WORLD FEDERATION OF ENGINEERING ORGANIZATIONS

WFEO Model Code of Practice for
Sustainable Development and Environmental Stewardship

Interpretive Guide

September 2013

Prepared by:
Committee on Engineering and the Environment

Foreword

This Interpretive Guide serves as an accompanying document to the Model Code of Practice and provides further amplification and explanation to engineers and national engineering organizations to interpret and implement the Model Code of Practice at a practical level. It is intended for practicing engineers who are members of one or more of the national organizations who are members of the World Federation of Engineering Organizations (WFEO). The Model Code of Practice has been prepared as a complement to the WFEO Model Code of Ethics for Engineers.

The Model Code of Practice and Interpretive Guide support the WFEO vision of the global engineering profession supporting the achievement of the United Nations Millennium Development Goals.

The Model Code of Practice and Interpretive Guide reflect the use of engineers' judgement by the use of the 'Should, May, Shall' terminology.[1]

[1] The 'Should, May, Shall' terminology has been generalized from **National Guideline on Environment and Sustainability**, Engineers Canada (2006). Retrieved on April 20, 2011 from http://www.engineerscanada.ca/e/pu_guidelines.cfm

The word *should* is used to indicate that among several possibilities, one is recommended as particularly suitable without necessarily mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is disapproved of but not prohibited (*should* equals *is recommended that*). The word *may* is used to indicate a course of action permissible within the limits of the guide (*may* equals *is permitted*).

Governing bodies for engineers who wish to adopt a version of the Model Code of Practice and Interpretive Guide in whole or in part are advised to consider substituting the word *shall* for the word *should* to indicate requirements that must be followed (*shall* equals *is required to*) to effectively implement in their jurisdiction.

Governing bodies for engineers who wish to reference or recommend, instead of adopting, the Model Code of Practice and Interpretive Guide in whole or in part, are advised to communicate that the Model Code of Practice and Interpretive Guide are voluntary i.e. it is not binding on their organization or its individual engineers unless they wish to make it so.

National bodies who register but do not necessarily govern engineers may wish to adopt or endorse this Model Code of Practice and Interpretive Guide voluntarily as a best or preferred practice to assist their members.

The Model Code of Practice and Interpretive guide are also relevant to natural science disciplines such as geoscience and planning. These disciplines are closely related to engineering and their areas of practice often overlap in work undertaken in development and environment contexts. Engineering and related disciplines also utilize expertise from the social sciences such as economics, finance and law. Collectively these professions will be instrumental in realizing the promise of sustainable development and environmental stewardship.

It is recognized that many engineers, and other professionals like geoscientists and planners, may be embedded within governments and other organizations in a managerial capacity that does not require engineering. As such their expertise may not be formally recognized and they may not even consider themselves as being practicing professionals. But in fact they often have significant influence in the decision making process. It is intended that the Model Code of Practice and Interpretive Guide will be useful to them in their professional activities and in their dealings with other practicing professionals and in soliciting the support of their respective professional organizations.

The title Engineer is normally given to a person who is allowed to engage in engineering under local law. In many jurisdictions this is a protected title given to a person licensed to practice as a "Professional Engineer" or "Engineer" under an applicable legislative act. Engineers may however practise under various titles in different jurisdictions. The differing use of titles for engineers is reflected in this document.

1.0 Introduction

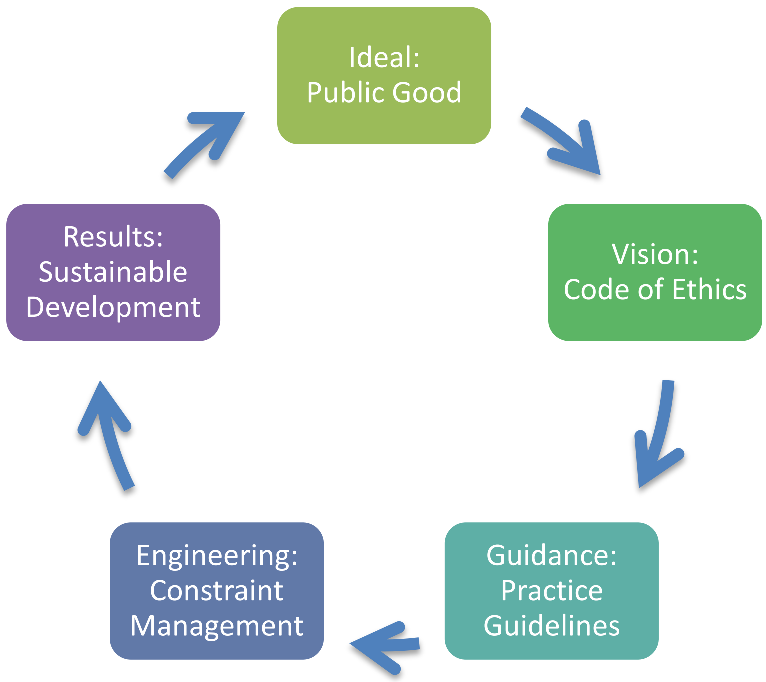
Engineers are not only concerned with developing projects that are sustainable, but also with a wide variety of environmental management responsibilities that impact society and the environment.

Engineers may be considered as structured problem solvers. If a problem is not defined then they will seek to define it and, if the scope for acceptable solutions is not given then they will try to identify the constraints. The issue of the "public good" figures prominently in the concepts of solutions and constraints.

The practice of engineering continues to evolve over time through a process of continuous improvement. This includes not only the technological aspects but the human aspects as well. Pursuit of the ideal of the "Public Good" through sustainable development contributes to the long-term benefit of society, the economy and the environment. As subject matter experts, engineers can have considerable influence on how an issue is dealt with on behalf of their client. There are few unambiguous standards to guide them and it is here where the role of engineering judgement comes into play.

In the practice of engineering the engineer uses their expertise and experience to develop strategies and tactics to deliver solutions to their clients. This places a potential burden on the engineer to consider not only narrow problems and the immediate solutions as may be requested but also whether there are implications for other stakeholders that must be considered within a wider context.

Figure 1
Engineering and the Public Good



In most countries, engineers and the profession are members of national, regional or state organizations, each with a **Code of Ethics**[2] that provides general guidance on the appropriate relationship of the engineer with the public, with clients and with other professional communities. Implicit in the concept of 'public' is the society and its economy, and the environment in which the society and economy resides. It is desirable to have some inclusion of the concepts of sustainable development and environmental stewardship within: the Engineering Code of Ethics, the various guidelines used to support professional practice and, across the range of activities that constitute Continuing Professional Development.

Guidelines are produced by engineering organizations to help engineers in their practice so that they can be comprehensive and consistent in their treatment of an issue. They typically consider the overall management of an area of engineering practice and can include the relationship between the engineer and various stakeholder communities.

This Model Code of Practice and Interpretive Guide are intended to explain the link between ethics and professional practice by considering engineering in the wider context of sustainable development and environmental stewardship. The Model Code of Practice is presented for consideration by the governing and registering bodies of engineers and other practitioners that they may register or govern. It may be posted on a wall as an engineer's expression of commitment

1.1 List of Definitions

There are numerous terms used to refer to the concepts of Sustainability, Development, Environment, Stewardship and other combinations thereof. It should be expected that local variations of such terms will be in use in different countries and in specific areas of engineering practice. This is quite reasonable provided that specific terms with explicit definitions, complemented with explanatory text, are cited by the user. The objective should be clarity rather than universality.

Engineers are advised to be wary of intentionally weak or vague definitions that are meant to circumvent professional practice and accountability. Engineers are encouraged to take advantage of internationally recognized definitions and adapt them to local use. It is in the local or community context where sustainable development and environmental stewardship occur, and where goals are set against which measurement of progress can be made.

For the purposes of this Interpretive Guide and use in engineering practice, the following set of standardized terms and definitions are suggested. Engineers are encouraged to consider how these could be applied within their local context.

Acquiescence
To accept or comply passively, without question or objection

[2] Note that there is no single universal Code of Ethics for engineers. While local versions of a Code of Ethics may vary in form from one jurisdiction to another they are however fairly consistent in terms of the concepts embraced.

Adverse Effect
Impairment of, or damage to: 1) the environment, 2) societal health and safety, and 3) property and functioning of the economy.

Climate Change
A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.[3]

Climate Change Adaptation
The process of engineering decision-making for adjustments in human or natural systems in response to vulnerabilities to climatic changes, that moderates harm or exploits beneficial opportunities.

Climate Change Mitigation
The reduction of anthropogenic Greenhouse Gas emissions by reducing the releases from sources and increasing the uptake by sinks to reduce overall radiative forcing in the atmosphere

Conservation
The planning, implementation and ongoing management of an activity to protect the set of physical, chemical and biological characteristics of the environment necessary to maintain the health of the natural world

Continuing Professional Development
The training and/or engineering practice, which enhances an engineer's skills, knowledge and ability to practice engineering. These activities typically include the application of theory, management of engineering, communication or understanding the social implications of engineering.[4]

Cost-Benefit Analysis
An economic analysis method that expresses the costs of an activity, in comparison to the benefits, using common units, to aid decision-making; The analysis would normally include capital, operating, maintenance, commissioning and decommissioning, social, and environmental costs.

[3] United Nations Framework Convention on Climate Change, (March 21, 1994) ARTICLE 1 Definitions. Retrieved on April 2011 from http://unfccc.int/essential_background/convention/background/items/1349.php

[4] Engineers Canada (2004) Guideline on Continuing Professional Development and Continuing Competence for Professional Engineers Retrieved on July 12, 2011 from http://www.engineerscanada.ca/e/files/guidelinecompetency2004.pdf

Cradle to Cradle
An approach that looks beyond efficiency to systems that are essentially waste free All material inputs and outputs are seen either as “technical” nutrients that are indefinitely reusable by society or as “biological” nutrients that are recyclable by nature.

Cumulative Effects
Cumulative effects are changes to the environment that are caused by an activity in combination with other past, present and future human activities. Individual effects that are incremental, additive and synergistic can lead to cumulative effects and must be considered collectively and over time, in order for a true measure of the total effect and associated environmental costs of an activity to be assessed.

Due Diligence
The care that a reasonable person exercises under the circumstances to avoid harm to other persons, property and the environment.

Ecosystem
The interactive system involving all of the organisms in a specified area, their interactions with each other, energy and material flows and the components of air, land and water.

End-of-Life
For goods and services, the period after which a product is expected to have reached the end of its useful or serviceable life, or when a service would no longer be expected to be available from the service provided.

Engineer
The title given to a person who is allowed to engage in engineering under local law In many jurisdictions this is a protected title given to a person licensed to practice as a “Professional Engineer” or “Engineer” under an applicable legislative act.

Environment
The natural and built components of the earth and includes:

i) air, land and water;
ii) all layers of the atmosphere and oceans;
iii) all organic and inorganic matter, and all living organisms; and,
iv) the interacting natural systems that include components referred in sub-clauses (i), (ii) and (iii) above.

The human built environment exists within the natural environment.

Environmental Assessment
The identification and evaluation of the effects of an undertaking and its alternatives on the environment

Environmental Audit
A systematic, documented, objective review of the manner in which environmental aspects of a program, project, facility or corporation are being managed

Environmental Impacts and Effects
An impact on the environment can lead to various effects. Impacts are primary events; they have magnitude and can lead to subsequent effects. Effects are secondary events; they have significance and may be good or bad, singular or multiple, immediate or distributed across time and space, and could be isolated or cumulative.

Environmental Impairment
Damage, harm or loss to the environment

Environmental Management System (EMS)
A continual cycle of planning, implementing, reviewing and improving the processes and actions that an organization undertakes to meet its business and environmental goals Most EMS's (i.e. ISO 14001) are built on the "Plan, Do, Check, Act" model. This model leads to continual improvement based upon:

- establishing policy or strategic direction;
- planning, including identifying environmental aspects and establishing goals [Plan];
- implementing, including training and operational controls [Do];
- checking, including monitoring and corrective action [Check]; and,
- reviewing progress and acting to make needed changes to the EMS [Act]

Environmental Protection
Measures and controls to prevent damage and degradation to the environment, including the sustainability of its living resources

Environmental Specialist
An individual not limited to engineers, who is qualified with training, knowledge and experience in a field or discipline of science dealing with the environment.

Environmental Stewardship
The wisest use of the finite resources in nature to produce the greatest benefit while maintaining a healthy environment for the foreseeable future.

Extended Producer Responsibility
A scheme under which producers assume responsibility for disposal costs that can reasonably be expected to arise when their products reach End-of-Life. This usually involves some up-front securitization mechanism.

Hazardous Substance
A substance or mixture of substances, other than a biocide, that exhibits characteristics of flammability, corrosivity, reactivity, toxicity or other harmful effects when released into the environment.

Hazardous Waste
A category of waste requiring special handling, treatment or disposal as specified in currently applicable regulations.

Innovation
An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.[5]

Liability
Legal responsibility to another or to society, which is enforceable by civil remedy or criminal penalty

[5] Definition from: Organisation for Economic Co-Operation and Development, Statistical Office of The European Communities, (08 Nov 2005). **Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data , 3rd Edition**. Page 46. ISBN 92-64-46 01308-3. Retrieved on (July 21, 2011) from http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/OSLO/EN/OSLO-EN.PDF

Life-Cycle Assessment
Assessing the environmental effects of a chemical, product, project, development or activity from its inception, implementation and operation through to termination or decommissioning.

Mitigation
In respect to a project, the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means.

Persistent Effect
A compound or substance that is resistant to degradation processes, and has the potential to accumulate in the environment and exert long-term environmental effects.

Precautionary Principle
Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.[6]

Quality of Life
The factors related to the state of health and well-being of an individual or a community.

Reclamation
The removal of equipment, buildings or other structures or appurtenances; and the stabilization, contouring, maintenance, conditioning or reconstruction of the surface of land resulting in a biologically productive landscape that is equivalent to pre-disturbed state.

Recycle
To do anything that results in providing a use for a thing that otherwise would be disposed of or dealt with as waste, including collecting, transporting, handling, storing, sorting, separating and processing the thing, but does not include the application of waste to land or the use of a thermal destruction process.

Remediation
The process of correcting or counteracting the contamination of structures, land or water to meet or exceed specified requirements. Requirements may be regulatory or set by stakeholders but must be specific.

[6] Definition from: Principle #15 of the Rio Declaration

Societal Values
The attitudes, beliefs, perceptions and expectations generally held in common in a society at a particular time.

Stakeholder
A person or organization that is directly involved with, or affected by, a development, product, or activity and therefore has an interest in it

Sustainability
Ability to meet the needs of the present without compromising the ability of future generations to meet their own needs, through the balanced application of integrated planning and the combination of environmental, social, and economic decision-making processes.

Sustainable Development
Sustainable development is development that meets the social, economic, and environmental needs of the present without compromising the ability of future generations to meet their needs[7].

Sustainable Economic Development
One of numerous variants of the term Sustainable Development [There is little consistency among definitions for this and other related terms in the literature. This term in not defined in this document and its use is avoided in the guidelines.]

Valued World Component
Any part of the social, economic and environmental system that is considered important based upon cultural values, resource impacts and environmental concerns.

Vulnerability
The degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate, including climate variability and extremes or any other natural events or man-made activity

Waste
Any material or substance that is unwanted by its generator

World
The world is the entire earth. It consists of both of the natural environment and the human built environment; plus the people, their society and their global economy.

[7] Definition from: Brundtland Commission report

2.0 Defining Sustainable Development and Environmental Stewardship

The modern concepts of environment and of sustainability emerged in the later part of the 20th century. The level of awareness and understanding of these concepts is still low across much of society and their application is not well integrated into engineering practice. The concepts themselves are still evolving and are moving towards a more integrated methodology. For professionals in many jurisdictions, these concepts are likely to be managed, if at all, as separate objectives. For the purpose of the Model Code of Practice and this Interpretive Guide, they are discussed as two complementary themes and then integrated into a single comprehensive framework.

2.1 What is Sustainable Development?

Sustainable Development[8] is a challenging concept to define precisely. Many professional groups, including engineering organizations, have developed specific; though often discipline centric, definitions for their area of practice. Although these definitions contain many common themes they nonetheless vary considerably from country to country and even across different disciplines within a given country. Often they are problematic in that they do little to distinguish between what are our discretionary wants versus what are our essential needs.

The Brundtland Commission considered the issue of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given. It also considered the idea of 'limitations' imposed by the state of technology and social organization on the environment's ability to meet present and future needs. In 1987 it published what is perhaps the broadest, best known and most widely accepted definition of sustainable development:

> "Sustainable development is development that meets the social, economic, and environmental needs of the present without compromising the ability of future generations to meet their needs." [9]

The Brundtland definition is used throughout this Guideline.

---

[8] The term "sustainable development" was first proposed by the World Commission on Environment and Development (WCED) in its 1987 report Our Common Future (also known as the Brundtland Commission report after its Chair Gro Harlem Brundtland). See http://www.un-documents.net/wced-ocf.htm

[9] The Brundtland Commission, included 23 members from 22 countries, was formed by the United Nations in 1984, and for three years studied the conflicts between growing global environmental problems and the needs of less-developed nations. See http://en.wikipedia.org/wiki/Brundtland_Commission)

2.2 What is Environmental Stewardship?

Environmental Stewardship is a more difficult concept to define than sustainable development. Few organizations have developed organizational centric definitions for environmental stewardship in their own area of interest. Stewardship means to take care of something even if it does not belong to you. Environmental stewardship has largely been the concern of governments and a few non-governmental organizations – as such it has often been addressed implicitly as a result of some narrower objective such as protecting an endangered species or preserving a representative area in a threatened ecosystem.

It is generally accepted however that over the long-term the health of our society and its economy are dependent on the health of the environment. While this is fairly easy to understand when taken in narrow perspectives, such as protecting farmland or the drinking water supply, it is more challenging when we consider society as a whole within the broader environment. Since human society is a part of the environment however, it is reasonable to suggest that protecting and enhancing the environment over the long-term is good for society.

So for the purposes of the Model Code of Practice, Environmental Stewardship is defined as:

> 'Environmental Stewardship is the prudent use of the finite resources in nature to produce the greatest benefit while maintaining a healthy environment for the foreseeable future'.

This concept of 'maintaining a healthy environment' is considered in the development of the Model Code and this Interpretive Guide for the application of sustainable development by engineers.

2.3 Relationship between Sustainable Development and Environmental Stewardship

Environmental stewardship is about keeping what we have while sustainable development is about getting what we need. Sustainable development is not merely focused on the present but is also about being able to continue to get what we need in the future. Likewise environmental stewardship is not merely focused on the past but is also concerned with maintaining things into the future. The two concepts meet in the present and carry forward together. We cannot fully satisfy one without satisfying the other. Indeed if the environment was under stress or damaged it would be to our benefit to facilitate its recovery in the interest of long-term sustainability.

While it is reasonable and indeed inevitable that non-renewable resource extraction will occur, this type of endeavour is always finite. Eventually we are forced to find new resources, to make better use of what we have, or undertake some combination of the two. Conservation has often been suggested as an alternative approach but the term can mean vastly different things to different people. Conservation is also really just a starting point and in a finite world we must continue to move towards true sustainability if our future needs are to be satisfied.

Sustainable development cannot be undertaken without consideration of environmental stewardship. Development almost always impacts the environment and yet true sustainable development includes consideration of "environmental needs". It is a necessary, though for some problematic, aspect of sustainable development that we must do better than merely protecting that portion of the environment that remains after development. Engineering provides powerful tools for dealing with these issues and can do so by advancing the application of sustainable development and environmental stewardship.

Conversely, environmental stewardship cannot be undertaken without consideration of sustainable development. It is possible that environmental stewardship could be limited to protecting/enhancing a portion of the environment and that there is no development aspect involved. We would be remiss however if we did not consider whether development in other places and times could potentially compromise local environmental stewardship efforts. Environmental stewardship therefore may or may not include an immediate sustainable development aspect but it does need to consider the inherent risk from future sustainable development efforts. It may be unadvisable to expect that such sustainable development efforts, however well intentioned, would always include consideration of previous environmental stewardship efforts.

2.4 Development that Encompasses Stewardship

Over the long-term the health of our society and its economy are dependent on the health of the environment. Sustainable development rarely comes without impacts to the environment and environmental stewardship rarely occurs without costs to the economy. In order for a society to protect and preserve the environment it must be able to afford to do so. For this to happen sustainable development and environmental stewardship must jointly inform our decision making. It seems reasonable therefore that without environmental stewardship we cannot have sustainable development and that without sustainable development we cannot afford environmental stewardship.

> "Effective environmental stewardship requires all of us to manage natural resources in ways that protect and enhance – rather than compromise – the ability of future generations to meet their own needs"[10]

The term sustainable development is very useful for the purpose of communicating within the profession and with other stakeholders in society at large. For the purpose of the Code of Practice and this Interpretive Guide sustainable development is recognized as a fully developed and inclusive concept with environmental stewardship explicitly included as part of an integrated sustainable development framework.

---

[10] United States Environmental Protection Agency, (2005). Everyday Choices: Opportunities for Environmental Stewardship - Technical Report. Retrieved on April 2011 from http://www.epa.gov/environmentalinnovation/pdf/techrpt.pdf

2.5 The Engineers Role

The engineering profession plays a significant role in economic development and in protecting the environment. As such it is ideally situated to play a significant role in sustainable development. If engineers are to be relevant to current and future generations and provide guidance and leadership to society, then a more proactive approach to sustainability is required. This Model Code of Practice and Interpretive Guide will assist the engineer to pursue this role.

Engineers across many disciplines are involved at various levels in the development and management process. This may be proactive across a "cradle to cradle" management-of-resource process. But much of engineering practice may be more limited in its temporal scope:

- Some of this may be neutral as in infrastructure development that has been subjected to an environmental impact assessment process.
- Some of this may be negative where little thought may have been given to the post-project phase.
- And some of this may be positive such as in the remediation of contaminated sites.

The engineering profession is usually neutral – it tends to provide guidance of a practical nature and advocates for informed decision making. Engineering projects however are usually not neutral – most engineering outcomes affect the environment, the economy that functions within the environment, and the people who work in the economy and live in the environment.

Given their technical capabilities and their role in many design and management processes, engineers have the opportunity to influence many broad and long-term outcomes. Often this is done in the name of economic and resource efficiency. Short-term environmental impacts are often considered as a design constraint. Broader long-term environmental outcomes are much more difficult to predict, may lead to unintended consequences[11] and therefore present a significant challenge for the engineer. For instance, engineers are often pressured to consider short-term cost cutting measures which may compromise sustainable development or that may have long-term consequences that are beyond the scope of their current mandate.

[11] The Law of Unintended Consequences is an adage or idiomatic warning that an intervention in a complex system always creates unanticipated and often undesirable outcomes. See http://en.wikipedia.org/wiki/Unintended_consequences

Engineers often undertake 'value engineering' where they seek to improve products and processes by considering their function and cost. This is an excellent opportunity to pursue sustainable development through more efficient use of resources and the production of better goods and services. Engineers however should not use value engineering for the sole purpose of reducing costs.

Engineers work as employees, employers, researchers, academics, consultants, and in regulatory and managerial roles. They frequently work as a team where they are involved with other specialists and this means that they may or may not have control of, or be solely responsible for, a particular project. To the greatest extent possible however, engineers should understand and manage the environmental aspects of projects that they are involved with.

"Engineers are involved with two kinds of projects:

1. They design and build projects that meet basic human needs (potable water, food, housing, sanitation, energy, transportation, communication, resource development and industrial processing).
2. They solve environmental problems (create waste treatment facilities, recycle resources, clean up and restore polluted sites and protect or restore natural ecosystems)."[12]

Engineers also participate in a broad range of activities such as the designing, building, commissioning, managing and decommissioning of projects that may provide goods and services and/or solve environmental problems. They also provide technical advice that influences many other decision-makers. If the profession is to expand its role to ensure that it is part of the solution rather than part of the problem, then it is crucial to ensure that its participation truly considers the public good over the long-term and that its input is provided at all levels.

It is well understood that 'environmental engineers' are concerned with protecting the environment from the potentially harmful effects of human activity, and with protecting society from the effects of adverse environmental factors. This concept appears to some limited extent across the various engineering disciplines. All engineers however need to consider the impact that their undertakings (i.e. systems and structures) will have on the environment and what effect the environment may have back on those undertakings.

Engineers are faced with a dilemma however. They are usually neither the ultimate decision maker for a project nor do they necessarily reflect the perspective of the local community. Both these factors, namely the decision making constraint and the need for sensitivity, must be recognized and respected if the engineer is to influence the development and management process. In some cases the engineer may have significant support in pursuing sustainable

[12] World Federation of Engineering Organisations, (2002). Engineers and Sustainable Development, Prepared by the World Federation of Engineering Organisations' Committee on Technology, August 2002. Retrieved on December 2010 from http://www.sudvel-uofk.net/Engineers%20for%20sustainable%20development/WFEOCDText9-02.doc

development and environmental stewardship. In other cases the best that can sometimes be hoped for is for the engineer to improve the outcome of what might have otherwise occurred without their input. In either case the engineer has the potential to contribute positively to the future and can do so by providing leadership within their area of practice.

3.0 The Model Code of Practice – "Think Global and Act Local"

1. Maintain and continuously improve awareness and understanding of environmental stewardship, sustainability principles and issues related to your field of practice.

2. Use expertise of others in the areas where your own knowledge is not adequate to address environmental and sustainability issues.

3. Incorporate global, regional and local societal values applicable to your work, including local and community concerns, quality of life and other social concerns related to environmental impact along with traditional and cultural values.

4. Implement sustainability outcomes at the earliest possible stage employing applicable standards and criteria related to sustainability and the environment.

5. Assess the costs and benefits of environmental protection, eco-system components, and sustainability in evaluating the economic viability of the work, with proper consideration of climate change and extreme events.

6. Integrate environmental stewardship and sustainability planning into the life-cycle planning and management of activities that impact the environment, and implement efficient, sustainable solutions.

7. Seek innovations that achieve a balance between environmental, social and economic factors while contributing to healthy surroundings in both the built and natural environment.

8. Develop locally appropriate engagement processes for stakeholders, both external and internal, to solicit their input in an open and transparent manner, and respond to all concerns – economic, social and environmental in a timely fashion in ways that are consistent with the scope of your assignment. Disclose information necessary to protect public safety to the appropriate authorities.

9. Ensure that projects comply with regulatory and legal requirements and endeavour to exceed or better them by the application of best available, economically viable technologies and procedures.

10. Where there are threats of serious or irreversible damage but a lack of scientific certainty, implement risk mitigation measures in time to minimize environmental degradation.

4.0 Model Code of Practice for Sustainable Development and Environmental Stewardship – Amplification and Commentary

The following sections provide further explanation and guidance on the 10 principles that comprise the Model Code of Practice.

4.1 Model Code of Practice #1 – Maintaining and Improving Knowledge and Competency

Maintain and continuously improve awareness and understanding of environmental stewardship, sustainability principles and issues related to your field of practice.

AMPLIFICATION

- Engineers should recognize the general extent to which their professional activities can affect the environment and sustainability. They should have a working knowledge of sustainability considerations and issues.
- They should recognize the importance of Environmental Management Systems (EMS) to identify, control, and reduce these effects.
- They should stay informed of the major environmental issues facing society so that they may broadly judge the potential interaction of their professional activities with those issues.
- They should maintain their expertise and keep up with advancements in technology and increased specialization as a part of due diligence and the application of reasonable care.

COMMENTARY

Sustaining the viability of our environment is a broad responsibility of all citizens. Likewise, our society must seek to reconcile these environmental needs with our need for responsible development. Engineers should take a pro-active and cooperative role to assist society to meet these challenges. This could apply even though the individual professional activities of some members may primarily involve expertise that is apparently unrelated to environmental matters.

Engineers are responsible for maintaining their knowledge in areas that have a bearing on the quality and effect of their work. As society has developed an increased awareness of the degree to which development activities can affect the environment, so the engineers involved in designing and implementing developments must maintain a reasonable level of understanding of those environmental concerns, and the possible significant effects of their professional activities on the environment.

The foregoing responsibility does not imply that every individual engineer can or should be an environmental specialist. As with any other specialization, there will be degrees of environmental expertise that will be required for specific circumstances. The general obligation is to possess sufficient knowledge of relevant environmental issues to be able to competently judge the degree of need for specialist assistance. Given the normal technical responsibilities of engineers, society may expect them to anticipate and understand environmental problems.

Legal responsibilities such as environmental legislation can place responsibility for environmental impairment on any individual. In such cases, a defence for the individual may have to rely upon demonstrating due diligence; the premise that the individual took all reasonable measures to mitigate the problem or adapt to the situation. An important element of due diligence is being able to document that reasonable care has been exercised. The individual can ensure a high level of due diligence by ensuring that, where appropriate, activities take place within an adequate Environmental Management System, which is either consistent with or formally certified to a recognized standard.

Maintaining expertise is also a part of due diligence and the application of reasonable care. There are many challenges to this including increased specialization, devolution of routine work to technologists and technicians, increased use of information technology and automation, and the expansion of skills and areas of practice beyond traditional engineering science.

Established methodologies are often applied simply because they are easy and generally accepted. Advancements in technology, and improved approaches to planning and management, mean that innovation can often enable a better solution. In some cases innovative solutions can even enhance the environment at little or no cost. Engineers should strive to advance the state of the art in their professional area and pursue innovations that can help advance the application and effectiveness of sustainable development.

The 21st century is observing an increase in the role of information technology and connectivity that is significantly impacting the practice of engineering. There is an increasing need for cooperation between different professions – that requires improved communication skills and a deeper understanding of the role of engineering in society. Engineering is also becoming increasingly globalized with work done in jurisdictions with high levels of education but lower labour rates. Regardless of how this develops it is likely that engineering, and those who practice it, will evolve to serve this wider market that will be seeking broader engineering services than those traditionally offered.

Sustainable development is an emerging aspect of engineering practice and in many areas is overtaking the more narrow discipline-specific activity of 'protection of the environment'. This practice of sustainable development can be expected to evolve and engineering education and continuing professional development will need to include an understanding of sustainable development.

4.2 Model Code of Practice #2 – Limits to Competency

Use expertise of others in the areas where your own knowledge is not adequate to address environmental and sustainability issues.

AMPLIFICATION

- Engineers should recognize that environmental issues and sustainability are interdisciplinary in nature, requiring the expertise of a range of disciplines.
- They should undertake only that aspect of environmental work that they are competent to perform by virtue of education, training and experience.
- They should seek out and use environmental specialists to provide expert advice on environmental issues.
- Disciplines outside of engineering should be consulted, particularly for the social and external economic impacts that are generally outside of molst engineering training and practice.

COMMENTARY

As the practice of environmental science requires the integration of diverse disciplines and philosophies, many projects will require a team of specialists to address complex environmental issues. Engineers should undertake only that work that they are competent to perform by virtue of education, training and experience.

Integrated decision-making that includes the expertise of knowledgeable specialists is often required in environmental issues. This is especially true when dealing with hazardous substances that may be released into the environment, whether on purpose or by accident, over the life of a project. Hazardous waste may also be generated by a project during its construction or at the end-of-life when the project is decommissioned. Throughout the lifecycle of a project the control of hazardous substances and hazardous wastes needs to be considered and this often requires specialized expertise from many disciplines.

4.3 Model Code of Practice #3 – Social Impacts

Incorporate global, regional and local societal values applicable to your work, including local and community concerns, quality of life and other social concerns related to environmental impact along with traditional and cultural values.

AMPLIFICATION

- Engineers should recognize that keeping a broad perspective beyond one's own locality and the immediate future is healthy for the profession and for society. They should also note that local conditions and social impacts influence the options available and the subsequent engineering actions.
- They should also identify the positive and negative effects of proposed actions outside the immediate local environment and over the long-term.
- Seeking information and input on societal values and ensuring these are considered in engineering will help maintain or even enhance these values and the quality of life.
- Engineers are often given specific instruction as to the problem to be addressed and the type of solution that is expected. However, merely solving the problem as given may have unintended consequences. Engineers should look beyond the initial solutions given to them to better understand the consequences to the public and account for them in the implementation.
- They are encouraged to entertain a healthy scepticism on behalf of the public good. Engineers' responsibility is with the public and all of the pertinent issues of the problem require assessment.

COMMENTARY

Incorporating sustainable development into projects is a logical extension of the traditional broad but local view of the public good. Engineers need to consider the wider implications of their proposed solutions. Engineers should 'Think Global and Act Local', that is they should take a big-picture long-term perspective. To the extent that information and technology enables the profession the public good should be paramount from the here-and-now to the then-and-there.

Traditional and cultural values may be of vital importance in the assessment of impacts in some societies in the world. Consultation processes need to be planned and executed to ensure that these values are defined and understood by all stakeholders. These can be accounted for in the development of engineering solutions to minimize negative social impacts on tradition and culture.

Most engineering outcomes affect the environment, the economy that functions within the environment, and the people who work in the economy and live in the environment. When engineers implement solutions they are trying to satisfy their clients' requirements while protecting the public. Engineering projects however are usually not neutral and can have unintended consequences that need to be considered.

The first principle of the engineers Code of Ethics is to "hold paramount the safety, health and welfare of the public". This has traditionally been centred on the idea of safety but is usually considered in broad terms - hence the concepts of health and welfare are also included.

When relying solely on traditional practices and existing permitting processes to protect the interests of the environment engineers should always be vigilant of the intent of sustainable development. What may be considered safe or harmless in the short-term may not be so over the long-term. There is also the danger of externalizing or exporting risk to others outside of the local environment. The health and welfare of the local public may be safeguarded but that of broader community may be at risk.

4.4 Model Code of Practice #4 – Sustainability Outcomes

Implement sustainability outcomes at the earliest possible stage employing all applicable standards and criteria related to sustainability and the environment.

AMPLIFICATION

- Engineers should begin the environmental assessment process at the earliest planning stages of an initiative to provide the basis for project life-cycle environmental management.
- The assessment of impacts should consider scientific research, engineering design principles and local operating experiences.
- Engineers should follow and comply with procedures and requirements for environmental assessment established by government authorities where these exist.
- They should explore, develop and document criteria which reflect known standards that may apply, relating to sustainability, design or carrying capacity and in accordance with scientific research and experience, with respect to projects, or initiatives, which they are planning or designing.
- They should recognize the value of multi-disciplinary involvement, including the natural and social sciences, in the decision making process for projects having environmental impacts.
- They should identify and promote cost-efficient solutions and approaches in integrating environmental, social, and economic considerations, which reflect the concepts of sustainability.
- They should communicate all relevant technical, economic, environmental, and social information to the decision-makers who are responsible for the environmental impact assessment process.

COMMENTARY

Engineers should bring the same structured problem solving approach to the environmental review process as they do in engineering design, where known criteria, standards and procedures are applied in the planning, design development and life-cycle assessment process.

The recognition of specialist responsibility in this area is paramount. The engineer must be vigilant in selecting a process or assembling a team to apply sufficient expertise to the proposed development.

Of similar concern is the need for engineers to recognize societal values applicable to the social and economic effects of developments and their contribution to sustainable outcomes. Local and neighborhood concerns, quality of life, specific effect concerns (e.g. visual, sound, odour), along with traditional and cultural values, have all gained acceptance as pertinent and definable criteria that many jurisdictions are now interpreting and applying.

The engineer must be aware of applicable local environmental codes and standards which may be applicable in the country or region where a project may be located or a product may be used. International standards from organizations such as the International Standards Organization may be required or may enhance sustainability where no standards exist. It is incumbent on the engineer to determine if such standards exists and apply them or use an alternative such as ISO in locations where there are no such standards or requirements for environmental assessment.

Engineers should bring their expertise and comprehensive approach to problem solving, to optimize the returns of a project, product or service to society at large.

4.5 Model Code of Practice #5 – Costing and Economics

Assess the costs and benefits of environmental protection, eco-system components, and sustainability in evaluating the economic viability of the work, with proper consideration of climate change and extreme events.

AMPLIFICATION

- Engineers should conduct an economic analysis of their project in comparison to the benefits. The analysis should normally include all capital, operating, maintenance, commissioning, decommissioning, social, and environmental costs.
- They should include environmental protection and sustainability in life cycle assessment for comprehensive project costing.
- Engineers involved in manufacturing should consider the true costs which include use of a raw resource, manufacturing, by-products and end-of-life disposal.
- They should recognize that environmental protection and associated costs are an integral part of project development.
- An assessment of the costs and benefits of mitigating climate change through GHG reductions should also be considered.
- Engineers should consider the costs of adapting their work to improve resilience to the impacts of changing climate and extreme weather.

COMMENTARY

In theory the engineering objective is the most sustainable solution that can be cost-effectively obtained. In practice the profession is competitive and subject to many competing interests that constrain system wide and life-cycle thinking.

Engineers usually must provide the technical detail that will form the basis for costing developments, even if the overall decisions about proceeding with a development are the responsibility of others. Consideration of the full scope of environmental costs at the earliest possible stage of project development will often provide considerable cost savings, as compared with retrofitting or remedial actions. Project costing must now routinely consider the full, life-cycle costs, from project conception to final decommissioning. If the technical detail for the project life-cycle fails to consider the full scope of environmental costs, then project decision makers may reach an invalid decision about the true economic viability of a project.

These environmental costs may include: prevention, mitigation or compensation for adverse effects, operational and long term monitoring, inspection and maintenance and decommissioning and reclamation costs. Although it was once common to externalize some or most of these costs, current awareness and resulting legislation are requiring that environmental costs be assigned to project proponents. Consequently, engineers need to advise the responsible parties of these obligations.

4.6 Model Code of Practice #6 – Planning and Management

Integrate environmental stewardship and sustainability planning into the life-cycle planning and management of activities that impact the environment, and implement efficient, sustainable solutions.

AMPLIFICATION

- Engineers should recognize that many of their projects are likely to have impacts on the environment. Effects to be considered should include air, land and water pollution, dust, noise and visual pollution, electromagnetic pollution and other environmental factors that may impact on human beings as well as the natural environment.
- They should identify the possible environmental effects and sustainability of all substantial aspects of a project (e.g. design, construction, operation and decommissioning), using the life-cycle assessment approach.
- Prevention of adverse effects is the preferred option, followed by mitigation. This is best done under a risk assessment / risk management approach.
- They are encouraged, in assessing project alternatives, to seek opportunities not only to protect, but also to enhance the environment and its sustainability.
- They should, where possible, work within an Environmental Management System that requires the identification and prioritization of environmental aspects and the organization of cost-effective programs to control and reduce the related effects for the ongoing operation.
- They should know how to design and understand the operation of infrastructure to minimize the effects of long term changes in the environment including the impacts of the changing climate.
- They should identify the sources, types and quantities of resources required to complete a project and undertake to find innovative ways to minimize the need for the resources, especially resources with scarcity issues. Priority should be given to the use of local materials, products and services.
- They should make reasonable investigations as to the individual and cumulative effects on other micro ecosystems in the vicinity of the work being completed as well as the social and economic implications.
- They should take into account the short and long-term as well as direct and indirect consequences.
- They should assess reasonable alternative concepts, designs and/or methodologies.
- They should, wherever applicable, monitor the effect of changing climate on standard design practices and adapt their daily decisions and project designs to accommodate these changes as they evolve.
- They should comply with all relevant legislation, approvals and orders relating to the sustainable treatment of resources and disposal of same resources and by-products. In

addition, even where not required by legislation, approvals or orders, they should arrange to increase the lifecycle of a resource as a means to increase sustainability.

COMMENTARY

Engineers must recognize that societal expectations and demands for environmental protection are such that if environmental effect prevention and mitigation is not inherent in the initial project development, it will likely be required subsequently, probably at much higher cost and after public debate.

Almost every aspect of a project can have either direct or indirect environmental effects, both positive and negative. Project setting, design, construction, operations, maintenance, decommissioning and reclamation all have environmental consequences, which must be considered early in project evaluation. To effectively address such environmental issues requires a systematic evaluation procedure. Developing effective prevention or mitigation strategies requires integrated project planning. Engineers are encouraged to ensure that such evaluation procedures are in place and are followed so that effective environmental protection strategies are an integral part of their activities. The engineer, as well as the project proponent, has a responsibility to consider environmental effect prevention and mitigation as a part of doing business. Using a risk assessment / risk management approach can help ensure that potential problems are identified early and appropriate measures are taken to avoid them.

Sound engineering, the application of modern technology and innovative design approaches are important aspects in achieving sustainability. All aspects of a project must be fully investigated and their negative effects mitigated. Therefore, the engineer should endeavour to resolve all issues surrounding a project or product before proceeding.

For product development, the appropriate choice of materials, packaging requirements, storage, transportation and end of life considerations are key factors. Alternatives to disposal in landfill, such as reducing, reusing and recycling of products should be considered. The use of the 'extended producer responsibility approach, where products that have reached their end-of-life are managed by the manufacturer, can help minimize resource requirements and environmental impacts over the product's life-cycle. The use of local materials, products and services is one way to contribute to resource efficiency while fostering local involvement in solutions.

Sustainability has, in the past, often focused on the development and use of natural resources. A change in this focus is required. Engineers must understand the effect of all projects on resources, both natural and man-made and should look for alternatives. Although waste minimization is a key part of sustainability so is the effect of a project on its surroundings. As well, many projects also present an opportunity to consider planning and design alternatives that may actually enhance the environment by having a positive effect.

Climate change is a recognized phenomenon and should be considered in all aspects of planning and engineering. The engineer should stay apprised of climate change projections and apply reasonable improvements to the systems and structures that they design in order to accommodate these changes.

4.7 Model Code of Practice #7 - Innovation

Seek innovations that achieve a balance between environmental, social and economic factors while contributing to healthy surroundings in both the built and natural environment.

<u>AMPLIFICATION</u>

- Engineers are structured problem solvers. If a problem is not defined then they will seek to define it and if the scope for acceptable solutions is not given then they will try to identify the constraints. A problem well-defined enables the pursuit of innovative solutions.
- They recognize however that a client's resources may be limited and that a balance is required between various environmental, social and economic factors. Achieving this balance affects both the built environment and the natural environment.
- They also play a key role in transforming science into technology for application in the real world. Innovation, in the form of both hard technologies (i.e. devices) and soft technologies (i.e. methodologies, processes and procedures) is often fostered by the profession.
- They recognize that once established, innovative solutions can often be reapplied throughout the profession. Innovation therefore is a key aspect in the development and application of better solutions by the engineering profession.
- Engineers should identify and further the reapplication of good innovative solutions through knowledge transfer, capacity building and measurement of outcomes.

COMMENTARY

When engineers undertake work for a client they must balance the desire to do a thorough job against pressures to control costs and meet deadlines. For many projects an engineer's experience in work of similar nature will allow them to proceed rapidly towards a solution. If a robust and well established solution with a good record for past performance can be applied then this process is fairly straightforward. But if there are persistent shortcomings or significant concerns about the consequences of the proposed approach then it may not be a very good solution after all.

Established methodologies are often applied because they are easy and generally accepted. Precedence does not necessarily mean that they are the best approach. Advancements in technology, and improved approaches to planning and management, mean that innovation can often enable a better solution. In some cases innovative solutions can even enhance the environment at little or no cost. Engineers are uniquely placed to facilitate innovative approaches and to assess the improvements in cost reduction and/or minimizing negative outcomes for both the built and local environments.

Engineers should strive to advance the state of the art in their professional area and pursue innovations that can help advance the application and effectiveness of sustainable development.

4.8 Model Code of Practice #8 – Communication and Consultation

Develop locally appropriate engagement processes for stakeholders, both external and internal, to solicit their input in an open and transparent manner, and respond to all concerns – economic, social and environmental in a timely fashion in ways that are consistent with the scope of your assignment. Disclose information necessary to protect public safety to the appropriate authorities.

AMPLIFICATION

- Engineers should assign a high priority to appropriately informing and involving the public and external stakeholders early on and throughout the process. The same priority and approach should be invoked with internal stakeholders such as employees.
- The principles for guiding action should include accountability, inclusiveness, transparency, commitment and responsiveness.
- Engineers should make best efforts to reach, involve and hear from all of those who are affected directly and indirectly.
- Engineers should provide clear, timely and complete information and endeavour to ensure that decision processes, procedures and constraints are understood and followed.

- Engineers should, within their ability and the constraints of their assignment, allocate sufficient resources for effective engagement.
- They should be responsive, accessible and endeavour to understand public and other stakeholder concerns.
- Engineers should encourage stakeholders and other professions to be involved during all stages of a project that may have an environmental impact. They should recognize the value of early involvement and action versus reaction. This would allow meaningful input and identified concerns to be addressed as early as possible in the process.
- Engineers should recognize the importance of social and economic values in the environmental assessment process and the potential need for local, neighbourhood, traditional and cultural criteria through stakeholder involvement.
- They should document in writing their approach to problem solving for disclosure to their clients as well as other stakeholders.
- They should immediately advise their employer and/or client of any concern they may have about potentially adverse effects discovered in the course of any assignments in which they are involved.
- They are encouraged to interact with other disciplines to bring theoretical and technological research into applied practice.
- Engineers should actively share their expertise and educate other professions, government and the public to improve environmental understanding and sustainability practices. Engineers should pursue membership and participation in the work of professional societies to influence society's views on sustainable development and environmental stewardship.

COMMENTARY

Public involvement is a critical element of the environmental study process and engineers should, to the extent that their assignment allows, take steps to engage with the public early and continually during the project. The public should be involved in the identification of social, economic, and environmental impacts, as well as impacts associated with relocation of individuals, groups, or institutions. Reasonable notice to the public of either a public hearing or the opportunity for a public input is essential.

Timely information obtained in an open and transparent fashion is useful to help clients understand the possible consequences of overruling or disregarding engineering decisions or judgments. Working with others to improve environmental understanding and sustainability practices is also useful to help clients and stakeholders to be aware of societal and environmental consequences of projects.

When engineers become aware of public concerns relative to an assignment they may be involved in, the nature of the concern should be investigated in a timely manner. Once they have determined the validity of the concern they should promptly communicate the information through the normal lines of responsibility. Engineers are encouraged to seek a second professional or specialist opinion as to the technical validity of their conclusions whenever possible, especially when there appears to be a difference of opinion with the other responsible parties regarding environmental effects.

In disclosing information about environmental effects, engineers should communicate the information through normal channels and lines of responsibility. Where, in the opinion of the professional, the withholding of confidential information poses a potential threat to the environment, he or she should make reasonable effort to contact responsible parties before disclosure of the information to the proper regulatory authority. However, engineers must recognize their individual responsibilities for reporting releases and for environmental protection in accordance with legislated reporting requirements and the Code of Ethics.

Engineers are well situated to document in writing their approach to problem solving for disclosure to their clients as well as other stakeholders including the public, governments and funding authorities such as the World Bank and various International Development Agencies. This can help ensure that unbiased information is available to contribute to informed decision making.

Engineers are encouraged to be actively involved with environmental issues. They should go beyond merely facilitating improvements. By being pro-actively involved with the public , they may anticipate and prevent, rather than react.

Engineers are uniquely poised between the two extremes of absolute preservation and unfettered development. Education is crucial: firstly, for engineers so that they will say "no" when "no" needs to be said; secondly, to be participants of bodies constituted to formulate environmental laws and their enforcement; and thirdly, for the public so that they see engineers as true stewards who have viable, knowledge-based solutions.

Engineers deal with environmental issues. Research is one means to improve designs, procedures and technologies. The solution to complex long-term problems requires the participation of industry, governments and academia. Engineers are encouraged to interact with others to translate from theoretical research into applied practice.

The practice of engineering continuously improves due to technological advances, innovation and design changes. Parallel to this, environmental consequences need to be addressed. This is central to the concept of sustainability. Thus, continuous attention also needs to be given to improving an engineers' environmental understanding and practices.

4.9 Model Code of Practice #9 – Regulatory and Legal Requirements

Ensure that projects comply with regulatory and legal requirements and endeavour to exceed or better them by the application of best available, economically viable technologies and procedures.

AMPLIFICATION

- Engineers should develop and maintain current knowledge and understanding of local legislation, regulations, approvals, codes and guidelines; their purposes and limitations, and should ensure that these requirements are applied both on a procedural and substantive basis.
- They should ensure there is proper documentation of adherence to environmental procedures, protocols and regulations and that such information be provided to regulatory agencies in a timely fashion.
- They should have regard for both the reality and the trend of environmental legislation by managing and assign professional responsibility for both action and omission. They should reflect this reality in their professional duties accordingly as it relates to themselves, their employer, colleagues and clients.
- They should comply with all relevant legislation, approvals and orders relating to the sustainable treatment of resources and disposal of same resources and by-products. In addition, even where not required by legislation, approvals or orders, they should arrange to increase the lifecycle of a resource as a means to increase sustainability
- They should endeavour to go above and beyond standards and regulatory requirements to protect the health and well being of the public. They are encouraged to take into account evidence of cumulative, synergistic and persistent effects, where these may not be fully considered in standards or regulations.
- Make public regulatory authorities aware of all environmental effects of any assignment they are involved in, through the normal regulatory review and approval process.
- Engineers should maintain client and/or employer confidentiality unless otherwise required by relevant laws, regulations, approvals or orders. Where any confidential information is disclosed to public authorities, the engineer should ensure that their employers and clients are advised of such disclosure as soon as possible.
- Engineers should ensure that appropriate action or notification of proper authorities occurs in any instance where they believe that public safety or the environment is endangered, or where required by relevant legislation, approvals or orders.

- For countries where limited regulatory standards exist, engineers should advise on, and use international or other national regulations, codes or standards that are judged to be locally appropriate

COMMENTARY

Engineers are responsible for knowledge and awareness of environmental laws and regulations, either directly or through the retention of qualified specialists. Due diligence is required in the conduct of professional duties to ensure that everything reasonable is done to comply with environmental requirements. This implies an understanding of environmental policy and appropriate behaviour, including the obligation to establish and maintain clear lines of management responsibility, and the maintenance of technical excellence. Environmental audits and the implementation of an Environmental Management System are effective means for accomplishing these objectives.

Engineers should know their obligations with respect to the role of the regulatory authorities relative to protection of the environment. In dealing with employers, clients and public regulatory authorities, engineers shall not intentionally withhold information concerning environmental effects of any assignment they may be working on. Current legislation may hold them personally responsible or liable for any offences, omissions, or acquiescence. Due diligence is a moving standard which will be more clearly defined by the Courts with the passage of time. In this regard, engineers have an obligation to their colleagues, employers, client and regulatory authorities, for a well-documented and comprehensive approach to problem solving where environmental concerns are involved.

Engineers must conduct their work in a manner such that the confidentiality to their employer or client is maintained to the maximum degree possible. In doing so, however, in some instances there may be regulatory requirements to release or report information relating to environmental effects.

4.10 Model Code of Practice #10 – Risk Mitigation

Where there are threats of serious or irreversible damage but a lack of scientific certainty, implement risk mitigation measures in time to minimize environmental degradation.

AMPLIFICATION

- Engineers are often uniquely situated to implement the principles of the "precautionary principle" and while there are various interpretations, the most applicable for engineers is that presented in the UN Rio Declaration: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." Engineers may use a precautionary approach through an assessment of risks to recommend actions that can help protect, restore or even improve the environment.
- Uncertainties in scientific data or incomplete evidence of adverse impacts should be addressed through risk management. This includes an assessment of risks, developing actions that address the highest risks and communication of these risks and actions to stakeholders.
- Engineers should understand the consequences of specific actions and also of inaction. A risk assessment / risk management approach will inform and support decisions on actions or inactions.
- Risk assessment can assess the potential impacts of not taking specific actions even when there may be no incremental costs to the client in remaining inactive.
- Engineers should provide to the decision-maker a clear statement of the potential actions required to protect, to restore and, if possible, to improve the environment that may be impacted by their projects respecting local needs and concerns .

COMMENTARY

Engineers are often employed for their ability to deal with uncertainty. Problem definition and constraint identification allow costs and benefits to be evaluated and projects to move forward. The use of the precautionary principle can help this process. Engineers should be wary however in that the precautionary principle can be misused or even abused.

The precautionary principle is intended to help deal with uncertainty. It provides a basic no-regret approach to help determine if an action should or should not be undertaken when the associated risks are not known with full certainty. This can be difficult to interpret however and can be used to suggest that the precautionary principle either does not apply, applies but demands certainty that cannot be had, or that measures that do not benefit the client should not be taken.

The potential for misuse is significant. For instance, one possible interpretation of the precautionary principle is that the burden of proof falls on those wishing to take an action. Although this approach may limit liability it does not support advocacy for the environment. A more useful interpretation of the precautionary principle that goes beyond the no-regrets approach by including costs is that of Principle #15 of the United Nations Rio Declaration:

> "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[13]

This suggests an approach where engineers can use the precautionary principle to recommend actions that have little or no costs, and that can help protect, restore or even improve the environment. A risk assessment / risk management methodology can be employed to identify potential concerns and appropriate measures to deal with them. For instance, an inventory of infrastructure that might be vulnerable to the impacts of climate change would help identify potential risks and possible mitigation measures. Such an inventory would also be useful whether or not climate change proves to have a significant negative effect on any particular piece of infrastructure.

The Rio Declaration definition of the precautionary principle may be scaled to the ability of practitioners to apply it. Its application is recommended so as to avoid other self-serving definitions that might be used to circumvent accountability and responsibility.

[13] REPORT OF THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT, (Rio de Janeiro, 3-14 June 1992). Annex I, RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT. Retrieved on August 8, 2011 from http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

5.0 Concluding Remarks

It is recognized that the Model Code of Practice and this Interpretive Guide may present challenges for many engineers – some may perceive them as not relevant to their area of practice, or beyond their control, or beyond their skill set to implement at a significant level. While engineers cannot solve all problems they can work towards better solutions in their practice and also contribute to the advancement of the profession's capabilities to do so.

> **"The implications of sustainability for engineers are major. Long-term thinking on resources and paradigm shifts in economics and technology design are necessary. Improving the quality of life without merely increasing the quantity of goods is required. Engineers must become more effective at identifying real needs rather than wants. This will require them to become problem framers so they can help decide on the most effective directions for technology to take. In addition there is an educational function; some clients may not be aware of sustainable alternatives when scoping a new project. The engineering profession must lead the way and be seen to lead the way towards a more sustainable future."[14]**

The World Federation of Engineering Organizations and its more than 15 million engineers worldwide have pledged to engage in sustainable development and environmental stewardship in the practice of engineering. Adoption of the WFEO Model Code of Practice and Interpretive Guide demonstrates this commitment.

[14] Engineers New Zealand, (May 2005). Practice Note 05, Sustainability and Engineers. ISSN 1176-0907. Retrieved on December 2010 from http://www.ipenz.org.nz/ipenz/practicesupport/practice_notes.cfm