Environmental Assessment Tool for Cage Aquaculture in the Great Lakes Version 1.1

by

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Part Two: Assessment Pathway Flowcharts

DISCUSSION DRAFT
Prepared for the Great Lakes Fishery Commission
Council of Lake Committees
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### Part 2

#### Assessment Pathway Flowcharts

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#### Appendices

1. Introductions in the Great Lakes Basin Procedures for Consultation
2. Checklist of the Extant, Established Fishes of the Great Lakes
3. Approved Species Lists
4. Great Lakes Water Quality Agreement Annex 3- Control of Phosphorous
Section I.
Determination of Pathway

Q1. Is organism at issue:
A1. fish
A2. shellfish
A3. plant

T1 Go to Plant Assessment Tool [under construction]
T2 Go to Shellfish Assessment Tool [under construction]

Q2. Will broodstock, eggs, fry or other marketable life stages of organisms be collected or harvested by operator?
A1 yes
A2 no

Go to page 2, Question 5.

Q3. Will harvest of organisms take place in infested waters (i.e. waters that have aquatic nuisance species (ANS))? This includes any water body in the Great Lakes region.
A1 yes
A2 no

H1. Harvesting organisms in these infested waters may pose a hazard to the Great Lakes aquatic ecosystem if ANS were accidentally released. Operator must demonstrate acceptable specific points during processing that enable identification and removal of aquatic nuisance species organisms. Revise and include Guidelines (Jensen et al., 2000) when developed. If demonstration is acceptable, and user accepts risk, proceed to Question 4. If not, recommend harvesting in water bodies that do not contain ANS.

H2. Collection methods may pose hazard to habitat. Operator must identify ways to minimize impact of collecting or harvesting in this area. If so identified, and you are willing to accept risk, proceed to Question 5. If not, recommend harvesting in areas less vulnerable to collection methods.

A1 yes
A2 no

Acceptable

Q4. Could habitat damage due to collection methods (e.g. seining) occur or could excessive removal of organisms cause a crash in abundance of a wild reproducing population?
A1 yes
A2 no

Go to Question 5.
Q5 Are growout methods included in operation?  
A2. no  
Go to Section X, Impacts of Facility and Infrastructure

Q6. Is organism to be cultured within a body of a Great Lake, OR a G.L. connecting water body OR a tributary that flows into a Great Lake?  
A2. no

A1. yes

Q7. Will organism be cultured in a facility whose effluent may reach a tributary that flows into the Great Lakes, a connecting water body of the Great Lakes or one of the Great Lakes?  
A2. no

A1. yes

Q8 Does culture species constitute a new introduction into the Great Lake at issue? (Hotlink to Species in the Great Lakes. Crossman, 1999)  
A2. no

A1. yes

H3. Introducing a new species poses a hazard to the Great Lakes. Refer to the Council of Lake Committee’s Procedures for Consultation for Introductions in the Great Lakes Basin (1992). If endorsed, proceed to Question 9. If not endorsed, revise operation proposal so that cultured organisms and effluent will not reach a tributary that flows into the Great Lakes, a connecting water body of the Great Lakes or one of the Great Lakes. (Hotlink to CLC Procedures)

Q9 Is species approved for culture by managing agency? (Hotlink to approved species lists.)  
A2. no

A1. yes

T3. Contact management agency in your jurisdiction for further information. (Hotlink to management agencies)
Section II
Assessment of Suitable Environment

Q10. Can organisms survive and thrive in the environmental conditions of the surrounding aquatic ecosystem? Critical factors include: temperature, pH, and dissolved oxygen over entire growout period.

A1. yes

A2. no

H4. A sub-optimal environment poses hazards to cultured organisms including: reduced growth, higher susceptibility to disease or mortality. If willing to include these risks, continue to Question 11. Otherwise, consider relocating facility to an area that is more likely to have better conditions for organism’s health.

Q11. Are conditions optimal for organisms to acquire food (currents fast enough to disperse pollutants yet slow enough to allow fish to acquire food before it is taken from the net area) and facility management (are average wave heights not too strong for structural integrity of facility and possible hazard to facility employees)? Critical factors include current speed, ice, wave height, fetch and depth.

A1. yes

A2. no

H5. Excessively rapid currents pose hazards to cultured species including reduced feed retrieval, excessive energy use, increased susceptibility to injury and excessive stress. Another hazard is damage to structural integrity of facility leading to escape of cultured organisms. If willing to accept these risks, proceed to Section III, Effects on Other Lake Users. Otherwise, consider revising proposal to locate facility in a more suitable environment.

Accept risk

Proceed to Section III, Effects on Other Lake Users.
Section III.
Effects on Other Lake Users

Q 12. Is the proposed facility or its related infrastructure close to an area that is culturally significant to, or subject to a land claim by Native American or First Nations people?

A1. yes
H6. This poses a hazard to a culturally significant area. Consult with Native American or First Nations agencies to determine if facility will be suitable for area. If willing to accept risk to area, proceed to question 13. If not, relocate to site outside of culturally significant area.

A2. no
Accept risk

Q13. Will the proposed facility or its related infrastructure be close to a historically significant area?

A1. yes
H7. This poses a hazard to a historically significant area. Consult with designated historical agency to determine if facility will be suitable for area. If willing to accept risk to area, proceed to question 14. If not, relocate to site outside of historically significant area.

A2. no
Accept risk

Q14. Will the proposed facility or its related infrastructure be located in an area that will impede navigational traffic? (Hotlink to USACOE District Regulatory Offices, and Canadian Coast Guard)

A1. yes
H8. This poses a hazard to navigation in this area. Consult with the Army Corp. of Engineers or Canadian Coast Guard to determine if navigational traffic will be adversely affected. Upon approval, proceed to Question 15. If not approved, relocation of facility will be required.

A2. no

Proceed to Question 15.
Q15. Is the proposed facility and its related infrastructure located in an area that may adversely affect other lake users?

A1. yes

A2. no

Q16. Does the proposed facility meet site regulations outlined in the Coastal Zone Management Act or other legislation that applies to coastal zones?

A1. yes

A2. no

Proceed to Section IV Disease Effects.

H9. Proximity of facility poses a hazard to other lake users. Therefore, other users, if any, must be identified and solicited for comments on proposed facility. Contact relevant government agency to coordinate such public input. If no other users, or you are willing to accept risk to identified users, proceed to Section IV Disease Effects. If not, further interaction with other users will be necessary (e.g. town hall meetings) to resolve facility issues. Alternatively, relocation of facility outside of area that would adversely affect other users may be necessary.

T4. Do not proceed with approval unless regulatory guidelines are met.
Section IV
Disease Effects

Q17. Has a fish health specialist inspected production stock and/or broodstock following procedures and diagnostic in the (revised) Great Lakes Fish Disease Control Policy and Model Program (Hnath, 1993)?

T5. Have a fish health specialist evaluate broodstock and/or production stock following the (revised) Great Lakes Fish Disease Control Policy and Model Program, and then proceed to Question 18. Do not proceed with culture of organisms until completion of fish health evaluation.

Q18. Has broodstock/production stock been given an “A” or “B” classification?

H10. A “B” Classification is assigned when one or more pathogens were found in within the past two years. These pathogens may pose a hazard to both the cultured fish and subsequently to wild fish if a disease outbreak occurs wild stocks. If willing to accept risk proceed to Question 20. If not, consider using different broodstock/production stock.

A1. yes, “A” Class

Go to Question 20.

A2. yes, “B” Class

H11. Broodstock or production stock with a “C” Classification may pose a hazard to both the cultured fish and subsequently to wild fish if a disease outbreak occurs wild stocks. If willing to accept risk proceed to Question 20. If not, consider using different broodstock/production stock.

A1. yes

A2. no

Q19. Has stock come from one of the Great Lakes or from a tributary flowing into a Great Lake?

T6. A “C” classification from a source other than the Great Lakes or a Great Lakes tributary poses new disease hazards to native or naturalized Great Lakes species. Do not proceed with culture of these organisms in a lake-based facility unless you implement procedures outlined in the Protocol to Minimize the Risk of Introducing Emergency Disease Agents with Importation of Salmonid Fishes from Enzootic Areas (Horner et al., 1993).

A1. yes

A2. no

A3. no. The stock thus gets a “C” classification.

A3. no. The stock thus gets a “C” classification.

A2. no
Q20. Has a Wild Fish Health Survey been conducted, or are there data on wild broodstock pathogens in the area of the proposed aquaculture facility?

A1. yes

A2. no

Responsible agency should encourage Great Lakes Fish Health Committee to assess wild fish in proposed area to determine if hazardous disease agents have been found in the area. Proceed to Section V, Impacts on Recovery or Rehabilitation Plans.

Q21. Did wild fish test positive for any disease agents listed in the (revised) Great Lakes Fish Disease Control Policy and Model Program?

A1. yes

A2. no

Q22. Is the species or the strain to be cultured resistant to disease caused by the identified pathogen? If yes, provide documentation supporting this statement.

A1. yes

A2. no

Q23. Is it feasible to vaccinate fish against disease?

A1. yes

A2. no

Q24. Is operator willing to vaccinate?

A1. yes

A2. no

Q25. Are rearing conditions within optimal ranges that will minimize susceptibility of disease? (Refer to Section II, Suitable Environment section.)

A1. yes

A2. no

H12. Culturing fish in sub-optimal conditions and exposing them to disease agents pose a hazard to both the cultured fish and subsequently to wild fish if a disease outbreak occurs. If willing to accept risk proceed to Section V, Impacts on Recovery Plans, otherwise see supporting text for alternative recommendations.
Section V.
Impacts on Recovery or Rehabilitation Plans

Q26. Are there any species at risk that may be adversely affected by an aquaculture facility's infrastructure or large accidental release of cultured organisms? Consult with the federal and state or province government agency responsible for species at risk. Note: User should consider stocks or genetically distinct populations that are also at risk.

H13. The operation poses a hazard to wild organisms that are already “at risk” of decline or extinction. Do not proceed with operation as proposed unless approval has been granted by responsible agency. If approved, proceed to Question 27. If disapproved, consider relocation to area that will not adversely affect “at risk” organisms.

Q27. Could an aquaculture facility’s infrastructure or a large accidental release of cultured fish adversely affect Great Lakes Fish Community Objectives recovery or rehabilitation plans (e.g. lake trout or whitefish recovery plans)?

H14. The proposed operation is a hazard to species targeted for rehabilitation. If operator has identified methods that will avoid adverse effects on recovery or rehabilitation, and you are willing to accept this risk, continue to Section VI, Impacts on Areas of Concern. If unwilling to accept this risk, consider relocating facility to different site.
Section VI.

Impacts on Areas of Concern

Q28. Is proposed aquaculture facility in the “zone of influence” of a designated Area of Concern (Consider also state and provincial AOC’s and Aquatic Biodiversity Investment Areas)?

A1. yes

Proceed to Section VII, Effects of Settleable Solids on Benthos and Shellfish

A2. no

Go to Question 32.


A1. yes

A2. no

Go to Question 32.

Q30. Are there fish-eating predators (e.g. birds) in recovery plans?

A1. yes

H15. Fish-eating predators may be at risk from harassment. If willing to accept risk, ensure protective, secure predator apparatus is included in proposal and go to Q. 31. If unwilling to accept risk, consider relocation of facility to area not heavily populated with fish-eating predators.

A2. no

Proceed to Section VII, Effects of Settleable Solids on Benthos and Shellfish

Q31. Could escaped cultured species significantly harm area species by interbreeding, predation or competition for food or habitat?

A1. yes

A2. no

Go to Question 32.

H16. The recovery species in the AOC plan may be at risk from interspecific hybridization, predation or competition for food or habitat. More information is needed about the recovery species before a decision can be reached. Contact local lead person at www.cciw.ca/glimr/raps/aoc-map.html. If willing to accept risk, go to Question 32. If not, consider culturing different species or relocate to a site where adverse interactions with recovery species are less likely to occur.

A2. No. It is known that they could not adversely affect area species.
Q32. Does recovery plan include improvement of degraded benthos?
A1. yes

A2. no

Q33. Does Recovery Plan identify eutrophication or undesirable algae as evidence of impaired beneficial use?
A1. yes
A2. no

Q34. Does the AOC at issue identify remediation of contaminated sediments?
Accept risk

A1. yes

Consult web page: www.cciw.ca/glimr/raps/aoc-map.html

A2. no

Proceed to Section VII, Effects of Settleable Solids on Benthos and Shellfish

Q32. Does recovery plan include improvement of degraded benthos?

H17. Benthic organisms may be at risk unless measures are in place for the removal of excess food, feces, and mortalities. If these measures are in place and you are willing to accept this risk, proceed to Q34. If not, consider relocation of proposed facility.

H18. Recovery plans may be hampered by the addition of an aquaculture facility in this area. A mass balance analysis may be necessary to quantify risk. Contact appropriate federal, state or provincial agency for assistance. If it is determined that water quality will not be adversely affected, and you are willing to accept this risk, go to Question 34.

H19. Contaminated sediments may pose a hazard to cultured organisms due to possible exposure to contaminants. This may also pose a hazard to food safety. If you are willing to accept this risk, proceed to Section VII, Effects of Settleable Solids on Benthos and Shellfish. If not, consider relocation of facility.

Q32. Does recovery plan include improvement of degraded benthos?
Section VII.
Effects of Settleable Solids on Benthos and Shellfish

Q35. Are the proposed rearing units located directly in a Great Lake or a connecting water body of a Great Lake?

A1. yes

Q 36. Are there waste containment and collection measures in place for excess food, feces, and mortalities?

A1. yes

A2. no

Provide documentation of efficacy, then proceed to Section VIII, Impacts on Breeding Areas, Nurseries and Fish-eating animals.

H20. This poses a hazard to shellfish that are intended for harvest. Operator should develop plans minimize release of settleable solids. If these plans are acceptable, and you are willing to accept risk to the shellfish at issue, proceed to Question 38. If not, consider relocating facility or reducing volume of production.

A1. yes

H21. This poses hazard to benthic organisms. Operator should develop plans minimize release of settleable solids. If these plans are acceptable, and you are willing to accept risk to the benthos at issue, proceed to Question 46. If not, consider relocating facility or reducing volume of production.

Q37. Is proposed facility within a “zone of influence” (see definition) for harvested shellfish beds? Note endangered benthic organisms are addressed in Recovery and Rehabilitation assessment.

A1. yes

A2. no

Q38. Is water distance from bottom of cages to lake substrate sufficient enough to avoid impeding water flow and causing excessively high sedimentation of aquacultural waste?

A1. yes

A2. no

H20. This poses a hazard to shellfish that are intended for harvest. Operator should develop plans minimize release of settleable solids. If these plans are acceptable, and you are willing to accept risk to the shellfish at issue, proceed to Question 38. If not, consider relocating facility or reducing volume of production.
Q39. Is water current velocity sufficiently strong enough to disperse aquacultural waste products, maximize water exchange and restore oxygen levels but not so strong as to impede the feeding ability of cultured organisms?

A1. yes

Go to Question 39

A2. no

H22. This poses a hazard to benthic organisms. Operator should develop plans to minimize release of settleable solids. If these plans are acceptable, and you are willing to accept risk to the benthos at issue, proceed to Question 40. If not, consider relocating facility or reducing volume of production.

Q40. Will the addition of this facility to other neighboring aquaculture facilities result in adverse cumulative effects on benthic organisms? In other words, will there be an overlap of settleable solids on benthos if this facility is located at the proposed site?

A1. yes

H23. This poses a significant hazard to benthic organisms. Operator should develop plans to minimize release of settleable solids. If these plans are acceptable, and you are willing to accept risk to the benthos at issue, proceed to Question 41. If not, consider relocating facility or reducing volume of production.

A2. no

Q41. Are there known fouling agents (zebra mussels) in proposed facility area?

A1. yes

H24. This poses a hazard to the culture operation (see supporting text). If willing to accept risk, proceed to Section VIII, Impacts on Breeding Areas, Nurseries and Fish-eating Animals. If not, consider relocating facility.

A2. no

Proceed to Section VIII, Impacts on Breeding Areas, Nurseries and Fish-eating Animals.
Section VIII.
Impacts on Breeding Areas, Nurseries, and Fish-eating Animals

Q42. Is the proposed aquaculture species known to migrate to streams and rivers?

- A1 yes
- A2 no

Q43. Are there wild populations of the same species or other fish species that could be adversely affected by biotic interactions with escapees from culture facility during spawning season? Consider the following types of interactions: predation, parasitism, competition, mutualism, disease and multitrophic effects.

- A1 yes
- A2 no

Q44. Is the facility located within a “zone of influence” for a known spawning area?

- A1 yes
- A2 no

H25. Culturing this particular species poses a hazard to wild populations (see supporting text). If willing to accept this risk, proceed to Question 44. If not, recommend culturing a different species or relocating facility away from spawning habitat.

- Accept risk

H26. This poses a hazard to spawning areas due to the potential of habitat degradation from the facility structure or released effluent. If willing to accept this risk, proceed to Question 45. If not, consider relocating facility away from spawning grounds.

- Accept risk
- Go to Question 45.
Q45. Is the facility close to known mammal or bird breeding or nesting habitats or colonies?

A2 no

Proceed to Section IX, Cumulative Impacts Due to Proximity to Other Aquaculture Facilities

A1 yes

H27. The location of this facility poses a hazard to breeding or nesting mammals or birds due to the structure of the facility or its operations. This also poses a hazard to cultured organisms due to possible increased exposure of piscivorous breeders or nesters. Operators must identify methods of minimizing interference with wild nesters including a predator deterrent plan. If plan is acceptable and you are willing to accept risk to breeders and nesters, proceed to Section IX, Cumulative Impacts Due to Proximity to Other Aquaculture Facilities. If not, consider relocating facility to area that is not close to mammal or bird breeding or nesting habitats or colonies.
Section IX
Water Quality and Cumulative Impacts

Q46. Will water quality standards be met under the Clean Water Act’s NPDES, Great Lakes Initiative and other federal, provincial, state and municipal regulations?

A1. yes

A2. no

T6. Do not proceed with culture of organisms unless federal, provincial, state, and municipal water quality standards are met.

Q47. Will proposed level of production maintain water quality within allowable levels stated in the Great Lakes Water Quality Agreement? (Hotlink to Agreement)

A1. yes

A2. no

H28. This poses a risk to water quality by introducing excess nutrients, especially phosphorus into a Great Lake. If willing to accept this risk, proceed to Question 48. If not, production level must be reduced, alternative feed should be used or mechanisms must be put in place to minimize excess aquacultural waste entering the water column.

Q48. Are other aquaculture facilities close enough to create an adverse cumulative effect on water quality? (Hotlink to Canadian Ministry of the Environment and State Pollution Control Agencies)

A1. yes

A2. no

Accept risk

If supporting evidence that cumulative effects can be provided, Proceed to Section X, Impacts of Facility and Infrastructure.

H29. This poses a hazard to water quality by introducing excess nutrients, especially phosphorus into a Great Lake. If willing to accept this risk, proceed to Section X, Impacts of Facility and Infrastructure. If not, production level must be reduced, alternative feed should be used or mechanisms must be put in place to minimize excess aquacultural waste that will enter the water column.
Section X
Impacts of Facility and Infrastructure

Q49. Will additional building of structures or roads be necessary for operation?

A1 yes

Q50. Will new infrastructure or roads adversely affect life cycles of any listed “Species at Risk” or species involved in Fish Community Objectives recovery or rehabilitation plans (Also consider Aquatic biodiversity Investment Areas)? (Hotlink to USFWS, COSEWIC, COSSARO and Fish Community Objectives).

A1 yes

H30. This poses a hazard to “at risk” species or to species undergoing recovery or rehabilitation plans. User should consult with responsible government agency for the species at issue. If you are willing to accept risk, proceed to Section XI, Genetic Effects. If not, recommend relocating facility to area that is less vulnerable to additional construction of buildings or roads.

A2 no

Proceed to Section XI, Genetic Effects.
Section XI.
Genetic Assessment

Q51. Has organism been genetically engineered?

A1 yes

Q52. Has a biosafety assessment been completed for the proposed project using the Manual for Assessing Ecological and Human Health Effects of Genetically Engineered Organisms? (http://www.edmonds-institute.org)

A2. no

Q53. Did the biosafety assessment identify specific hazards posed by the genetically engineered organisms?

A1 yes

User should provide copy of completed worksheet from Manual for Assessing Ecological and Human Health Effects of Genetically Engineered Organisms and then proceed to Question 54.

A2 no


H32. This poses a significant hazard to the Great Lakes aquatic environment. Consider disapproval of project as lake-based aquaculture. Project revision options include: (1) relocation to a secure land-based facility where GEOs and effluent cannot reach a Great Lake, G.L. connecting body or G.L. tributary; or (2) switching to culture of non-engineered organisms.
Q54. Are there wild relatives of the cultured species in the Great Lakes?

A1 yes, wild relatives exist in genetically distinct populations.

A2. yes, wild relatives exist as one panmictic population.

A3. Yes, but population structure is unknown.

H33. This may pose hazards of increased vulnerability to environmental change and decreased production for genetically distinct populations. Fish management agency should assess genetic structure of the species in the Great Lakes and estimate risk. Proceed to Question 57.

Q55. Are any of the genetically distinct populations located in the specific Great Lake that is the site of the proposed aquaculture operation?

A1 yes, wild relatives exist in genetically distinct populations.

A2. no

H34. Reproduction by escaped organisms may pose a hazard of increased vulnerability to environmental change and decreased production of genetically distinct populations in other Great Lakes bodies. Consult with fish population/conservation geneticists to estimate genetic risks from escapees. See supporting text for approach. Proceed to Question 56.

Consulted with fish population/conservation geneticists

Q56. Given the outcome of the risk estimation, is user willing to accept risk?

A2. Accept risk.

A1. Not willing to accept risk.

H35. Because this poses a risk to other genetically distinct populations, risk management options include 1) sterilization 2) relocation to a land-based facility where organisms and effluent cannot reach a Great Lake, G.L. connecting body or G.L. tributary; or 3) culture different species. If option is sterilization, review caveats in supporting text and then proceed to Optional Precautionary Plans; if relocation, go to Land-based Assessment; if using different species, begin Lake-based Assessment again.
Q57. What is the geographical origin of broodstock of the species to be cultured? (Note: if unknown, consult with operator to determine this answer. If still unknown, assume broodstock derived from non-local populations.)

A1. Broodstock was derived solely from a local wild population. Provide supporting documentation.

A2. Broodstock was derived from non-local populations.

Proceed to Optional Precautionary Plans

Q58. Is it feasible to make cultured species permanently sterile?

A1. yes

A2. no or unknown

H36. Escapees from non-local and fertile aquaculture stocks may pose a genetic hazard to populations of wild relatives in the Great Lakes. Consult with fish population/conservation geneticists to estimate the risk of increased vulnerability to environmental change and decreased production (See supporting text for approach), then proceed to Optional Precautionary Plans. Alternatively, users may consider revision of proposal to make risk acceptable either by using a 1) local stock, 2) a non-local stock that can be sterilized, 3) a different species (and return to beginning of assessment tool), or 4) relocating facility to a land-based facility where organisms and effluent cannot reach a Great Lake, Great Lake connecting body or Great Lake tributary. If operator chooses option 1,2 or 3, proceed to Optional Precautionary Plans. If option 4, then go to Land-based Assessment.

Q59. Is operator willing to culture permanently sterile organisms?

A1. yes

A2. no

Ensure that all growout fish are permanently sterile. Proceed to Optional Precautionary Plans.
Q 60. What is the genetic population origin of the species to be cultured? (Note: if unknown, consult with operator to determine this answer. If still unknown, assume source includes non-local populations.)

A1. Sole source is a local genetically distinct population

Proceed to Optional Precautionary Plans

A2. Source includes non-local, genetically distinct population.

Q61. Is it feasible to make cultured species permanently sterile?

A2 no or unknown

H37. Using non-local and fertile populations poses hazards of increased vulnerability to environmental change and decreased production for known genetically distinct populations. Consult with the fish population/conservation geneticists to estimate these risks then proceed to Optional Precautionary Plans. Alternatively, users may consider revision of proposal to make risk acceptable either by using a 1) local stock, 2) a non-local stock that can be sterilized, 3) a different species (and return to the beginning of assessment tool), or 4) relocating facility to a land-based facility where organisms and effluent cannot reach a Great Lake, Great Lake connecting body or Great Lake tributary. If operator chooses option 1, 2 or 3, proceed to Optional Precautionary Plans. If option 4, then go to Land-based Assessment.

A1 yes

Q62. Is operator willing to culture permanently sterile organisms?

A2 no

A1 yes

Ensure that all growout fish are permanently sterile. Proceed to Optional Precautionary Plans.