socioeconomic and social justice impacts that are not quantified in our example summary.

Our example analysis shows that: (i) an economic analysis of the requirements in the Order can and should be developed using standard applied economic principles, (ii) the costs of implementing the Order are substantial and would lead to land fallowing, crop switching, and severe business and job losses, and (iii) a standard economic analysis of the requirements specified in the Order would provide a foundation to identify ways to reduce implementation costs and resulting economic and environmental impacts.

Approach Overview

The CCWB did not prepare an economic analysis of the nitrogen discharge limits, riparian setbacks, or other requirements specified in the Order. Standard economic methodology is available to quantify economic impacts of the Order. We apply such an approach to illustrate the range of economic impacts for an example requirement (nitrogen discharge limits) and an example crop (iceberg lettuce as a proxy to establish per acre costs that are then extended to all head and leaf lettuce acreage) in an example region (Monterey County). This partial analysis should be extended to evaluate the effect of the Order on the Central Coast economy and identify ways to reduce economic impacts.

The following summarizes a standard economic impact analysis approach (see also TM 1) and the bullet point under each item describes how this approach was applied to assess impacts in this TM:

1. Develop the incremental compliance costs for each water quality management action, including hardware/equipment, operations, monitoring and record-keeping, land use change, administration, and all opportunity costs.
    - **This TM** develops example costs for nitrogen discharge limits for iceberg lettuce in Monterey County.
2. Assess how those implementation costs would apply to different crop types, rotation systems, regions, and alternatives.
    - **This TM** includes a partial accounting of costs for an example 2-crop iceberg lettuce rotation. It does not include additional management and compliance costs.
3. Use an agricultural economic model to evaluate how the implementation costs imposed by each alternative would affect agricultural production, returns, and land use (crop mix, acreage, and land retirement). Prepare a geospatial analysis to overlay changes in crop mix and land retirement on Farmland Mapping and Monitoring Program data (or other land use data to assess significance of impacts on agricultural land).
    - **This TM** does not develop a full agricultural economic model. Therefore, we are not able to estimate fallowing and change in crop mix (we would need to extend the analysis to other crops and develop this type of model). This should be done as a next step by the CCWB. However, we do develop an example farm budget analysis that illustrates producers' ability to cover costs, generate a profit, and assess risk. This analysis clearly shows that net income would fall to a level that would make it difficult to cover farming costs in most years.
4. Use results from the agricultural economic model to evaluate direct effects on agricultural income, output, and jobs. Link these results to an input-output model, such as IMPLAN, to estimate impacts on the broader regional economy, especially on jobs and income for backward-linked industries. Develop additional analysis to quantify the distribution of impacts (particularly for disadvantaged communities) and consider the impact to economically important forward-linked industries.

- **This TM** develops an example IMPLAN analysis for the example impacts developed for nitrogen discharge limits in Monterey County lettuce. This approach should be refined and extended to include other crops, costs, and regional considerations.

5. Use the results of (1) – (4) to evaluate the effects of the proposed Order and assess significance of socioeconomics, agriculture, land use, environmental justice, and other associated resources.

    - **This TM** indicates where this is likely to occur but does not quantify these costs.

The following section summarizes an example economic analysis of nitrogen discharge limits. This is followed by a summary of riparian setback requirements. A final section summarizes impacts, limitations, other costs, and recommended next steps.

Nitrogen Discharge Limits Example Economic Impact

Based the magnitude of impacts shown in this initial analysis, our experience developing similar studies, and our professional opinion, the impact of the Order is likely to include substantial land fallowing and crop switching. There was insufficient time to develop a full economic impact analysis of nitrogen discharge limits proposed in the Order, as described above.

We reviewed existing, peer-reviewed literature and assembled data to develop a partial economic impact analysis for an example crop (iceberg lettuce[1]) and production region (Monterey County). The next step would be to extend this to all crops, develop a calibrated economic model of Central Coast agriculture, and assess specific impacts on land fallowing and crop switching. This should include evaluating regulatory alternatives to identify options that reduce overall costs and achieve a desired level of benefit. This is the standard economic impact analysis approach.

The economic analysis is developed using an example of iceberg lettuce. We simplify the analysis by focusing on the effect of nitrogen application rates on crop yield. Crop quality could also be affected and result in additional costs, but that is not factored into our example analysis. Further, we consider both a single iceberg lettuce crop and a two-crop annual rotation (iceberg lettuce followed by iceberg lettuce). In practice, rotations are intensive and vary across the Central Coast. Other production practices and costs also vary (e.g., planting/harvesting date, yield, packaging, bed spacing, pest management, etc.). The example analysis uses representative production costs and returns.

The first step is to relate changes in nitrogen application to changes in crop yield. We use the peer-reviewed article by Hoque et al. (2010)[2] to illustrate the effect of nitrogen application on iceberg lettuce yields. Their study used field-controlled trials to evaluate the effect of varying N, P, and K application

[1] As noted earlier, we develop per acre costs for iceberg lettuce and then apply these costs to Monterey County lettuce acreage (head and leaf). The per acre costs for leaf lettuce are similar to head lettuce. Head lettuce is a large share of crop value in the Salinas Valley. Iceberg was valued at $459 million and leaf lettuces were valued at $733 million in the 2018 Monterey County Crop Report.

[2] Hoque, M., H. Ajwa, M. Othman, R. Smith, M. Cahn. 2010. Yield and Postharvest Quality of Lettuce in Response to Nitrogen, Phosphorus, and Potassium Fertilizers. *HortScience*. 45(10):1539-1544.

rates on romaine and iceberg lettuce yields. We acknowledge some of the important agronomic questions embedded in their work and focus specifically on nitrogen application rates.

Hoque et al. (2010) estimate a lettuce yield-nitrogen relationship (or yield function). It shows the expected relationship of increasing yields that increase at a diminishing rate. That is, lettuce yields increase with nitrogen application as a quadratic function[3]:

$$\text{(TM 1)}\ Yield = -0.0006 * N^2 + 0.3188 * N + 15.522$$

The nitrogen discharge limits and implementation schedule[4] are specified in the Order. Under compliance pathway 1, the nitrogen discharge is calculated as applied nitrogen per acre per year plus a portion of the nitrogen in compost plus nitrogen applied in irrigation water less what is removed in the harvested crop (or sequestration of other removal methods). The calculated nitrogen discharge in compliance pathway 1 cannot exceed the discharge limits (N in lb/ac/yr), which are reduced to 50 pounds per acre per year by 2050. Under compliance pathway 2, the nitrogen applied from fertilizer plus a portion of the nitrogen in compost must equal the nitrogen removed in the harvested crop (or sequestration or other removal methods).

Given that the nitrogen in irrigation water and the percent proportion of nitrogen in the harvested crop are beyond control of the grower, the primary response available to the grower is to reduce applied nitrogen to meet discharge limits[5] specified in the Order.

Nitrogen removed in the harvested crop is calculated using the conversion coefficient for iceberg lettuce defined in table MRP-1 "Nitrogen Removal Conversion Coefficients" in Appendix B to the Order. Applied irrigation water nitrogen is calculated from the publication by the University of California Cooperative Extension (UCCE) and UC Davis Plant Science[6]. The most current 2017 UCCE iceberg lettuce production budget[7] is used to define production practices, costs, and returns.

An iceberg lettuce yield function is calculated over a range of applied nitrogen per acre per crop using equation (TM 1). The yield at each application rate corresponds to a quantity of nitrogen removed by the harvested crop. Nitrogen in applied irrigation water is accounted for using the default UCCE applied water requirements for iceberg lettuce of 12 inches (January – April season), and assuming an aggregate level of 10 mg/L of nitrogen in the groundwater.

The analysis assumed an application of compost at the rate of 2 tons of compost per crop and assumes a (conservative) 1% nitrogen content of the compost[8]. As shown in Section C of Attachment A to the Order, according to CCWB data, the current median nitrogen fertilizer application rate for the reporting

[3] Yield is measured in tons/ha and N is measured in kg/ha as shown in the formula. We convert yield to cartons/ac and N to lb/ac for reporting purposes and all subsequent calculations.
[4] Per Table C.1-2 of the Draft Order.
[5] We note that 2022 and 2024 levels are targets, not limits. The analysis focuses on the more salient discharge limits.
[6] Cahn, M. L. Murphy, R. Smith, T. Hartz, On-Farm Trials Evaluating the Fertilizer Value of Nitrogen in Irrigation Water. UCCE and UC Davis Plant Science.
[7] Tourte, L. R. Smith, J. Murdock, D. Sumner. 2017. Sample Costs to Produce and Harvest Iceberg Lettuce. Central Coast Region.
[8] The general range is 1-3%. The lower value of 1% is applied since no compost decomposition factor is included in the calculation.

years 2014 through 2018 ranges between 150 and 180 lbs N/ac/crop, the 90th percentile is 275 lbs N/ac/crop, and the recommended range is between 120 and 220 lbs/N/ac/crop. A baseline nitrogen fertilizer application rate of 209 lbs/N/ac/crop is applied in our analysis. An example two-crop rotation (two iceberg lettuce crops per year) is used, with total nitrogen discharge calculated as double the single crop value. In practice, standard rotation systems vary across the Central Coast regions and this should be refined in future work. The resulting applied nitrogen and nitrogen discharge amounts are used to estimate (using OLS regression) a quadratic function[9] that relates estimated nitrogen discharge (ND) to the level of applied nitrogen (AN):

$$\text{(TM 2)}\ ND = -0.0003 * AN^2 + 0.6856 * AN + 38.308$$

Equation (TM 2) is used to calculate the maximum nitrogen that could be applied and still meet the nitrogen discharge limits contained in the Order decreasing from 200 to 50 lbs/ac/year, with implementation limits set to start in 2030[10] as shown in Order Table C.1-2. Results are summarized in Table 1, below.

Table 1. Discharge Limits and Constraints on Nitrogen Applied Needed to Achieve Discharge Limit

Discharge Limit (N lbs/ac/yr)	Total Nitrogen Applied (N lb/ac/yr)	Nitrogen Applied (N lb/ac/crop)
200	327	163
100	208	104
50	144	72

Equation (TM 1) is then used to estimate lettuce yield from the applied nitrogen and the yield reduction is calculated as the yield loss relative to the baseline application of 209 lbs N/ac/crop. The gross cost is the gross revenue loss with lower yields. The net cost is the loss in gross revenue, less the harvest cost that would have been incurred. Costs are reported on a per crop and per acre basis, for a simplified example of two iceberg lettuce crops per year. In practice, more intensive rotations with other crops are standard practice and are what supports the high land values, jobs, tax revenue, and economic activity in the Central Cost.

Direct Economic Impact

The iceberg nitrogen applied and removed calculations are used to estimate the expected cost per acre. This per acre cost is then applied to total head and leaf lettuce acreage in Monterey County. Annual crop reports show combined head and leaf lettuce harvested acreage has ranged between 95,000 and 110,00 acres over the last decade. Harvested acreage counts an acre that produces 2 crops per year as 2 acres. This analysis uses 100,000 acres as a representative total acreage. Table 2 summarizes the example cost of the nitrogen discharge limits for head and leaf lettuce production in Monterey County. Results show estimated yield loss, gross revenue loss per acre, and total direct impact in Monterey County at 2030,

[9] AN is in lb/ac/crop and ND is in lb/ac/year.
[10] Limits start in 2026, this TM evaluates the limits starting in 2030 and thereafter.

2040, and 2050 discharge limits (200, 100, 50 lb/ac/yr). A 12-month average price of $13.80 per 42-lb carton[11] is applied, average annual yield is 900 cartons/ac using the UCCE production budget.

Estimated annual direct gross revenue losses from the nitrogen discharge limits for lettuce range from $78 to $446 million per year in Monterey County alone. As of 2019, the total lettuce crop was valued at $1.19 billion (leaf lettuce crop was valued at $730 million and the head lettuce crop at $459 million). This estimated impact is an approximate reduction of 40% of the current industry value of head and leaf lettuce production in Monterey County.

Table 2. Direct Economic Impact Summary of Nitrogen Discharge Limit, Monterey County Lettuce Example

Nitrogen Discharge Limit (N lbs/ac/yr)	Yield Loss (cartons/ac)	Gross Loss ($/ac)	Direct Impact (Million $/yr)
200	56.5	$1,470	$78.0
100	206.8	$5,375	$285.3
50	323.4	$8,405	$446.2

The direct impact represents changes in gross sales value for lettuce. This industry is inextricably linked to other sectors of the economy. Since most of the agricultural products from Monterey County are fresh vegetables and fruit, much of the required cooling, processing, and distribution takes place in the immediate region. Substantial changes in the profitability and quantities of the key crops grown, such as lettuce, will cause ripple or "multiplier" effects on other businesses and employment. These effects are termed secondary economic effects as opposed to the loss of primary product above that are direct economic effects. The total economic impact is the sum of the direct and secondary impacts.

Total Economic Impact

Secondary impacts (also known as "multiplier" effects or "indirect and induced" effects) are estimated using the Impacts for Planning and Analysis (IMPLAN) model and data developed by MIG, Inc. The IMPLAN 2014 R3 database is applied, and all dollar impacts are indexed to current dollars using the GDP Implicit Price Deflator. IMPLAN is an input-output model that can be used to quantify the effect of changes in expenditures in one sector of the economy on related sectors. Gross revenue impacts are modeled as a change in final demand for the IMPLAN Vegetable and Melon Farming sector.

Total impacts are summarized in Table 3. Total gross value impacts are $119.4 million per year at the 200 lb/ac/yr limit and $683 million per year at the 50 lb/ac limit. Total annual job losses are between 1,985 and 11,340. Labor wages fall by between $54.1 million and $309.4 million per year. It is important to note again that many of the farm jobs affected by the Order are in areas classified as economically disadvantaged communities. Therefore, these losses are likely to result in additional socioeconomic and social justice impacts that are not represented in this impact summary. Finally, value

[11] Using recent historical data from USDA AMS.

added, which is a measure of net local economic activity, falls by between $85.6 and $489.6 million per year.

Table 3. Total Economic Impact of Nitrogen Discharge Limits on Employees, Producers, and Businesses ($ in millions)-Monterey County Lettuce Example

Nitrogen Discharge Limit (lb/ac/yr)	Impact	Jobs	Wages	Value Added	Output Value
200	Direct	-935	-$38.4	-$59.4	-$78.0
	Secondary	-1,050	-$15.7	-$26.2	-$41.4
	Total	**-1,985**	**-$54.1**	**-$85.6**	**-$119.4**
100	Direct	-3,415	-$140.4	-$217.2	-$285.3
	Secondary	-3,835	-$57.4	-$95.9	-$151.4
	Total	**-7,250**	**-$197.8**	**-$313.0**	**-$436.7**
50	Direct	-5,340	-$219.6	-$339.6	-$446.2
	Secondary	-6,000	-$89.8	-$149.9	-$236.8
	Total	**-11,340**	**-$309.4**	**-$489.6**	**-$683.0**

This analysis should be interpreted as an example for only one crop type (iceberg lettuce) and only partially accounting for the economic cost of the proposed nitrogen discharge limits. It uses a standard calculation method based on public data and published research to estimate agronomic response. The example economic impacts illustrate two important points:

1. An analysis that is tasked with exploring the impacts of the regulations on the physical environment must consider the impact on the land use, labor employment, and secondary processing impacts of these restrictions. This analysis can and should have been done.
2. The cost of the proposed draft discharge restrictions is substantial and could have far-reaching effects on land use and the social structure in the Salinas Valley. These effects can be estimated using a standard economic analysis approach.

Losses of nearly three-quarters of a billion dollars per year would have devastating impacts on the local economy. The direct losses alone represent over 40% of the current lettuce crop gross value in Monterey County. Additional impacts to other crops, rotations, and other Central Coast counties would occur. Impacts to jobs and labor income would disproportionately fall on farm workers and disadvantaged communities. We have not considered what crops might replace some of the lost lettuce acreage. This next phase in the analysis would require developing an economic model of Central Coast agriculture.

Consumer Impacts

The Salinas Valley, which largely resided in Monterey County, is colloquially known as the world's salad bowl. In seasons that are staggered with Yuma and the Imperial Valley, it is the major producer of

fresh vegetables, berries, and leafy greens. A decrease in production (supply) caused by implementation of the Order would affect retail prices and purchases by consumers. The impact to consumers is called the consumer surplus loss.

The effect of a change in supply or demand on market-clearing price depends on market structure and how price responsive producers and consumers are (price elasticity). We develop an example analysis to illustrate the potential consumer surplus loss.

We apply a standard Equilibrium Displacement Model (EDM[12]) to illustrate an example magnitude of consumer price impacts resulting from changes in Monterey County lettuce production alone. A more detailed analysis should be prepared using data for other major crops in the Central Coast region. Lettuce supply and demand elasticities[13] are set at 0.21 and -0.336, reflecting a relatively inelastic supply response and consumer (retail) demand response.

We calculate[14] the change in consumer surplus under the 200, 100, and 50 lb/ac/yr nitrogen discharge limits. Table 4 summarizes the results. Annual consumer losses range from $87 million to $472 million. These are interpreted as additional direct losses to consumers due to higher produce prices at the store.

Table 4. Annual Consumer Loss from Nitrogen Discharge Limits on Lettuce in Monterey County ($ in millions)

Nitrogen Discharge Limit (lb/ac/yr)	Consumer Surplus Loss ($ in millions)
200	$87.4
100	$309.9
50	$472.6

As demonstrated in Table 4, the consumer loss from Monterey County lettuce nitrogen discharge limits alone is considerable—not to mention other crops and counties in Region 3 that can and should be analyzed.

Farm-Level Fiscal Impacts and Risk

In addition to regional economic impacts to the Central Coast economy and economically disadvantaged communities in the area, the direct costs of the proposed Order can be used to illustrate effects on farming risk. This gives us a sense for the magnitude of land fallowing that the nitrogen discharge limit will likely prompt.

[12] Wohlgenant, M. The EDM and Measures of Consumer Welfare. In: The Oxford Handbook of the Economics of Food Consumption and Policy. Eds: Lusk, J, J. Roosen, J. Shogren.

[13] Using results in: Russo, C. R Green, R. Howitt. Estimation of Supply and Demand Elasticities of California Commodities. 2009. UC Davis Agricultural and Resource Economics. These values should be updated/refined in future economic impact analyses.

[14] The formula is: $\Delta CS = P_0 Q_0 (\frac{\eta \varepsilon k}{\varepsilon - \eta} - k)(1 + 0.5 * \frac{\varepsilon k}{\varepsilon - \eta})$; where k is the percentage change in supply (production), ε is the supply elasticity, and η is the demand elasticity. See Wohlgenant reference in footnote above. We note that the price effect would have an offsetting impact to producers that is not calculated in this example analysis.

Yield losses up to 323 cartons of lettuce per acre would likely make producing multiple crops per year infeasible. The two-crop iceberg lettuce rotation used in this simplified example calculates the net economic impact as the loss in revenue minus the harvest costs. Under the proposed nitrogen discharge limits, a grower's best option, would be to reduce overhead costs and farm a single crop per year that is most profitable given the fixed amount of nitrogen a grower may use under this order. However, profit would decline substantially compared to current conditions and land values and lease rates would fall in proportion to this substantial drop in productivity or convert to other urban uses.

Yields and prices vary due to weather, pests, and market conditions that are beyond the control of any individual grower. Reduced yields and/or higher production costs will increase farming risk. An example analysis is developed to illustrate the impact of the Order on farming risk and returns.

The UCCE iceberg lettuce crop budget is used in the analysis. Estimated cash operating costs are around $9,950 per acre. Gross return is around $12,000 at a crop price of $13.80 per carton. Non-cash overhead costs are estimated at $500 per acre and cash overhead cost are around $2,000 per acre. Although the gross value of the crop is significant, so are farming costs. This means that margins are thin. An increase in cost or change in yield increases farming risk, calculated for purposes here as the probability that returns cover operating and overhead costs.

A stochastic farm budget analysis is developed to quantify the change in variability of net farm income (e.g. risk) and change in the probability of covering cash operating costs. The stochastic analysis applies historical variation in price, yield, and cost to evaluate the probability of various levels of gross returns (or profits). The 2000 - 2017 historical time series of real prices and average iceberg lettuce yields is used to fit the historical price and yield distribution. A Monte Carlo simulation is developed to illustrate the range of outcomes based on the historical distribution.

Outcomes are expressed as the probability of realizing a net return (revenue minus variable operating costs). Net return per acre is defined as gross revenue (price * yield) minus variable/operating costs (e.g., cost to plant, raise, and harvest a crop), noncash overhead costs (e.g., capital recovery costs for equipment and other investments), and cash overhead costs (e.g., office expenses, property taxes, insurance). Operating costs can be avoided if a field is not planted. Overhead costs must be paid whether or not the field is planted. We define the following threshold levels based on the ability to cover cash overhead costs and cash plus noncash overhead costs[15] (these thresholds correspond to the different color bands shown in Figure 1):

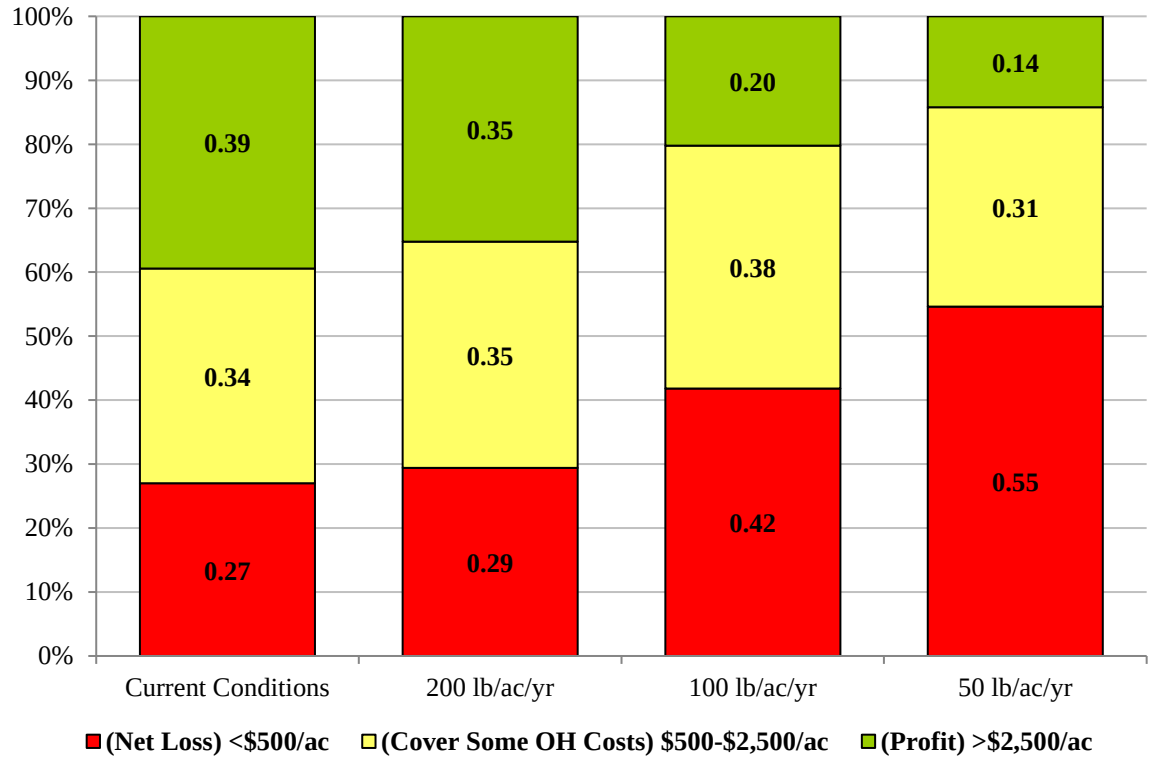
- **Lower Threshold**. A return of $500 per acre would cover noncash overhead costs only (but would not cover cash overhead costs). Below this point the grower is losing money on a per-acre basis for that crop.
- **Mid Threshold**. A mid-point return of $2,500 per acre would cover both cash and noncash overhead costs. Between $500 and $2,500 per acre the grower would be covering a portion of overhead costs but would realize no profit.

[15] All costs are defined using the UCCE iceberg lettuce budget.

- **Upper Threshold**. Above $2,500 the grower covers cash overhead and non-cash overhead costs. In other words, the grower is realizing a profit.

Figure 1 illustrates the results of the analysis. Under current conditions, growers can expect to cover at least some overhead costs or generate a profit (return on investment) with 73% probability (.39 +.34), shown by the green and yellow bars in the left-hand column. Under the 50 lb discharge limits shown in the far-right bar, this falls by 28 percentage points to 45% (0.14 +0.31). That is, a grower cannot cover cash overhead costs in more than half of years. The probability of covering all costs (making a profit) during a year falls to 14%. That is, in more than half of years a grower would have been better off not planting at all. This is clearly not sustainable and would lead to land fallowing or conversion to other land uses. The figure also shows the incremental changes as the discharge limits are reduced from 200 to 50 lbs/ac. The increase in farming risk is apparent even at the 200 lb nitrogen discharge limit (the second column in Figure 1). The analysis illustrates the Order would substantially increase farming risk. This would likely lead to crop switching and land fallowing and conversion to other land uses.

Figure 1. Probability Chart of Iceberg Lettuce Returns Covering Operating and Overhead (OH) Costs



Other factors such as food safety scares, trends in consumer purchases, weather, pests, disease, and water supply can impact crop availability and quality in any year. For example, in 2019 an *E. coli* O157:H7 outbreak affected romaine lettuce (and other leafy greens) demand right before important fall holidays. Under current conditions, growers can stay in business because these bad years are followed by other good years. As illustrated above, the frequency of occurrence of the good years would be

reduced under implementation of the Order. This increase in risk strongly indicates that growers would be likely to exit the industry.

It is important to note that this analysis was developed for one example crop. The impacts are more dramatic for other, typically lower-margin crops including broccoli and other cole crops often included as breaks in the rotation. We would expect additional impacts as this analysis is extended to other crops and areas.

Setback Requirements

Attachment A of the Order defines riparian setbacks for agricultural areas that are contiguous with riparian water bodies. The two major types of setback requirement, a riparian setback for Riparian Priority areas, and the more general operational setback for ranches that are outside the priority areas but are in places where setbacks are required for discharge control. From an economic damage/valuation perspective there is little difference between these two types of setbacks since both require land to be permanently fallowed.

Table A.C.5 – 21 in the Order shows the stream miles and acreage potentially affected by setback requirements by HUC-8 name. For the purposes of this example analysis we assess the annual cost of the setback to the agricultural industry in the greater Salinas Valley which we define as the HUC-8 Salinas Valley plus the Pajaro Valley. The total irrigated acres in the greater Salinas Valley is 253,526 acres. According to Table A.C.5 – 21, the total acreage for all setbacks in this region is 2,163 acres.

The simplest method of establishing the direct costs of this level of setback is to use the going annual rental rate of irrigated crop land in these regions to establish the annual cost of removing this quantity of land agricultural crop production. Given the specialized and valuable nature of crop production in the Pajaro and Salinas Valleys, rents are substantially higher than standard agricultural crop land that is restricted to a single annual crop of lesser value. Cropland rents in the two valleys are sustained by the high value of the vegetable and berry crops grown, and the fact that almost all areas are multi-cropped.

The American Society of Farm Managers and Rural Appraisers[16] publishes trends in agricultural land and lease values, in which they valued annual rental rates for the crop land in Monterey County over a range of $820 per acre to $3,300 per acre year, or an average rental value of $2,300 per acre per year. A second source is a 2017 publication by the Resource Conservation District of Santa Cruz County[17] analyzing the potential for cover crops in the Pajaro Valley. The study records a lease value for land used for growing vegetables at $1,700 an acre per year.

Using a conservative value of $1,900 per acre per year, the annual cost of lost lease value for the 2,163 acres is $4.1 million. This represents the additional direct costs to producers. Additional costs of

[16] Trends in Agricultural Land and Lease Values. California Chapter of the American Society of Farm Managers and Rural Appraisers. Folsom, California.

[17] Rotational Crop Plan Economic Analysis. 2017. Resource Conservation District of Santa Cruz County.

developing and maintaining the setbacks are not included in this example calculation. In addition, setbacks, depending on their location, may affect other farming practices, such as additional food safety setbacks, and this would impose additional costs. Other paperwork and compliance time are also not considered in this example analysis but would result in greater costs. Similar to the nitrogen discharge limits, these direct compliance costs would create additional multiplier impacts in the Central Coast economy.

Concluding Remarks

It is clear, in our professional opinion and based on the analysis summarized in this TM, that the Order would likely lead to significant land fallowing, changes in crop composition, permanent land use conversions, and socioeconomic impacts. Going from multiple crops to just one crop a year would have devastating impacts on grower returns.

We developed this as a data-driven example analysis using a standard economic methodology. We expect other factors would lead to greater costs. Since we did not develop a full economic model, we were not able to assess the potential for switching to other crops. Other factors considered in the analysis that were not quantified include:

- This example was developed for Monterey County iceberg lettuce production only. The nitrogen discharge limits in the Order apply to other crops and throughout the Central Coast region. Impacts would increase if these other crops and areas are considered.
- We did not develop a calibrated economic model of Central Coast agriculture, markets, and rotations. This analysis would allow us to capture the interaction between different crops due to rotations and their implications for changing markets, land fallowing, and crop mix.
- Other regulations that affect farming costs were not considered in the analysis but would have a cumulative effect on impacts. For example, the Sustainable Groundwater Management Act (SGMA) is expected to reduce water supply and increase water costs. AB 1066 and SB 3 could exacerbate the effects of general labor scarcity and increase wage/labor costs.
- Costs, returns, cultural practices, and other costs should be validated through grower interviews. This analysis was based on standard UCCE crop budgets. Our standard approach would be to first work with the industry to refine these data and estimates in order to prepare a more precise analysis. This would also develop compliance costs for other components of the Order (e.g., management time and developing riparian setback areas)
- We did not evaluate other compliance costs. This would further increase operating costs and increase farming risk. Other requirements specified in the Order include:
    - Expanded requirements for irrigation and nutrient management for groundwater, including the targets and prescriptive nitrogen discharge limits considered in this study
    - Expanded requirements for irrigation and nutrient management for surface water, including targets and prescriptive limits

- Expanded pesticide management for surface water and groundwater, including specified surface water monitoring and threshold limits
- Expanded riparian habitat management requirements that would require retiring productive farmland and developing setback areas
- Expanded sediment and erosion management for surface water
- Increased reporting requirements in surface water and groundwater reporting areas in the form of ACF, RAMPs, TNA, and INMPs.

In summary, we developed an example analysis showing the per acre cost of nitrogen discharge limits on iceberg lettuce, and the effect on farming risk. We used those per acre costs to estimate the total direct, indirect, and induced impacts to lettuce in Monterey County. Our example analysis shows that the Order is likely to result in substantial land fallowing, land conversion, and other socioeconomic impacts in the Central Coast regions. The analysis considered the impacts of nitrogen discharge limits. This is one of several costs imposed by the Order, and one of several other regulatory changes (e.g., SGMA) that will affect farming costs in the Central Coast. We recommend that the CCWB extend the framework described in this TM (and our other TM) to evaluate the incremental and cumulative impact of the Order and identify strategies that reduce economic impacts on local communities.